Rate Constants for the Quenching of Excited States of Metal Complexes in Fluid Solution

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The rate constants for the quenching of the excited states of metal ions and complexes in homogeneous fluid solution are reported in this compilation. Values of k_q for dynamic, collisional processes between excited species and quenchers have been critically evaluated, and are presented with the following information, among others, from the original publications, when available: description of the solution medium, temperature at which k_q was determined, experimental method, range of quencher concentration used, lifetime of the excited state in the absence of quencher, activation parameters, quenching mechanism. Data collection is complete through the end of 1986, and covers the coordination compounds of 26 metals, including the ions and complexes of the inner- and outer-transition metals, and porphyrin complexes of nontransition metals. Data for 261 excited states quenched by more than 400 inorganic quenchers and 600 organic quenchers have been extracted from almost 500 publications. The introduction to the work contains a discussion of the conceptual background to quenching, including a general treatment of the kinetics, an explanation of the tables, and a list of recent review articles. Uncommon kinetics mechanisms and equations, used to obtain the reported values of k_q, are discussed in detail as part of the notes to the tables. Indexes of excited states, quenchers, and authors are appended.

Key words: excited states, metal complexes, quenching, rate constants, solutions, spectra.

Contents

1. Introduction 220
2. Conceptual Background 221
   2.1. Excitation of Substrates 221
   2.2. Decay of Excited States 221
   2.3. Quenching of Excited States 221
   2.4 Types of Quenching Processes 222
   2.5 Fundamental Quenching Kinetics 222
   2.6. Other Considerations of the Kinetics 224
      2.6.a. Effects of Ionic Strength 224
      2.6.b. Multiple Forms of the Quencher . 224
      2.6.c. Nonselective Measurements 224
      2.6.d. Secondary Reactions 224
      2.6.e. Partially Unquenchable Reactions 225
      2.6.f. Quenching of a Higher-Energy Excited State 225
      2.6.g. Static Quenching 225
   2.7. Correction of k_q for Diffusion 225
   2.8. Cage Escape Efficiency 225
3. Explanation of the Tables 226
   3.1. Scope of the Compilation 226
   3.2. Procedures of Selection 226
   3.3. Nomenclature and Speciation 226
   3.4. Errors and Uncertainties 227
   3.5. Arrangement of the Tables 227
      3.5.a Excited States 227
      3.5.b. Column Headings 227
      3.5.c. Quenchers 227
      3.5.d. Solvent 227
      3.5.e. Temperature 228
      3.5.f. Solution Medium 228
      3.5.g. Rate Constants 228

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3.5.h. Comments 228
3.5.i. References 228
3.5.j. Indexes 228
3.6. Experimental Methods 228
3.6.a. Excitation Sources 228
3.6.b. Analytical Measurements 228
3.6.c. Signal Recording 229
4. Recent Review Articles 229
5. Acknowledgments 229
6. Lists of Abbreviations and Symbols 230
7. Figures 232
8. Tables of Quenching Data 234
1. Aluminum complexes 234
2. Cadmium complexes 236
3. Cerium complexes 236
4. Chromium complexes 237
5. Copper complexes 256
6. Dysprosium complexes 258
7. Europium complexes 259
8. Indium complexes 263
9. Iridium complexes 266
10. Iron complexes 271
11. Magnesium complexes 272
12. Molybdenum complexes 276
13. Neodymium complexes 277
14. Osmium complexes 278
15. Palladium complexes 292
16. Platinum complexes 295
17. Rhenium complexes 300
18. Rhodium complexes 303
19. Ruthenium complexes [except $Ru(bpy)_3^{2+}$] 308
20. $Ru(bpy)_3^{2+}$ by inorganic quenchers 367
21. $Ru(bpy)_3^{2+}$ by organic quenchers (except MV^{2+}) 403
22. $Ru(bpy)_3^{2+}$ by MV^{2+} 427
23. Samarium complexes 435
24. Terbium complexes 436
25. Tin complexes 457
26. Titanium complexes 458
27. Tungsten complexes 458
28. Uranium complexes 459
29. Zinc complexes 476
9. Notes on the Tables 501
10. References 507
11. Indexes 521
11.1. Author Index 521
11.2. Index of Excited States 530
11.3. Index of Inorganic Quenchers 532
11.4. Index of Organic Quenchers 537

1. Introduction

Over the past 30 years, the photochemistry and photophysics of metal coordination complexes have been active areas of research, drawing upon and merging with the extensive experience of coordination chemists, spectroscopists, and organic photochemists with regard to the synthesis of compounds, the development of experimental techniques, and an understanding of the kinetics and theories of excited states. The development during this time of fast kinetics techniques (conventional and pulsed-laser flash photolysis, time-resolved spectrofluorimetry) and the use of computers for experimental control and data management have caused these research areas to evolve into mature disciplines.

Two very important events occurred almost simultaneously a little more than 15 years ago that triggered a surge of activity in the field: the observation that the luminescent excited state of tris(2,2′-bipyridine)ruthenium(2 +) ion [$Ru(bpy)_3^{2+}$] can photosensitize electron-transfer reactions, and the first worldwide energy crisis brought on by the oil embargo as a result of the Yom Kippur War in the Middle East. It was recognized almost immediately that the electron-transfer reactions of the excited state of $Ru(bpy)_3^{2+}$ and, by extension, those of other coordination complexes, in fluid solution leads to the formation of energy-rich species which, through the manipulation of their subsequent reactions, can result in the generation of storable fuels. The development of schemes for the photochemical conversion and storage of solar energy involving coordination complexes began in earnest, and with it detailed studies of all the quenching reactions of excited states (electron transfer, energy transfer, proton transfer, etc.) and the chemistry of the products of those processes.

Theoretical treatments soon made the connection between the rate constant of the quenching reaction (k_q) and the energetics of the reactants. Existing k_q data were applied to theory, resulting in a demand for more data to test the theory. As a result, values of k_q for the reactions of the excited states of many coordination complexes with many quenchers under widely diverse experimental conditions have been published in the literature to date. Up to now, it has been very difficult for researchers to find the values of k_q they want, or to know exactly what has been done and what has not. In addition, those values of k_q that have been published in the review literature have not been subjected to a critical evaluation of their quality, not have they been part of a compilation in which the experimental conditions of their determination, and thus their validity, have been described.

This compilation is devoted to the presentation and critical evaluation of k_q for dynamic, collisional processes between electronically excited species and quenchers in fluid homogeneous solution. The excited states have been limited to those of ions and complexes of the inner- and outer-transition metals, and porphyrin complexes of nontransition metals. Quenchers include inorganic and organic species, as well as the ground state of the substrates. In addition to displaying the k_q values for excited state/quencher couples and the literature references for the sources of the rate constants, the tables contain descriptions of the solution medium, the temperature at which the experiment was performed, the experimental method used, the range of quencher concentrations used, and activation parameters, as well as other pieces of information extracted from the original publications that could be useful to the reader for the evaluation of the quality of the results.

This introduction to the compilation continues, in Sec. 2, with a discussion of the conceptional background to quenching: the excitation of coordination complexes, the decay of the excited states, the types of quenching processes, and the fundamental "Stern–Volmer" kinetics of quenching. Consideration is given to the conditions that lead to deviations from Stern–Volmer behavior, the relationship of the kinetics of diffusion to k_q, and the efficiency of escape of redox products from the solvent cage as a result of electron-transfer quenching. The structure of the tables is examined in Sec. 3: the scope of the compilation, the procedures for the selection of values of k_q from the literature, the problems of nomenclature and speciation, and our concern with the errors and uncertainties that accompany the numerical quantities. The detailed arrangement of the tables is described, as well as the experimental methods used by authors to obtain the data. We offer, in Sec. 4, a list of recent review articles about aspects of the quenching of excited states of coordination complexes that may be useful to the reader. A list of abbreviations and symbols, and the molecular structures of some of the more complicated polymeric and heterocyclic quenchers precede the tables; the tables are followed by notes which describe the mechanisms and equations that have been used in specifically referenced papers for the extraction of the values of k_q. A number of indexes have been included: Author Index, Index of Excited States, Index of Inorganic Quenchers, and Index of Organic Quenchers.

2. Conceptual Background

2.1. Excitation of Substrates

Absorption of light in the ultraviolet, visible, or near-infrared regions of the spectrum by a coordination complex substrate (S) of the general form M–L, where M is the metal center and L represents the ligands in generic terms, results in the generation of electronically excited states within the period of photon absorption ($\sim 10^{-16}$ s). The subsequent rapid passage of the system along deactivation routes leads to the eventual formation, generally, of the lowest excited state of the substrate (*S), which is relatively long lived due to the spin restrictions governing its conversion back to the ground state; the efficiency of population of *S from the absorption of one photon at the wavelength of excitation is η^*. Depending on the coordination complex involved, *S can be charge–transfer (metal-to-ligand, ligand-to-metal, complex-to-solvent), metal-centered, or ligand-localized in nature; the excitation may reside in nonbonding or antibonding orbitals, may be localized or diffuse, and will have orientations in space appropriate to the symmetry of the state.

Irrespective of the nature of the specific system, *S and S are different species; *S is a stronger reductant and oxidant, is more energetic, and, because of its unique electronic configuration, has the possibility of exhibiting greatly differing patterns of reactivity (acid–base, substitution, etc.). These reactive pathways are kinetically competitive with nonradiative and radiative modes of decay; this latter route results in the emission of light (luminescence) which can serve as a marker for the presence of *S, depending upon the relative rate constants of the various competing processes. In the case of some complexes, luminescent decay is not kinetically competitive, emission is not observed, and the detection of *S must be accomplished through the use of an alternative technique, such as the monitoring of the absorption of *S.

2.2. Decay of Excited States

In the most general sense, the formation of *S and its subsequent decay, when unperturbed, via radiative, nonradiative, and reactive intramolecular modes can be described by reactions (1)–(4), where I_a is the rate at which the light is absorbed by S:

$$S + h\nu \xrightarrow{I_a\eta^*} {}^*S, \tag{1}$$

$$^*S \xrightarrow{k_{rd}} S + h\nu', \tag{2}$$

$$^*S \xrightarrow{k_{nr}} S + \text{heat}, \tag{3}$$

$$^*S \xrightarrow{k_{rx}} \text{products}. \tag{4}$$

The lifetime of unperturbed *S, τ_0, is defined as $\tau_0 = 1/k_0$, where $k_0 = k_{rd} + k_{nr} + k_{rx}$.

2.3. Quenching of Excited States

The subject of this compendium is the second-order rate constant k_q for the bimolecular reaction between an electronically excited species *S and a quencher Q which contributes to the deactivation of *S. The simplest view of the primary processes in quenching is that of irreversible reaction (5) occurring in a single step:

$$^*S + Q \xrightarrow{k_q} \text{products}. \tag{5}$$

When the microscopic details of quenching are considered, the diffusion of *S and Q together to form *S–Q, a precursor complex in which a very weak interaction exists between the pair, is written explicitly. *S–Q is an outer-sphere encounter complex which is held within the solvent cage for a short period of time (sub-ns); the deactivation of the encounter complex to yield products with a rate constant k_{de} must compete with the breakup of the solvent cage and the release of *S and Q into the bulk solvent [reaction (6)]:

$$^*S + Q \underset{k_{-d}}{\overset{k_d}{\rightleftharpoons}} {}^*S\text{–}Q \xrightarrow{k_{de}} \text{products}. \tag{6}$$

By making use of the scheme in reaction (6) and the steady-state approximation for the concentration of *S–Q, the observed quenching rate constant k_q can be expressed by Eq. (7),

$$k_q = \frac{k_d k_{de}}{k_{-d} + k_{de}}. \tag{7}$$

In this mechanism, k_d is the rate constant for the bimolecular diffusional encounter of *S and Q, which can be calculated by use of the Debye–Smoluchowski equation [M. V. Smoluchowski, Phys. Z. **17**, 557 (1916); P. Debye, Trans. Electrochem. Soc. **82**, 265 (1942)], and k_{-d} is the rate con-

stant for the unimolecular dissociation of *S–Q into the parent components. In the case of outer-sphere encounters, k_{-d} can be calculated by means of the Eigen equation [M. Eigen, Z. Physik. Chem. (Frankfurt am Main) **1**, 176 (1954)].

The deactivation of *S–Q can be visualized as occurring via competing radiative, nonradiative, and reactive reactions (8)–(10), which are analogous to those of *S [reactions (2)–(4) above].

$$
{}^{*}\mathrm{S{-}Q} \begin{cases} \xrightarrow{k'_{rd}} \mathrm{S} + \mathrm{Q} + h\nu'', & (8) \\ \xrightarrow{k'_{nr}} \mathrm{S} + \mathrm{Q} + \mathrm{heat}, & (9) \\ \xrightarrow{k'_{rx}} \mathrm{Q} + \mathrm{photoproducts}. & (10) \end{cases}
$$

In addition, the "precursor complex" can engage in reactions not available to *S in bulk solution: transformation into a "successor complex" via intramolecular energy transfer, electron transfer, proton transfer, or formation of an exciplex via the redistribution of the electronic energy across the entire species [reaction (11)],

$$
{}^{*}\mathrm{S{-}Q} \xrightarrow{k'_{pr}} \text{successor complex.} \qquad (11)
$$

Therefore, k_{de} is defined in terms of the rate constants of reactions (8)–(11) as $k_{de} = k'_0 + k'_{pr}$, where $k'_0 = k'_{rd} + k'_{nr} + k'_{rx}$.

In the case of outer-space encounters, it is commonly assumed that k'_{rd}, k'_{nr}, and k'_{rx} have values very similar to those of the corresponding reactions of *S, and that quenching is mainly, if not exclusively, due to reaction (11) which defines the nature of the quenching process. Very likely, $k'_{pr} \gg 1/\tau_0$, where τ_0 is the lifetime of *S.

2.4. Types of Quenching Processes

Quenching can occur via one or more of the following primary processes simultaneously:

(I) Transfer of electronic energy from *S to Q, with the formation of *Q, an electronically excited state of Q, (ET);

(II) transfer of one electron from *S to Q (oxidative electron transfer, OT);

(III) transfer of one electron from Q to *S (reductive electron transfer, RT);

(IV) formation of an exciplex between *S and Q (EX);

(V) transfer of one proton from *S to Q or vice versa (proton transfer, PT);

(VI) hydrogen abstraction or some other chemical reaction between *S and Q (HA, CR);

(VII) catalysis of the radiationless deactivation of *S by Q (collisional deactivation, CD).

The most predominant processes involving coordination complexes are I, II, and III; the other processes are only seldom observed.

Generally, each of these processes can be represented by a different successor complex. Therefore, reaction (11) can be expanded into reactions (12)–(16) to show the various successor complexes, which undergo further conversion toward the final products.

$$
{}^{*}\mathrm{S{-}Q} \xrightarrow{k'_{pr}} \begin{cases} \mathrm{S{-}{}^{*}Q} \quad \mathrm{ET}, & (12) \\ \mathrm{S^{+}{-}Q^{-}} \quad \mathrm{OT}, & (13) \\ \mathrm{S^{-}{-}Q^{+}} \quad \mathrm{RT}, & (14) \\ {}^{*}(\mathrm{S{-}Q}) \quad \mathrm{EX}, & (15) \\ \mathrm{PT,\ HA, CR,\ CD,\ etc.} & (16) \end{cases}
$$

Intramolecular reactions (12)–(16) are written as irreversible processes. Of course, the principle of microscopic reversibility demands that consideration be given to the possibility of the reformation of *S–Q through the occurrence of the reverse reactions that are, undoubtedly, energetically unfavorable.

Processes II, III, V, and VI can be experimentally demonstrated by the identification of their products as stable compounds or transient intermediates following flash excitation. The experimental evidence for the formation of an exciplex is generally the observation of its absorption or emission in flash photolysis. Energy transfer is experimentally demonstrated if the emission or photoreaction of *Q is observed. In addition, thermodynamic considerations and comparisons with analogous systems are widely used to suggest the most probable mechanism, at least among energy and electron transfer.

Nevertheless, it remains a challenge to obtain a clear answer concerning the exact nature of the intermediates, inasmuch as the same final products could arise from different successor complexes existing simultaneously in the same reaction. Similarly, analogous final products from analogous systems may arise from different successor complexes.

Experimental evidence in favor of a particular quenching process does not exclude the possibility that some fraction of the quenching acts occurs via a different mechanism. The experimentally determined value of k_q is, however, an overall rate constant representing the sum of the k_q values for the individual processes; the relative importance of the various processes can only be evaluated indirectly.

2.5. Fundamental Quenching Kinetics

The experimental determination of k_q is based on the measurement of a property (Λ) that is proportional to the concentration of one or more of the species involved in the overall photochemical process. The mathematical relationship between Λ and k_q is derived from the assumed mechanism by the use of the usual treatment of time-independent (steady-state) and -dependent kinetics. The derived relationship contains Λ and [Q] as variables, and k_q and/or other rate constants as invariant parameters when Q and the other species are present as unique species; the problem of the variation in the nature of Q as a function of solution medium is addressed in Sec. 2.6.b below.

It is obvious that the reliability of the values of k_q reported by a researcher depends ultimately on the validity of the relationship derived from the assumed mechanism. Evidence in favor of a specific mechanism is generally obtained by the measurement of Λ for a set of experiments in which [S] is maintained constant and [Q] is changed across an

appropriately wide range (at least one order of magnitude); clearly, the observed dependence of Λ on [Q] must be that expected for the assumed mechanism. Of course, a mechanism may be assumed, and k_q evaluated at only one [Q]; such a procedure, however, does not give any evidence for the mechanism, and the quality of the value of k_q determined in that way is open to question. It is important to note that k_q is always related to k_{de}, which is the sum of the rate constants of all the deactivation processes of *S–Q. The relative contribution of each deactivation mode to the overall quenching process can be evaluated, in principle, through additional measurements; this point, however, will not be discussed further.

The most commonly measured properties (Λ) are the intensity of emission from *S under continuous steady-state excitation, and the decay of emission from *S, or absorption by *S, after pulsed excitation.

By assuming that the quenching mechanism is represented by reactions (1)–(5), application of the steady-state treatment, where $d[{*S}]/dt = 0$ and $[S]_{ss}$ is the steady-state concentration of *S [Eq. (17)], leads to the relationship [Eq. (18)] between k_q and the intensity of the emission from *S in the absence (I_l^0) and presence (I_l) of Q.

$$[{*S}]_{ss} = \frac{I_a \eta^*}{k_0 + k_q[Q]}, \tag{17}$$

$$I_l^0/I_l = 1 + (k_q/k_0)[Q]. \tag{18}$$

Similarly, by defining the lifetime of *S in the presence of Q as $\tau = 1/(k_0 + k_q[Q])$, an equivalent relationship [Eq. (19)] between the lifetime of *S can also be derived from the expressions describing the time-dependent behavior of the concentrations of the species.

$$\tau_0/\tau = 1 + (k_q/k_0)[Q]. \tag{19}$$

These are the Stern–Volmer (S–V) relationships that are very widely used in the evaluation of k_q. The S–V constant (K_{SV}) is defined as:

$$K_{SV} = k_q/k_0 = k_q\tau_0. \tag{20}$$

S–V plots of I_l^0/I_l vs [Q] or τ_0/τ vs [Q] are predicted, by Eqs. (18) and (19), to be linear with slopes equal to K_{SV}, provided that Q does not absorb the exciting and emitting light, or that appropriate corrections have been made.

Similarly, if reaction (4) leads to a product, the quantum yield of which can be measured in the absence (Φ_0) and presence (Φ) of Q, Eq. (21) predicts that a plot of Φ_0/Φ vs [Q] be linear:

$$\Phi_0/\Phi = 1 + K_{SV}[Q]. \tag{21}$$

If reaction (5) leads to a product, the quantum yield of which is determined as a function of [Q], the steady-state treatment of the quenching mechanism predicts that a plot of $1/\Phi$ versus $1/[Q]$ be linear with an intercept/slope ratio equal to K_{SV}.

The calculation of k_q from K_{SV}, requires the independent measurement of τ_0 under the same experimental conditions. The use of a value of τ_0 measured under different conditions implies that τ_0 is independent of the change in the conditions, an assumption that must be proven for the value of k_q to be valid.

If the quenching is assumed to involve reaction (6) instead of (5), a contribution from *S–Q to the emission intensity under continuous excitation should, in principle, be taken into consideration; Eqs. (22)–(24) result, where $\gamma = \beta' k'_{rd}/\beta k_{rd}$, and β and β' are the ratios of the intensity of the emission at the selected wavelength and that under the entire emission band for *S and *S–Q, respectively.

$$[{*S}]_{ss} = \frac{I_a \eta^*(k_{-d} + k_{de})}{k_0(k_{-d} + k_{de}) + k_{de}k_d[Q]}, \tag{22}$$

$$[{*S\text{–}Q}]_{ss} = \frac{I_a \eta^* k_d[Q]}{k_0(k_{-d} + k_{de}) + k_{de}k_d[Q]}, \tag{23}$$

$$\frac{I_l^0}{I_l} = \frac{1 + \{k_d k_{de}[Q]/k_0(k_{-d} + k_{de})\}}{1 + \gamma\{(k_d[Q]/k_{-d} + k_{de})\}}. \tag{24}$$

Clearly, a plot of I_l^0/I_l vs [Q], based on Eq. (24), is not linear; the plot has a negative deviation from linearity, and reaches a plateau for $[Q] \to \infty$. The limiting value of I_l^0/I_l for $[Q] \to \infty$ is $k_{de}/\gamma k_0$. When $\gamma = 0$, i.e., when no emission occurs from *S–Q, Eq. (24) reduces to Eq. (25), which is identical to Eq. (18) via Eq. (7).

$$\frac{I_l^0}{I_l} = 1 + \left[\frac{k_d k_{de}}{k_0(k_{-d} + k_{de})}\right][Q]. \tag{25}$$

Even if $\gamma \neq 0$, the nonlinearity predicted by Eq. (24) is commonly not perceived because of the limitations of the experiment. The initial portion of the plot of I_l^0/I_l vs [Q] can be observed to be linear within the experimental error when $k_d[Q] < (k_{de} + k_{-d})$, i.e., $[{*S\text{–}Q}]_{ss} < [{*S}]_{ss}$. However, the initial slope has a value of $k_d(k_{de} - \gamma k_0)/[k_0(k_{-d} + k_{de})]$ which is not equal to k_q/k_0 via Eq. (7). Only if $k_{de} \gg k_0$, which is the usual case, will the initial slope approximate K_{SV}.

The steady-state approximation cannot be applied to the concentrations of intermediates following the absorption of light from a short-lived source. The solution of differential equations (26) and (27), that describe the dependence of the concentrations of *S and *S–Q as a function of time t, results in Eqs. (28) and (29), assuming that $[{*S}] = [{*S}]_0$ and $[{*S\text{–}Q}] = 0$ at $t = 0$.

$$\frac{d[{*S}]}{dt} = k_{-d}[{*S\text{–}Q}] - (k_{rd} + k_{nr} + k_{rx} + k_d[Q])[{*S}], \tag{26}$$

$$\frac{d[{*S\text{–}Q}]}{dt} = k_d[{*S}][Q] - (k_{-d} + k_{de})[{*S\text{–}Q}], \tag{27}$$

$$[{*S}]_t = C_1[{*S}]_0\exp(-m_1t) + C_2[{*S}]_0\exp(-m_2t), \tag{28}$$

$$[{*S\text{–}Q}] = C_3[{*S}]_0[\exp(-m_2t) - \exp(-m_1t)], \tag{29}$$

where

$$\begin{aligned} m_1 &= \tfrac{1}{2}(k_0 + k_{de} + k_{-d} + k_d[Q]) + \tfrac{1}{2}R^{1/2}, \\ m_2 &= \tfrac{1}{2}(k_0 + k_{de} + k_{-d} + k_d[Q]) - \tfrac{1}{2}R^{1/2}, \\ R &= (k_0 + k_{de} + k_{-d} + k_d[Q])^2 \\ &\quad - 4(k_0k_{-d} + k_0k_{de} + k_{de}k_d[Q]), \end{aligned} \tag{30}$$

and

$$C_1 = (k_0 + k_d[\mathrm{Q}] - m_2)/(m_1 - m_2),$$
$$C_2 = (m_1 - k_0 - k_d[\mathrm{Q}])/(m_1 - m_2),$$
$$C_3 = \frac{(k_0 + k_d[\mathrm{Q}] - m_2)(m_1 - k_0 - k_d[\mathrm{Q}])}{k_{-d}(m_1 - m_2)}.$$

According to these equations, [*S] decreases with time via biexponential kinetics, while [*S–Q] increases at short times, reaches a maximum, and then decreases. With increasing [Q], m_1 increases monotonically while m_2 reaches a limiting value of $m_2(\mathrm{lim}) = k_{de}$. The limiting value of m_2 at $[\mathrm{Q}] = 0$ is k_0.

In most cases, however, the faster component of the decay of *S, and the build-up period of *S–Q occur in times too short with respect to the resolution time of the apparatus; only the slower component of the decay is experimentally observed, and is identical for both *S and *S–Q. Under such conditions, provided that Q is not consumed to any significant extent during the time period of the experiment, the observed decay follows pseudo-first-order kinetics; the apparent rate constant m_2 can be evaluated, and a lifetime of *S under quenching conditions, $\tau = 1/m_2$, can be defined. In spite of the apparent differences between Eqs. (24) and (30), the plot of $m_2/k_0 = \tau_0/\tau$ versus [Q] from Eq. (30) is quite similar to that of I_l^0/I_l versus [Q] from Eq. (24). As with the intensity plot discussed above, the experimentally measurable portion of the τ_0/τ plot generally appears to be linear within the experimental error, with an initial slope equal to $k_d(k_{de} - k_0)/(k_{-d} + k_{de} - k_0)$, which is approximately equal to K_{SV} if $k_{de} \gg k_0$. Under these conditions, Eq. (31) can be applied:

$$\frac{\tau_0}{\tau} = 1 + \left[\frac{k_d k_{de}}{k_0(k_{de} + k_{-d})}\right][\mathrm{Q}] = 1 + (k_q/k_0)[\mathrm{Q}]$$
$$= 1 + K_{\mathrm{SV}}[\mathrm{Q}]. \qquad (31)$$

It is clear that whenever the approximations mentioned above are valid, the quenching of emission intensity and the quenching of the excited-state lifetime are exactly coincident. The lack of such coincidence is generally taken as evidence for a more complex mechanism, although this may not necessarily be the case.

2.6. Other Considerations of the Kinetics

There are several factors that cause the kinetics of quenching to become more complex than expected from the S–V equations.

2.6.a. Effects of Ionic Strength

When both S and Q are ionic species, the value of k_q is a function of the ionic strength of the solution (μ). Because μ will change as [Q] is changed, the value of k_q thus obtained will no longer be a constant for a set of measurements, the result being that the observed relationship between Λ and [Q] may be different from that expected for the proposed mechanism. In order for k_q to remain constant for a set of experiments in which [Q] is changed, it is necessary for μ to be maintained constant through the addition of appropriate amounts of an inert electrolyte. Due consideration must be given to the possibility that pairing of the presumed innocent added ions with S and/or Q can change the kinetic properties of *S and its successors.

Often, k_q is evaluated from measurements at very low [Q] in the absence of added electrolyte, where effects due to variations in the low values of μ are probably negligible; such values, obtained in the presence of low [S], can be taken as approximating k_q in the limit of $\mu \to 0$. Other methods of obtaining limiting values of k_q from measurements at constant (but variable) μ involve the use of the Debye–Hückel theory (subject to the usual limitations in its use) or, more valuably, the extrapolation of a plot of $k_q(\mu)$ versus an appropriate semiempirical function of μ (e.g., $\mu^{1/2}$).

2.6.b. Multiple Forms of the Quencher

If, in solution, Q is involved in equilibrium reaction (32) (e.g., acid–base, metal ion complexation, etc.) among its various i forms (Q_a, Q_b, Q_c, etc.), the quenching process can occur from some or all of the Q species, and will be a function of the solution medium parameters that affect the position of equilibrium. For experimental convenience, Λ is generally determined as a function of the total concentration of $\mathrm{Q}([\mathrm{Q}]_{\mathrm{tot}})$, where $[\mathrm{Q}]_{\mathrm{tot}} = \Sigma[\mathrm{Q}_i]$, and the mole fractions of each of the species (X_i) are expressed as $X_i = [\mathrm{Q}_i]/[\mathrm{Q}]_{\mathrm{tot}}$.

$$\mathrm{Q}_a \rightleftarrows \mathrm{Q}_b \rightleftarrows \mathrm{Q}_c. \qquad (32)$$

If the values of X_i are independent of $[\mathrm{Q}]_{\mathrm{tot}}$, the value of k_q can be obtained in the usual way, where k_q is actually the weighted average of the quenching rate constants for the individual forms: $k_q = \Sigma X_i k_q(\mathrm{Q}_i)$. Because X_i is a function of the solution medium, it is possible, in principle, to obtain the specific values of $k_q(\mathrm{Q}_i)$ through the judicious control of the medium. If, on the other hand, X_i changes with $[\mathrm{Q}]_{\mathrm{tot}}$, the concept of an average value of k_q is meaningless, and the constant cannot be calculated. The specific $k_q(\mathrm{Q}_i)$ values can be estimated from measurements in various solution media by means of appropriate algebraic procedures (e.g., best-fitting routines), provided that X_i can be independently determined for each experimental condition.

2.6.c. Nonselective Measurements

If the analytical methods used in the quenching experiments are not selective, and reflect the concentrations (and their changes) of *S and species that originate directly or indirectly from the quenching step (i.e., exciplex), nonlinear S–V plots for emission intensity under steady-state conditions and very complex time-dependent behavior of the system under pulse conditions may be observed. Very severe assumptions are often required to derive appropriate kinetics equations, and to calculate k_q.

2.6.d. Secondary Reactions

Measurements based on the quantum yields of photochemical products may be affected by secondary thermal and/or photochemical reactions. For example, the primary products of an electron-transfer quenching reaction are frequently consumed (and even depleted) through back elec-

tron-transfer reactions to form the ground state reactants. Secondary reactions must be included in the mechanistic scheme, and the corresponding kinetic equation must be used to calculate k_q. It is worth noting that data obtained from such systems have a larger uncertainty than those obtained by means of the usual S–V equations; moreover, assumptions about unknown parameters are often required.

2.6.e. Partially Unquenchable Reactions

If a photochemical reaction originates from two excited states of the substrate, but only one state is quenched, Eq. (21) applies only to the quantum yield of the quenchable part of the reaction; experimentally, the measured quantum yield is the sum of those quantities for both the quenchable and unquenchable parts of the reaction. Appropriate corrections must be made to the experimental values of Φ_0 and Φ in order for k_q to be calculated.

2.6.f. Quenching of a Higher-Energy Excited State

It is possible that a compound used for quenching *S is also capable of quenching a higher-energy excited state of the substrate **S. If *S originates from the intramolecular deactivation of **S, the quenching of **S causes the population of *S and the resulting luminescence to follow a quadratic dependence on [Q]. However, the lifetime of *S is generally unaffected by the involvement of short-lived **S.

2.6.g. Static Quenching

If the substrate and quencher form labile adducts in the ground state, such as in the case of ion pairs between ions of different signs, excitation of S in the adduct results in the quenching of the emission from *S due to intramolecular interactions within the adduct; the extent of adduct formation is governed by the concentrations of S and Q, and the equilibrium constant of the process. As a result, the population of *S, and the resulting luminescence and photoproduct formation are less than those occurring in the absence of static quenching, and are a complex function of [S] and [Q]. The existence of static quenching does not affect the lifetime of *S after pulsed excitation.

2.7. Corrections of k_q for Diffusion

When quenching is viewed as occurring via reaction (6), k_q, as expressed by Eq. (7), is approximately equal to $k_d k_{de}/k_{-d}$ when $k_{de} \ll k_{-d}$, and to k_d when $k_{de} \gg k_{-d}$. In the latter case, in order to reveal the relative importance of k_{de} in a homologous series of quenching processes, it is often convenient to use the classical Noyes theory of diffusional reactions to obtain a rate constant (k_{cor}) for the final step of a reaction, exclusive of diffusion. From the theory, this rate constant is calculated via Eq. (33):

$$1/k_{cor} = 1/k_q - 1/k_d. \tag{33}$$

When the mechanism of quenching is given by reaction (6), the expression for k_q in Eq. (7) can be substituted into Eq. (33), yielding Eq. (34), which is an expression for k_{cor} in terms of the elementary processes in reaction (6).

$$k_{cor} = k_d k_{de}/k_{-d}. \tag{34}$$

When $k_q \ll k_d$, $k_{cor} \sim k_q$; when $k_q \sim k_d$, $k_{cor} > k_q$. We have included k_{cor} values in this compilation only when the corresponding values of k_q were not reported in the original publication and could not be easily calculated from k_{cor}.

2.8. Cage Escape Efficiency

Because of the importance of electron-transfer quenching to potential applications of photosensitization, it is important to know the efficiency with which the primary products of quenching escape back electron transfer within the solvent cage and diffuse freely into the bulk solution. The major experimental approaches for the determination of this quantity (η_{ce}) are the measurement of the quantum yield of formation of a primary product [e.g., $\Phi(S^+)$ for S^+ from oxidative quenching] under continuous irradiation, and the measurement of [*S] and the concentration of one of the primary products of quenching after pulsed excitation; the latter technique requires that the molar absorptivities of the two species be known in order to effect the conversion of absorbance to concentration. When the measurement of $\Phi(S^+)$, for example, is used as the basis of the determination of η_{ce}, care must be taken to account for the back electron-transfer reaction of the redox products of quenching in the bulk solution, or to avoid it completely by the use of a selective sacrificial scavenger for one of the products. These secondary reactions must be included in the overall mechanism from which the kinetic equation for $\Phi(S^+)$ is derived.

If the quenching is assumed to occur via reactions (1)–(4), (6), and (35)–(38), a steady-state treatment leads to Eq. (39).

$$*S\text{–}Q \xrightarrow{k_{et}} S^+\text{–}Q^-, \tag{35}$$

$$*S\text{–}Q \xrightarrow{k_{oq}} \text{other quenching processes}, \tag{36}$$

$$S^+\text{–}Q^- \xrightarrow{k_{bt}} S\text{–}Q \rightarrow S + Q, \tag{37}$$

$$S^+\text{–}Q^- \xrightarrow{k_{ce}} S^+ + Q^-, \tag{38}$$

$$\Phi(S^+) = \eta^* \left[\frac{k_q[Q]}{k_q[Q] + k_0}\right] \left[\frac{k_{et}}{k_{et} + k_{oq}}\right] \eta_{ce}, \tag{39}$$

where

$$k_q = k_d(k_{et} + k_{oq})/(k_{et} + k_{oq} + k_{-d}), \tag{40}$$

and

$$\eta_{ce} = \frac{k_{ce}}{k_{ce} + k_{bt}}. \tag{41}$$

Inasmuch as η^*, k_0, k_q, and $\Phi(S^+)$ can be experimentally determined, the quantity f can easily be evaluated by the use of its defining Eq. (42),

$$f = \left[\frac{k_{et}}{k_{et} + k_{oq}}\right] \eta_{ce}. \tag{42}$$

It is important to note that f represents the fraction of all the quenching acts that eventually leads to the production of electron-transfer products in the bulk solution. Only when electron transfer is the sole quenching process ($k_{oq} = 0$)

does f represent the cage escape efficiency in electron-transfer quenching.

3. Explanation of the Tables

3.1. Scope of the Compilation

The compilation is complete through the end of 1986. The computer search of the bibliographic data base of the Radiation Chemistry Data Center (RCDC) of the University of Notre Dame, using the names of the metals and "porphyrin" as key words, the review of the personal literature files of the authors, and the examination of cross-referenced papers yielded a list of publications in books, serials, and periodicals. Publications of limited diffusion, such as dissertations, theses, and abstracts of conferences, were excluded from the list.

3.2. Procedures of Selection

In order to be included in this compilation, values of k_q had to be explicitly given in the published paper, or be capable of being calculated by us from values of K_{SV} and τ_0 (or k_0, k_d, k_{-d}, and k_{de}) reported in the same paper. No values of k_q were extracted from graphical treatments, nor were any calculated from K_{SV} and τ_0 taken from different sources.

The rate constant of quenching is that of a dynamic process occurring in a fluid solution in which there is the uniform distribution of substrate and quencher. Data concerning systems in which either the substrate or the quencher, but not both, might be preferentially confined to localized regions of a microenvironment, such as in the presence of micelles and polyelectrolytes, were accepted only if there was clear evidence that quenching requires the diffusion of at least one species through the medium.

In addition, preference was given to data concerning sufficiently well characterized chemical species obtained under sufficiently well defined experimental conditions. Data concerning poorly defined systems were included in the compilation only if more precise reports were lacking; we have taken the point-of-view that poor data are better than none at all, as long as the reader is provided with the information to evaluate the quality of the result.

We have found, not unexpectedly, the repetition of the same values of k_q for the same excited state/quencher couple under the same experimental conditions from the same laboratory in a number of references. In this case, reference is made only to the paper containing the largest amount of information and/or published in the most widely disseminated journal. The other references, however, are cited in the bibliography, and indication of their existence is made in the tables as a "comment." Occasionally, we have found *different* values of k_q for the same excited state/quencher couple under the same experimental conditions from the same laboratory; this situation can occur due to the reevaluation of data over the course of time by the authors, their recognition of the limitations in their experimental procedures, or the existence of inadvertent typographical errors. In this case, we have made a critical evaluation, on the basis of the information available, of the quality of the values, and have chosen one for display; as before, the other references are cited in the bibliography, and the alternative values are indicated as a comment.

For some very well-studied systems, there are multiple reports from different laboratories for the same excited state/quencher couple under the same, or very similar, experimental conditions. In these cases, all values are presented as independent entries for the following reasons. When the values of k_q are different, we believe that it is impossible for us to establish which value is more valid short of performing the experiment ourselves; the users of these data are urged to make their own evaluation of the quality of the numbers from the information given in the papers based on their own expertise. When the values are the same, or very similar, we have chosen not to average the values and combine the entries so as to avoid the loss of valuable pieces of information contained in the individual papers. To remove entries, we feel, would deprive the reader of the opportunity to make direct comparisons.

3.3. Nomenclature and Speciation

For all the coordination compounds, both substrates and quenchers, in this compilation, names and formulas are written with the symbol of the central metal as the initial portion for reasons of alphabetical ordering. The use of abbreviations for the ligands in the substrates was limited to 2,2′-bipyridine (bpy) and 1,10-phenanthroline (phen) and their derivatives, but were widely used for the quenchers as a space-saving measure; a list of all the abbreviations and symbols used appear below in Sec. 6.

The oxidation states of metallic quenchers, as superscripts in Roman numerals to the symbol of the element, are designated only in those cases where the exact nature of the species in solution is unclear. For labile complexes, which require the presence of both the free metal ion and the ligands in solution, the metal ion/ligand ratio ([M]/[L]) *in the bulk solution* is indicated in the "Solution Medium" column of the tables; labile complexes of unknown formulation, or those that may actually be a mixture of various species in equilibrium are indicated as M–L with the oxidation number of the metal shown.

Organic quenchers are indicated by their names, but the use of abbreviations is very widespread. Names and abbreviations were chosen in an attempt to achieve a delicate balance among several highly desirable features: succinctness, unambiguousness, uniformity, and clarity to even those not fluent in organic nomenclature. Therefore, the names used in the compilation may be different than those that appear in the original publications. For organic quenchers with complicated structures and correspondingly complicated formal names, such as polymeric viologens and heterocycles, generic abbreviations (PolyVio, OrgQue) are used; their structural formulas are shown below in the Figures (Sec. 7).

In a few cases, the nomenclature is, regretfully, ambiguous, reflecting analogous ambiguities in the original publications.

For the majority of ionic substrates and quenchers, the counterion has not been shown; it has been indicated as a comment in the tables in those few cases in which there is

evidence that its presence affects the photophysical properties of the substrate.

In addition to the substitutional equilibria exhibited by some metal complexes discussed above, a number of substrates and quenchers in this compilation undergo equilibrium reactions (e.g., acid–base, monomer–oligomer) in solution, so that the predominant species is a critical function of the solution composition and the total concentration of the substance. In general, the name used is that indicated in the original publication; no attempt was made to identify the predominant species under the experimental conditions used, although where important, information about the species is presented as a comment. As a result, the reader will find the names of both the acidic and basic forms, for example, in the tables and indexes.

A special case is represented by those transition metal ion quenchers that may be present in the solution as fully solvated and/or partially anated species. We have used the symbol of the simple ion (e.g., Co^{2+}) to indicate the ensemble of these species, the formula of the fully solvated ion [e.g., $Co(H_2O)_6{}^{2+}$] for that specific species, and abbreviated notations without the solvent molecules (e.g., $CoCl^+$, $CoCl_3^-$) to indicate partially anated species.

For the majority of the substrates reported in the compilation, only the lowest-energy excited state is quenched, and no indication of its term symbol is required to avoid ambiguity. When quenching is experienced by two lowest-energy excited states of a substrate, each state is identified by its spin multiplicity ([singlet] and [triplet] for the upper and lower state, respectively) or, in the case of Tb^{3+}, by the usual spectroscopic notations ([$^5D_3$] and [$^5D_4$] for the upper and lower state, respectively).

3.4. Errors and Uncertainties

In many cases, values of k_q are given with an error range or uncertainty estimation in the original publications; however, the criteria used by authors to evaluate the uncertainty in reported values are rarely disclosed, and range from well-defined statistical treatments (e.g., standard deviation) based on multiple replicate experiments, to empirical estimations based on the author's experience. As a result, it is impossible to express the uncertainty in values of k_q in a uniform way, and we have preferred not to report any errors at all. Similarly, no errors are given for values of τ_0, K_{SV}, temperature, or any other experimental value.

In addition, we have found that values of k_q and τ_0 are reported in the literature with a wide variation of significant figures which, it is presumed, reflects the quality of the data as evaluated by the author. However, in our opinion, the uncertainty in values of k_q and τ_0 obtained from independent measurements is unlikely to be less than $\sim 10\%$, even if the reproducibility of the single experimental result is better. As a result, we have reported all k_q and τ_0 values with a maximum of two significant figures, unless they were given to only one significant figure in the original publication, or the reported error involves the first figure. Data having an error larger than 40–50% have been labeled with "$\sim$." In cases where upper or lower limiting values are reported in the literature, only one significant figure is used.

The same criteria were used for the presentation of activation parameters and other experimental data with the exception of temperature and solute concentrations; in the latter case, for the sake of succinctness, values are given to one significant figure if the second figure is zero.

Despite the fact that rate constants and excited-state lifetimes are functions of temperature, many publications in the literature omit a reference to a specific temperature, or express it in a nonquantitative manner (e.g., room temperature, ambient temperature). In such cases, the "T" column is blank for such entries in the tables. Otherwise, the temperatures or their ranges are listed as presented by the authors. If the uncertainty in the temperature is greater than 1° C, the $\sim$ label is used.

3.5. Arrangement of the Tables

The data are contained in 29 tables which are ordered alphabetically according to the name of the metal of the substrate. In the case of ruthenium, which constitutes a large fraction of the total, the entries are subdivided further to display separately $Ru(bpy)_3^{2+}$ and inorganic quenchers, $Ru(bpy)_3^{2+}$ and organic quenchers except methylviologen N, N'-dimethyl-4,4′-bipyridinium dication; MV^{2+}), $Ru(bpy)_3^{2+}$ and MV^{2+}, and all other complexes of ruthenium.

3.5.a. Excited States

Within each table, the various excited states with the same metal are ordered alphabetically according to the letters in the formula; some formulas denote the exact molecular composition while others incorporate names of abbreviations of the ligands. Each successive excited state is numbered with a table number t and a sequence number m in a $t.m$ format.

3.5.b. Column Headings

The columns of the tables are headed with the following entries: No. (of the excited state), Quencher, Solvent, Solution Medium, T (temperature, °C), k_q, Comments, and Ref.

3.5.c. Quenchers

For any given excited state, the quenchers are divided into two groups: "inorganic" and "organic." Within each group, they are further ordered alphanumerically, and are preceded by a number of the form $t.m.n$, where t = the table number, m = the excited state number, and n = the quencher number.

3.5.d. Solvent

For any given quencher, the order of presentation of the data is alphabetical according, to the name, formula, or abbreviation of the solvent. For mixed solvent systems, the more abundant solvent is listed first; their ratio (v/v) is given in parentheses. When the ratio is 1:1 and H_2O is one of the solvents, that substance is listed first.

3.5.e. Temperature

Within any given solvent or solvent mixture, the ordering is by ascending values of the temperature, with the explicit value first and the approximate value second. The lowest level of ordering is given to those systems for which no value of the temperature is entered.

3.5.f. Solution Medium

Within any temperature group, the ordering is determined by the absence or presence of additional solutes, and by the degree of detail to which the solution medium is known. Systems that consist of the substrate and the quencher as the only solutes are presented first with the "Solution Medium" column blank; thereafter, *p*H and ionic strength (μ is units of mol/liter (L); salt used to control ionic strength in parentheses) conditions are given in ascending order, followed by buffers and other solutes in ascending values of their concentrations. Within this hierarchy of ordering, we have attempted to group data obtained in similar media close together.

When more than one additional solute is used in the experiments, we have adopted a specific protocol for the designation of the components, depending on the degree to which the information is specified in the original paper. For example, if both LiCl and NaCl were present, the designation "LiCl and NaCl" is used. However, if independent measurements were made on solutions containing LiCl and NaCl separately which gave the same value of k_q, "LiCl, NaCl" is shown. If, on the other hand, experiments were performed with either LiCl or NaCl, but the actual contents are not specified, "LiCl or NaCl" is displayed.

3.5.g. Rate Constants

Values of k_q are given in the units of L mol^{-1} s^{-1} for the second-order reaction. Values of k_{cor} are reported here, and are labeled as "(corr)." For values of k_q calculated by us from K_{SV} and τ_0 values, or from k_0, k_d, k_{-d}, and k_{de} values appearing in the same paper, the indicator "(calc)" is appended.

3.5.h. Comments

The Comments column contains a wealth of information in highly abbreviated form in essentially this order: the experimental method used in the evaluation of k_q; the lifetime of *S in the absence of quencher (τ_0 in the absence of air, τ_0^{air} in air- equilibrated solutions, τ_0^{und} in solutions of unknown O_2 content); the experimental method used for the determination of the lifetime in the absence of quencher, or the literature reference for the value used; the quenching mechanism (if uncertain, "?" is added); the range of [Q] used over which the value of k_q was determined, and, presumably, is valid; activation parameters; acid–base properties of *S; references to duplicate or alternative entries; other relevant information. Values of f, the fraction of the quenching acts that yield electron-transfer products in the bulk solution, are reported here; when $\eta^* < 1$, the value of η^* used in its calculation is also given.

3.5.i. References

References whether given for the source of k_q in the "Ref." column, for the source of τ_0 in the Comments column, or for alternate values of k_q in the Comments column, are presented as the RCDC bibliographic number; all numbered references are cited in full in the Bibliography (Sec. 10) in ascending numerical and chronological order.

3.5.j. Indexes

Following the Bibliography are the Author Index, Index of Excited States, Index of Inorganic Quenchers, and Index of Organic Quenchers. Every author in every paper cited in the Ref. column as a source of k_q is listed in the Author Index with the relevant RCDC number of each reference and the locator of the entry in the form *t.m*, where t = table number and m = excited state number. Each entry in the quencher indexes is coded in the *t.m.n* format, where n = quencher number. The substrates in the excited state index are coded in the *t.m* format. In order to obviate problems in organic nomenclature, the Index of Organic Quenchers is cross-referenced with alternative and common names, and abbreviations

3.6. Experimental Methods

The methods used to obtain k_q are coded in the Comments column as follows: excitation source/analytical measurement/signal recording. The same coding appears in parentheses after the value of τ_0 (or τ_0^{air}) if that quantity was independently determined in the paper. If the method used for k_0 and τ_0 is the same, no additional coding is given. If the lifetime was taken from the literature, the RCDC number of the reference is given in parentheses. The codes are given below in the List of Abbreviations and Symbols (Sec. 6).

If more than one experimental method was used, and both methods gave the same value of k_q, the entry "SS/LUM, LP/LUM/SST," for example, is used. When "SS/LUM or LP/LUM/SST," for example, is used, it means that we do not know which one of the two methods was actually used to obtain the reported k_q value.

3.6.a. Excitation Sources

The excitation of the substrate is accomplished by means of two main types of light sources: steady-state lamps, and lasers that provide a continuous light beam that is monochromatic or that can be passed through a wavelength selection device; pulsed lamps, lasers, or spark gaps that emit a flash of light with a short duration (ns to μs). The intensity of steady-state sources can also be modulated.

3.6.b. Analytical Measurements

Values of k_q are calculated on the basis of one or more of the following analytical measurements:

(i) Intensity of the luminescence of *S, either as an instantaneous measurement during continuous excitation or as a function of time after pulsed excitation, with the intensity being proportional to [*S];

(ii) Absorbance of *S, measured as a function of time

after pulsed excitation, with the magnitude of the absorbance being proportional to [*S];

(iii) amount of a photoproduct produced during a period of continuous or pulsed excitation, which, from the independent knowledge of the intensity of the monochromatic light absorbed by the substrate, can be converted into the quantum yield of formation of the product;

(iv) intensity of luminescence from *Q as an instantaneous measurement during continuous excitation;

(v) photocurrent and electric conductivity, which are generally measured as a function of time after pulsed excitation.

3.6.c. Signal Recording

Luminescence intensity, absorbance, photocurrent, and conductivity methods result in the generation of an electric signal that can be recorded as a function of the time elapsed after pulsed excitation. Each signal can be recorded independently as a single shot, or many signals from the same system may be collected together and averaged, generally via computer, in order to increase the signal/noise ratio and improve the quality of the value of k_q that results.

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6. Lists of Abbreviations and Symbols

LIGANDS

acac	Acetylacetonate ion
AMcapten	1-Methyl-8-amino-6,13,19-triaza-3,10,16-trithiabicyclo[6.6.6]eicosane
AMMEsar	1-Amino-8-methyl-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane
AMMEsarH	1-Amino-8-methyl-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane, protonated
13-At	1,4,7,10-Tetraazacyclotrideca-10-13-dienate ion, Fig. 1
AZAcapten	1-Methyl-6,8,13,19-tetraaza-3,10,16-trithiabicyclo[6.6.6]eicosane
AZAMEsar	8-Methyl-1,3,6,10,13,16,19-heptaazabicyclo[6.6.6]eicosane
benzo-15-crown-5	2,3-Benzo-1,4,7,10,13-pentaoxapentadeca-2-ene
bpy	2,2′-Bipyridine
-bpy	2,2′-Bipyridine (as monodentate ligand)
C^3,N'-bpy	2,2′-Bipyridyl-C^3,N'
5-Brphen	5-Bromo-1,10-phenanthroline
4,4′-Bu_2bpy	4,4′-Bis(*tert*-butyl)-2,2′-bipyridine
$(BUG)_2$bpy	2,2′-Bipyridine with polymeric side chains, Fig. 2
bzac	1-Phenyl-1,3-butanedionate ion
4,4′-Cl_2bpy	4,4′-Dichloro-2,2′-bipyridine
CLNOsar	1-Chloro-8-nitro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane
CLOHsar	1-Chloro-8-hydroxy-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane
5-Clphen	5-Chloro-1,10-phenanthroline
CLsar	1-Chloro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane
CMMEabsar	1-Chloromethyl-8-methyl-3,6,10,13,15,18-hexaazabicyclo[6.6.5]nonadecane
4,4′-$(COO)_2$bpy	2,2′-Bipyridine-4,4′-dicarboxylate ion
4,4′-$(COObz)_2$bpy	2,2′-Bipyridine-4,4′-dicarboxylic acid, dibenzyl ester
4,4′-$(COOchl)_2$bpy	2,2′-Bipyridine-4,4′-dicarboxylic acid, di(3β-cholestyl) ester
4,4′-$(COOcyc)_2$bpy	2,2′-Bipyridine-4,4′-dicarboxylic acid, dicyclohexyl ester
4,4′-$(COOdec)_2$bpy	2,2′-Bipyridine-4,4′-dicarboxylic acid, di(1-decahydronaphthyl) ester
4,4′-$(COOet)_2$bpy	2,2′-Bipyridine-4,4′-dicarboxylic acid, diethyl ester
4,4′-$(COOH)_2$bpy	2,2′-Bipyridine-4,4′-dicarboxylic acid
4,4′-$(COOnap)_2$bpy	2,2′-Bipyridine-4,4′-dicarboxylic acid, di(2-naphthyl) ester
4,4′-$(COOpr)_2$bpy	2,2′-Bipyridine-4,4′-dicarboxylic acid, di(2-propyl) ester
crypt	4,7,13,16,21-Pentaoxa-1,10-diazabicyclo[8.8.5]tricosane
cyclam	1,4,8,11-Tetraazacyclotetradecane
dbm	1,3-Diphenyl-1,3-propanedionate ion
diAMchar	1,12-Diamino-3,10,14,21,24,31-hexaazapentacyclo[10.10.10.10.$0^{4,9}$.$0^{15,20}$.$0^{25,30}$]dotriacontane
diAMsar	1,8-Diamino-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane
diAMsarH_2	1,8-Diamino-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane, diprotonated
diAZAchar	1,3,10,12,14,21,24,31-Octaazapentacyclo[10.10.10.10.$0^{4,9}$.$0^{15,20}$.$0^{25,30}$]dotriacontane
diCLsar	1,8-Dichloro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane
diNOsar	1,8-Dinitro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane
DMF	*N,N*-Dimethylformamide
DMG	Dimethylglyoximate ion
DMSO	Dimethylsulfoxide
Do_2Ca_2bpy	1,1′-Didodecyl-2,2′-bipyridine-4,4′-dicarboxamide
EDTA	Ethylenediaminetetraacetate ion
EFMEoxosar-H	1-Carbethoxy-2-oxo-8-methyl-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane, deprotonated form
en	Ethylenediamine
etioporphyrin I	2,7,12,17-Tetraethyl-3,8,13,18-tetramethylporphyrin
4-(Et_3P)bpy	2,2′-Bipyridine-4-(triethylphosphonio) cation
gly	Glycinate ion
C^3,N'-Hbpy	2,2′-Bipyridyl-C^3,N', protonated
HEDTA	Monohydrogen ethylenediaminetetraacetate ion
hfac	1,1,1,5,5,5-Hexafluoro-2,4-pentanedionate ion
HYMEoxosar-H	2-Oxo-8-methyl-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane, deprotonated form
3,3′-Me_2bpy	3,3′-Dimethyl-2,2′-bipyridine
4,4′-Me_2bpy	4,4′-Dimethyl-2,2′-bipyridine
Me_6cycladiene	5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-diene
Me_6cyclam	5,7,7,12,14,14-Hexamethyl-1,4,8,11-tetraazacyclotetradecane
Me_2dibenzoH_2phen	6,7-Dihydro-5,8-dimethyldibenzo[*b,j*]1,10-phenanthroline (DMCH)
MENOsar	1-Methyl-8-nitro-3,6,10,13,16,19-hexaazabicyclo[6.6.6]eicosane
5-Mephen	5-Methyl-1,10-phenanthroline
2,9-Me_2phen	2,9-Dimethyl-1,10-phenanthroline
4,7-Me_2phen	4,7-Dimethyl-1,10-phenanthroline
5,6-Me_2phen	5,6-Dimethyl-1,10-phenanthroline
3,4,7,8-Me_4phen	3,4,7,8-Tetramethyl-1,10-phenanthroline
3,5,6,8-Me_4phen	3,5,6,8-Tetramethyl-1,10-phenanthroline
$MePh_2P$	Methyldiphenylphosphine
mesoporphyrin IX	7,12-Diethyl-3,8,13,17-tetramethylporphyrin-2,18-dipropionic acid
N-Mevio	*N*-Methyl-4-(4-pyridyl)pyridinium cation
5-(NH_2)phen	5-Amino-1,10-phenanthroline
2-(NO_2)benz	2-Nitrobenzoate ion
4-(NO_2)benz	4-Nitrobenzoate ion
4-(NO_2)bpy	4-Nitro-2,2′-bipyridine
5-(NO_2)phen	5-Nitro-1,10-phenanthroline
NTA	Nitrilotriacetate ion
OEP	2,3,7,8,12,13,17,18-Octaethylporphyrin
pdo	1,3-Propanedionate ion
4,4′-Ph_2bpy	4,4′-Diphenyl-2,2′-bipyridine
phen	1,10-Phenanthroline
5-Phphen	5-Phenyl-1,10-phenanthroline
2,9-Ph_2phen	2,9-Diphenyl-1,10-phenanthroline
4,7-Ph_2phen	4,7-Diphenyl-1,10-phenanthroline
4,7-$(PhSO_3)_2$phen	1,10-Phenanthroline-4,7-di(phenyl-4-sulfonate) ion
py	Pyridine
sar	3,6,10,13,16,19-Hexaazabicyclo[6.6.6]eicosane
sep	1,3,6,8,10,13,16,19-Octaazabicyclo[6.6.6]eicosane
4,4′-$(SO_3)_2$bpy	2,2′-Bipyridine-4,4′-disulfonate ion
TEOA	Triethanolamine
terpy	2,2′,2″-Terpyridine
tfac	1,1,1-Trifluoro-2,4-pentanedionate ion
tfbzac	1-Phenyl-4,4,4-trifluoro-1,3-butanedionate ion
thd	2,2,6,6-Tetramethyl-3,5-heptanedionate ion
TMePyP	5,10,15,20-Tetrakis(1-methylpyridinium-4-yl)porphyrin
TPP	5,10,15,20-Tetraphenylporphyrin
TPTZ	2,4,6-Tris(2-pyridyl)-1,3,5-triazine
tta	1-Thienyl-4,4,4-trifluoro-1,3-butanedionate ion
uroporphyrin I	Porphyrin-2,7,12,17-tetraacetic-3,8,13,18-tetrapropionic acid

ORGANIC QUENCHERS

bpy	2,2′-Bipyridine
bpy^{2+}	2,2′-Bipyridinium dication (in *N,N′*-disubstituted derivatives)
$bpyH^+$	2,2′-Bipyridine, monoprotonated
$bpyH_2^{2+}$	2,2′-Bipyridine, diprotonated
β-CD	β-Cyclodextrin
CDTA	*trans*-1,2-Diaminocyclohexane-*N,N,N′,N′*-tetraacetic acid
DDT	2,2-Bis(4-chlorophenyl)-1,1,1-trichloroethane
DMSO	Dimethylsulfoxide
DQ^{2+}	*N,N′*-Ethylene-2,2′-bipyridinium dication (Diquat)
EDTA	Ethylenediaminetetraacetic acid
H-3-pyl	Pyridinium-3-yl cation radical
H-4-pyl	Pyridinium-4-yl cation radical
Me-2-pyl	*N*-Methylpyridinium-2-yl cation radical
Me-3-pyl	*N*-Methylpyridinium-3-yl cation radical
Me-4-pyl	*N*-Methylpyridinium-4-yl cation radical
MV^{2+}	*N,N′*-Dimethyl-4,4′-bipyridinium dication (methylviologen, Paraquat)
OrgQue1	see Fig. 3
OrgQue2	see Fig. 3
OrgQue3	see Fig. 3
OrgQue4	see Fig. 3
OrgQue5	see Fig. 3
OrgQue6	2,1,3-Benzothiadiazole-4,7-dicarbonitrile, Fig. 4
OrgQue7	1,1′-Bis(phenylmethyl)-3,3′-dicarboxamide-1,1′,4,4′-tetrahydro-4,4′-bipyridine, Fig. 5
OrgQue8	see Fig. 6
OrgQue9	see Fig. 6
OrgQue10	see Fig. 6

OrgQue11	see Fig. 7a
OrgQue12	see Fig. 7b
OrgQue13	2,2,6,6-Tetramethyl-4-oxopiperidine-1-oxyl radical, Fig. 8a
OrgQue14	2,2,6,6-Tetramethylpiperidine-1-oxyl radical, Fig. 8b
$phen^{2+}$	1,10-Phenanthrolinium dication (in *N,N'*-disubstituted derivatives)
$phenH^{+}$	1,10-Phenanthroline, monoprotonated
$phenH_2^{2+}$	1,10-Phenanthroline, diprotonated
Poly-2,4-ionene	Poly[(dimethylimino)-1,4-butanediyl(dimethylimino)-1,2-ethanediyl dication], Fig. 9
PolyPTZ	Polymeric phenothiazine, see Fig. 10
PolyVio1	Polymeric viologen, see Fig. 11
PolyVio2	Polymeric viologen, see Fig. 12
PolyVio3	Polymeric viologen, see Fig. 13
PolyVio4	Polymeric viologen, see Fig. 13
PolyVio5	Polymeric viologen, see Fig. 13
PolyVio6	Polymeric viologen, see Fig. 13
PolyVio7	Polymeric viologen, see Fig. 13
PolyVio8	Polymeric viologen, see Fig. 13
PolyVio9	Polymeric viologen, see Fig. 13
PolyVio10	Polymeric viologen, see Fig. 14
PolyVio11	Polymeric viologen, see Fig. 15
PolyVio12	Polymeric viologen, see Fig. 16
PolyVio13	Polymeric viologen, see Fig. 16
PolyVio14	Polymeric viologen, see Fig. 17
py	Pyridine
py^{+}	Pyridinium cation (in *N*-substituted derivatives)
pyH^{+}	Pyridine, protonated
sydnone	1,2,3-Oxadiazol-5-one, Fig. 18 (in mono- and disubstituted derivatives)
Triton X-100	$C_8H_{17}C_6H_4(OCH_2CH_2)_xOH$ (x = 9 or 10)
vio^{+}	4-(4-Pyridyl)pyridinium cation (in *N*-monosubstituted derivatives)
vio^{2+}	4,4'-Bipyridinium dication (in *N,N'*-disubstituted derivatives)
$vioH^{+}$	4,4'-Bipyridine, monoprotonated
$vioH^{2+}$	4-(4-Pyridyl)pyridinium cation, protonated (in *N*-monosubstituted derivatives)
$vioH_2^{2+}$	4,4'-Bipyridine, diprotonated

OTHER MATERIALS

ACbuf	Acetate buffer
AN	Acetonitrile
AQN	Poly[imino-2-(dimethylamino)hexamethylene-1-oxo], Fig. 19
BHDC	Benzyldimethyl-*n*-hexadecylammonium chloride
BObuf	Borate buffer
BRbuf	Britton-Robinson buffer (0.008 mol/L acetate, 0.008 mol/L phosphate, 0.008 mol/L borate)
n-BuOH	1-Butanol
t-BuOH	*tert*-Butyl alcohol
BuN	*iso*-Butyronitrile
CAbuf	Carbonate buffer
6CB	Cyanohexylbiphenyl
β-CD	β-Cyclodextrin
CMC	critical micelle concentration
CTAB	Cetyltrimethylammonium bromide
CTAC	Cetyltrimethylammonium chloride
DMA	*N,N*-Dimethylacetamide
DMF	*N,N*-Dimethylformamide
DMSO	Dimethylsulfoxide
dTBP	Tributylphosphate (perdeuterated)
EDTA	Ethylenediaminetetraacetic acid
EtMO	*N*-Ethylmorpholine
EtOH	Ethanol
FA	Formamide
HAc	Acetic acid
HSEtOH	Mercaptoethanol
IMIDbuf	Imidazole buffer
MeCH	Methylcyclohexane
MeOH	Methanol
Me_2SO_4	Sulfuric acid, dimethyl ester
MF	*N*-Methylformamide
MP	*N*-Methylpropionamide
NaAc	Sodium acetate
NTA	Nitrilotriacetate ion
Pbuf	Phosphate buffer
PHTHbuf	Phthalate buffer
PMA	Poly(methacrylic acid)
polybrene	Poly[(dimethyliminio)-1,3-propanediyl(dimethyliminio)-1,6-hexadiyl dication], Fig. 20; concentration based on the ionic charge
PPh_3	Triphenylphosphine
1-PrOH	1-Propanol
2-PrOH	2-Propanol
PVA	Poly(vinylalcohol)
PVS	Poly(vinylsulfate)
py	Pyridine
PYbuf	Pyridine buffer
SLS	Sodium lauryl sulfate
TBAB	Tetrabutylammonium bromide
TBAC	Tetrabutylammonium chloride
TBAF	Tetrabutylammonium hexafluorophosphate
TBAP	Tetrabutylammonium perchlorate
TBAS	Tetrabutylammonium trifluoromethylsulfate
TBP	Tributylphosphate
TEAC	Tetraethylammonium chloride
TEAP	Tetraethylammonium perchlorate
TEOA	Triethanolamine
THF	Tetrahydrofuran
TMAC	Tetramethylammonium chloride
TMP	Trimethylphosphate
TOAB	Tetraoctylammonium bromide
TPeAC	Tetrapentylammonium chloride
TPrAB	Tetrapropylammonium bromide
TPrAC	Tetrapropylammonium chloride
TRbuf	Tris buffer

OTHER ABBREVIATIONS AND SYMBOLS

(calc)	calculated from τ and K_{SV} or from rate constants for specific steps
(corr)	corrected for diffusional effects
E_a	activation energy
EQ	quenching of an higher-energy state
estd	estimated
f	fraction of quenching acts that yield electron-transfer products in the bulk solution
k_{dif}	diffusion rate constant (L mol^{-1} s^{-1})
k_{obs}	experimentally observed rate constant
k_q	quenching rate constant
K_{SV}	Stern-Volmer constant
K_{SV}^{τ}	Stern-Volmer constant from lifetime measurements
L	ligand
p_Q	partial pressure of gaseous Q in equilibrium with the solution
p_{app}	applied pressure
Q	quencher
S	substrate
*S	excited state of the substrate involved in quenching
SQ	static quenching
S-V	Stern-Volmer
TT	triplet-triplet annihilation
ΔG^*	free energy of activation
ΔH^*	enthalpy of activation
ΔS^*	entropy of activation
ΔV^*	volume of activation
η^*	efficiency of population of the quenched excited state
μ	ionic strength (mol/L)
τ_0	lifetime in the absence of quencher, air-free solution
τ_0^{air}	lifetime in the absence of quencher, air-equilibrated solution
τ_0^{und}	lifetime in the absence of quencher, solution of unknown O_2 content
ϕ	quantum yield of formation of the quenched excited state

Experimental methods

ABS	absorption
AVE	multiple shot with signal averaging
ECM	electric conductivity

EMI	emission quenching (method not specified)
FP	conventional flash
LIF	lifetime quenching (method not specified)
LP	laser flash
LUM	luminescence
MS	modulated light source
PCM	photocurrent
PM	phase modulation
PR	pulse radiolysis
QYP	quantum yield of a photoproduct
SL	spark lamp
SPC	single photon counting
SS	steady state irradiation
SST	single shot signal

Quenching mechanisms

CD	collisional deactivation
CR	chemical reaction
ET	energy transfer
EX	exciplex formation
HA	hydrogen abstraction
OT	oxidative electron transfer
PT	proton transfer
RT	reductive electron transfer

7. Figures

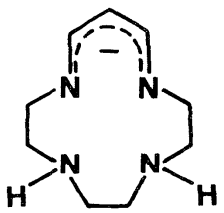

FIG. 1. 13-At.

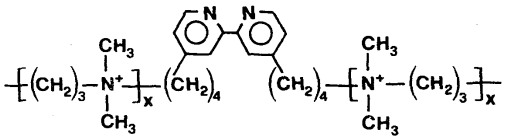

FIG. 2. $(BUG)_2$ bpy.

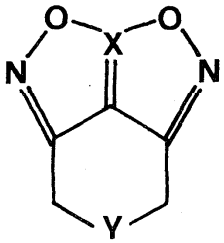

FIG. 3. OrgQuel (X = S, Y = SO_2); OrgQue2 (X = Se, Y = S); OrgQue3 (X = Se, Y = CH_2); OrgQue4 (X = S, Y = CH_2); OrgQue5 (X = S, Y = S).

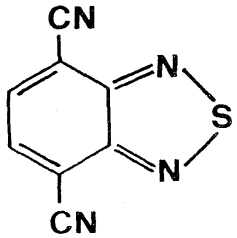

FIG. 4. OrgQue6.

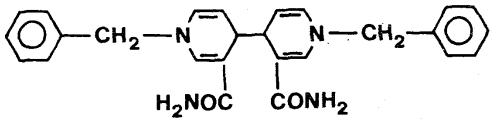

FIG. 5. OrgQue7.

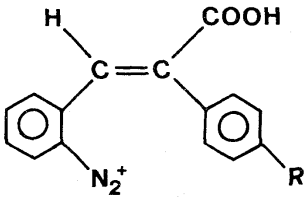

FIG. 6. OrgQue8 (R = Br); OrgQue9 (R = H); OrgQue10 ($R = OCH_3$).

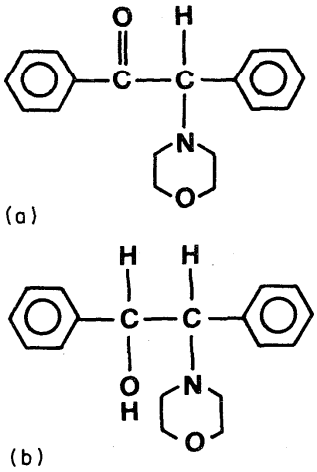

FIG. 7. (a) OrgQue11; (b) OrgQue12.

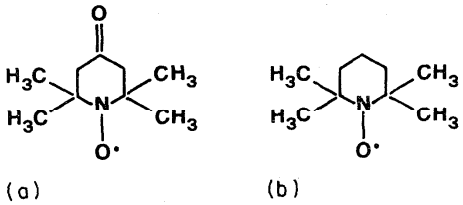

FIG. 8. (a) OrgQue13; (b) OrgQue14.

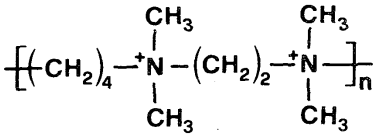

FIG. 9. Poly-2, 4-ionene.

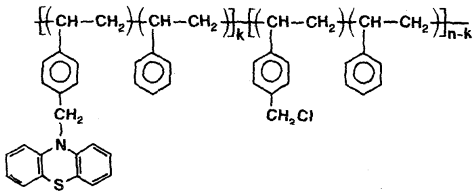

FIG. 10. PolyPTZ.

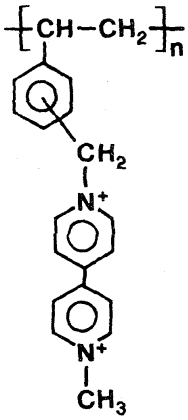

FIG. 11. PolyViol (41% quaternization).

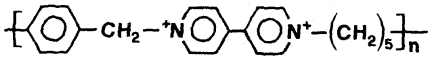

FIG. 12. PolyVio2.

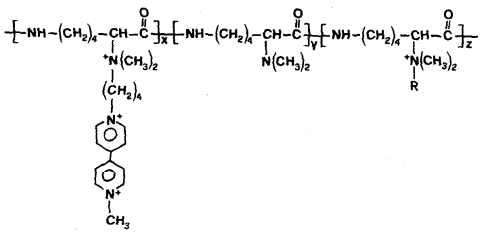

FIG. 13. PolyVio3 ($X = 5\%$, $Y = 95\%$); PolyVio4 ($X = 10\%$, $Y = 90\%$); PolyVio5 ($X = 12\%$, $Y = 88\%$); PolyVio6 ($X = 25\%$, $Y = 75\%$); PolyVio7 ($X = 5\%$, $Y = 45\%$, $Z = 50\%$, $R = C_2H_5$); PolyVio8 ($X = 5\%$, $Z = 95\%$, $R = C_2H_5$); PolyVio9 ($X = 5\%$, $Z = 95\%$, $R = C_3H_6SO_3$).

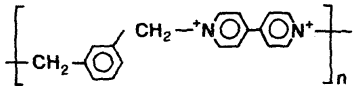

FIG. 14. PolyVio10.

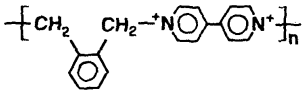

FIG. 15. PolyVio11.

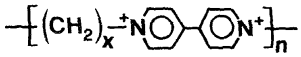

FIG. 16. PolyVio12 ($x = 4$); PolyVio13 ($x = 3$).

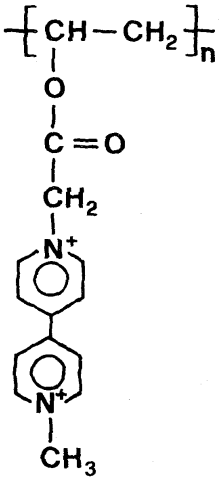

FIG. 17. PolyVio14 (40% quaternization).

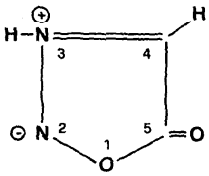

FIG. 18. Sydnone.

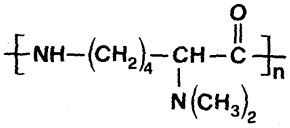

FIG. 19. AQN.

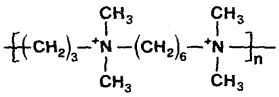

FIG. 20. Polybrene.

8. Tables of Quenching Data

TABLE 1. Quenching of excited aluminum complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
1.1. Al(phthalocyanine)Cl							
Inorganic Quenchers							
1.1.1.	$Co(bpy)_3^{2+}$	DMA/H_2O (2.3/1)		~15	2.3×10^7	LP/AES/AVE; ET; [Q] < 0.001 mol/L	84A122
1.1.2.	$Co(bpy)_3^{3+}$	DMA/H_2O (2.3/1)		~15	8.3×10^7	LP/AES/AVE; OT; f = 0.38; [Q] < 2×10^{-4} mol/L	84A122
1.1.3.	$Co(phen)_3^{2+}$	DMA/H_2O (2.3/1)		~15	5.3×10^7	LP/AES/AVE; ET; [Q] < 0.001 mol/L	84A122
1.1.4.	$Co(phen)_3^{3+}$	DMA/H_2O (2.3/1)		~15	1.9×10^8	LP/AES/AVE; OT; f = 0.53; [Q] < 2×10^{-4} mol/L	84A122
1.1.5.	$Co(terpy)_2^{2+}$	DMA/H_2O (2.3/1)		~15	1.3×10^8	LP/AES/AVE; ET	84A122
1.1.6.	$Co(terpy)_2^{3+}$	DMA/H_2O (2.3/1)		~15	1.5×10^8	LP/AES/AVE; OT; f = 0.066; [Q] < 2×10^{-4} mol/L	84A122
1.1.7.	$Fe(bpy)(CN)_4^-$	DMA/H_2O (2.3/1)		~15	2.8×10^8	LP/AES/SST; OT; f = 0	83E088
1.1.8.	$Fe(bpy)(CN)_4^{2-}$	DMSO/H_2O (4/1)		~28	5.8×10^8	LP/AES/SST; RT; f = 0	83E088
1.1.9.	*cis*-$Fe(bpy)_2(CN)_2^+$	DMA/H_2O (2.3/1)		~15	4.4×10^8	LP/AES/SST; OT; f = 0	83E088
1.1.10.	$Fe(C_5H_5)_2$	DMSO/H_2O (9/1)		~28	6.6×10^8	LP/AES/SST; RT; f = 0.07	83E088
1.1.11.	$Fe(CN)_6^{3-}$	DMA/H_2O (2.3/1)		~15	1.1×10^7	LP/AES/SST; OT; f = 0	83E088
1.1.12.	*cis*-$Fe(phen)_2(CN)_2^+$	DMA/H_2O (2.3/1)		~15	5.2×10^8	LP/AES/SST; OT	83E088
Organic Quenchers							
1.1.13.	1,4-Benzoquinone	DMA/H_2O (2.3/1)		~15	9.2×10^8	LP/AES/SST; OT; f = 0.40	83E088
1.1.14.	1,4-Bis(*N,N*-dimethylamino)benzene	DMA/H_2O (2.3/1)		~28	7.2×10^8	LP/AES/SST; RT; f = 0.84	83E088
	1,4-Bis(*N,N*-dimethylamino)benzene	DMSO/H_2O (4/1)		~28	1.9×10^9	LP/AES/SST; RT; f = 0.85	83E088
1.1.15.	4,4′-Bis(*N,N*-dimethylamino)biphenyl	DMSO/H_2O (4/1)		~28	1.7×10^8	LP/AES/SST; RT; f = 0.72; [Q] = (1-7) × 10^{-5} mol/L	83E088

TABLE 1. Quenching of excited aluminum complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
1.1. Al(phthalocyanine)Cl—Continued							
1.1.16.	2,5-Dichloro-1,4-benzoquinone	DMA/H_2O (2.3/1)		~15	5.5×10^8	LP/ABS/SST; OT; $f = 0.53$	83E088
1.1.17.	2,6-Dichloro-1,4-benzoquinone	DMA/H_2O (2.3/1)		~15	4.8×10^8	LP/ABS/SST; OT; $f = 0.59$; [Q] = (2-10) × 10^{-5} mol/L	83E088
1.1.18.	3,3′-Dimethyl-4,4′-diaminobiphenyl	DMSO/H_2O (4/1)		~28	7.9×10^7	LP/ABS/SST; RT; $f = 0.52$	83E088
1.1.19.	MV^{2+}	DMA/H_2O (2.3/1)		~15	$\sim 1 \times 10^2$	LP/ABS/SST; OT	83E088
1.1.20.	Phenothiazine	DMSO/H_2O (4/1)		~28	1×10^6	LP/ABS/SST; RT; $f = 0.52$	83E088
1.1.21.	Tetrachloro-1,4-benzoquinone	DMA/H_2O (2.3/1)		~15	4.5×10^8	LP/ABS/SST; OT; $f = 0.60$	83E088
1.2. Al(5,10,15,20-tetraphenylporphyrin)$^+$							
Organic Quenchers							
1.2.1.	1,4-Benzoquinone	EtOH			1.0×10^9	LP/ABS/SST; OT; $f = 0.25$; $\phi = 0.85$ (82E428)	83F182
1.3. Al(5,10,15,20-tetraphenylporphyrin)(OH)							
Organic Quenchers							
1.3.1.	1,4-Benzoquinone	Toluene			7×10^7 (calc)	FP/ABS/SST; $\tau_0 = 0.91$ ms; EX; biexponential decay, see Mech. [2]; same data in 81E718	82E636
1.3.2.	Methyl-1,4-benzoquinone	Toluene			2×10^7 (calc)	FP/ABS/SST; $\tau_0 = 0.91$ ms; EX; biexponential decay, see Mech. [2]; same data in 81E718	82E636
1.3.3.	1,4-Naphthoquinone	Toluene			3×10^7 (calc)	FP/ABS/SST; $\tau_0 = 0.91$ ms; EX; biexponential decay, see Mech. [2]; same data in 81E718	82E636
1.3.4.	9,10-Phenanthrenequinone	Toluene			6×10^7 (calc)	FP/ABS/SST; $\tau_0 = 0.91$ ms; EX; biexponential decay, see Mech. [2]; same data in 81E718	82E636
1.3.5.	Tetramethyl-1,4-benzoquinone	Toluene			8×10^6 (calc)	FP/ABS/SST; $\tau_0 = 0.91$ ms; EX; biexponential decay, see Mech. [2]; same data in 81E718	82E636

TABLE 2. Quenching of excited cadmium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
2.1. Cd(mesoporphyrin IX dimethyl ester)							
Inorganic Quenchers							
2.1.1.	O_2	Toluene			3.2×10^9	LP/ABS/SST; ET; [Q] = 0.0011 mol/L	81E738
2.2. Cd(5,10,15,20-tetraphenylporphyrin)							
Organic Quenchers							
2.2.1.	1,4-Benzoquinone	EtOH			3.0×10^9	LP/ABS/SST; OT; $f = 0.16$	83F182

TABLE 3. Quenching of excited cerium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
3.1. Ce^{3+}							
Inorganic Quenchers							
3.1.1.	Cr^{3+}	H_2O	1 mol/L $HClO_4$; 1.1 mol/L $NaClO_4$		7.7×10^7	SL/LUM/SPC; τ_0^{air} = 44 ns; OT; [Q] ≤ 0.15 mol/L	80A287
3.1.2.	Cu^{2+}	H_2O	1 mol/L $HClO_4$; 1.1 mol/L $NaClO_4$		5.2×10^8	SL/LUM/SPC; τ_0^{air} = 44 ns; OT; [Q] ≤ 0.08 mol/L	80A287
3.1.3.	Eu^{3+}	H_2O	1 mol/L $HClO_4$; 1.1 mol/L $NaClO_4$		1.1×10^7	SL/LUM/SPC; τ_0^{air} = 44 ns; OT; [Q] ≤ 0.50 mol/L	80A287
3.1.4.	Fe^{3+}	H_2O	1 mol/L $HClO_4$; 1.1 mol/L $NaClO_4$		1.1×10^9	SL/LUM/SPC; τ_0^{air} = 44 ns; OT; [Q] ≤ 0.008 mol/L	80A287
3.1.5.	Tl^{3+}	H_2O	1 mol/L $HClO_4$; 1.1 mol/L $NaClO_4$		6.7×10^8	SL/LUM/SPC; τ_0^{air} = 44 ns; OT; [Q] ≤ 0.029 mol/L	80A287

TABLE 4. Quenching of excited chromium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.1. $Cr(5\text{-}Brphen)_3^{3+}$							
Inorganic Quenchers							
4.1.1.	$Cr(5\text{-}Brphen)_3^{3+}$	H_2O/AN (24/1)	1 mol/L HCl	22	5.4×10^7	LP/LUM/SST; τ_0 = 0.18 ms; CD; τ_0 extrap'd to [S] = 0	81E458
	$Cr(5\text{-}Brphen)_3^{3+}$	H_2O/AN (24/1)	1 mol/L NaCl, BRbuf; pH 9.5	22	8.1×10^7	LP/LUM/SST; τ_0 = 0.17 ms; CD; τ_0 extrap'd to [S] = 0	81E458
4.1.2.	O_2	H_2O	1 mol/L HCl	25	4.0×10^7	SS/LUM; τ_0 = 0.16 ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) × 10^{-4} mol/L	78F366
4.2. $Cr(CN)_6^{3-}$							
Inorganic Quenchers							
4.2.1.	ICN	DMF		22	3.2×10^4	LP/LUM/SST; τ_0 = 6.5 ms; E_a = 38 kJ/mol (−55 to 60 °C); $\Delta S^{\ddagger}$ = −48 J/mol·K; τ_0 at 25 °C	83E203
	ICN	DMF	5×10^{-4} mol/L TOAB	22	2.4×10^4	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C	83E203
	ICN	DMF	0.005 mol/L TOAB	22	1.6×10^4	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C	83E203
	ICN	DMF	0.015 mol/L TOAB	22	1.0×10^4	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C	83E203
	ICN	DMF	0.025 mol/L TOAB	22	5×10^3	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C	83E203
	ICN	DMF	0.1 mol/L TOAB	22	1×10^3	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C	83E203
4.2.2.	O_2	DMF		22	1.7×10^6	LP/LUM/SST; τ_0 = 6.5 ms; [Q] = 0.0012 mol/L; τ_0 at 25 °C	83E203
Organic Quenchers							
4.2.3.	Benzophenone	DMF		22	2.0×10^1	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C; OT?	83E203
4.2.4.	1-Chloro-4-nitrobenzene	DMF		22	1.6×10^3	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C; OT?	83E203
4.2.5.	2,4-Dinitroaniline	DMF		22	3.3×10^4	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C; OT?	83E203
4.2.6.	2,4-Dinitrobenzaldehyde	DMF		22	6.5×10^4	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C; OT?	83E203
4.2.7.	1,2-Dinitrobenzene	DMF		22	1.3×10^4	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C; OT?	83E203

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.2.	**$Cr(CN)_6^{3-}$**—Continued						
4.2.8.	1,3-Dinitrobenzene	DMF		22	1×10^3	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C; OT?	83E203
4.2.9.	Methyl iodide	DMF		22	1.6×10^3	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C	83E203
4.2.10.	Naphthacene	DMF		22	3.5×10^7	LP/LUM/SST; τ_0 = 6.5 ms; E_a = 2.6 kJ/mol (−55 to 60 °C); $\Delta S^{\ddagger}$ = −100 J/mol·K; ET; τ_0 at 25 °C	83E203
4.2.11.	4-Nitroaniline	DMF		22	1.1×10^3	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C; OT?	83E203
4.2.12.	2-Nitrobenzaldehyde	DMF		22	2×10^4	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C; OT?	83E203
4.2.13.	Nitrobenzene	DMF		22	2.2×10^2	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C; OT?	83E203
4.2.14.	2-Nitrotoluene	DMF		22	2.2×10^2	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C; OT?	83E203
4.2.15.	9,10-Phenanthrenequinone	DMF		22	6×10^3	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C; OT?	83E203
4.2.16.	Tetrabutylammonium bromide	DMF		22	1×10^2	LP/LUM/SST; τ_0 = 6.5 ms; τ_0 at 25 °C	83E203
4.2.17.	Tetrabutylammonium iodide	DMF		22	3×10^2	LP/LUM/SST; τ_0 = 6.5 ms; E_a = 28 kJ/mol (−55 to 60 °C); $\Delta S^{\ddagger}$ = −110 J/mol·K; τ_0 at 25 °C	83E203
4.3.	**$Cr(5\text{-Clphen})_3^{3+}$**						
	Inorganic Quenchers						
4.3.1.	$Cr(5\text{-Clphen})_3^{3+}$	H_2O	1 mol/L HCl	22	1.7×10^7	LP/LUM/SST; τ_0 = 0.18 ms; CD; [Q] = [S] ≤ 0.0013 mol/L; τ_0 extrap'd to [S] = 0	81E458
	$Cr(5\text{-Clphen})_3^{3+}$	H_2O	1 mol/L NaCl, BRbuf; pH 9.5	22	3.5×10^7	LP/LUM/SST; τ_0 = 0.15 ms; CD; τ_0 extrap'd to [S] = 0; same k_q with SS/QYP, see Mech. [5]	81E458
4.3.2.	Fe^{2+}	H_2O	1 mol/L H_2SO_4	25	4.8×10^7	SS/LUM; τ_0 = 0.18 ms (LP/LUM/AVE); RT	78F366
	Fe^{2+}	H_2O	1 mol/L HCl	25	1.2×10^8	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/AVE); RT	79E270

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.3. $Cr(5\text{-}ClphenH)_3^{3+}$—Continued							
4.3.3	I^-	H_2O	1 mol/L HCl	25	8.0×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/AVE); RT?	79E270
4.3.4.	O_2	H_2O	1 mol/L HCl	25	3.7×10^7	SS/LUM; τ_0 = 0.16 ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) × 10^{-4} mol/L	78F366
	O_2	H_2O	1 mol/L HCl	25	3.7×10^7	SS/LUM; τ_0 = 0.13 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) × 10^{-4} mol/L; same k_q from same lab in 78A388	79E270
4.4. $Cr(4,4'\text{-}Me_2bpy)_3^{3+}$							
Inorganic Quenchers							
4.4.1.	$Cr(4,4'\text{-}Me_2bpy)_3^{3+}$	H_2O/AN (24/1)	5 mol/L HCl	22	2.0×10^6	LP/LUM/SST; τ_0 = 0.31 ms; CD; τ_0 extrap'd to [S] = 0	81E458
4.4.2.	Fe^{2+}	H_2O	1 mol/L H_2SO_4	25	8.2×10^5	SS/LUM; τ_0 = 0.21 ms (LP/LUM/AVE); RT	78F366
	Fe^{2+}	H_2O	1 mol/L HCl	25	2.2×10^6	SS/LUM; τ_0^{air} = 77 μs (estd); RT	79E270
4.4.3.	I^-	H_2O	1 mol/L HCl	25	4.0×10^7	SS/LUM; τ_0^{air} = 77 μs (estd); RT?	79E270
4.4.4.	O_2	H_2O	1 mol/L HCl	25	4.2×10^7	SS/LUM; τ_0 = 0.18 ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) × 10^{-4} mol/L	78F366
	O_2	H_2O	1 mol/L HCl	25	3.4×10^7	SS/LUM; τ_0 = 0.23 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) × 10^{-4} mol/L; same k_q from same lab in 78A388	79E270
4.5. $Cr(3,4,7,8\text{-}Me_4phen)_3^{3+}$							
Inorganic Quenchers							
4.5.1.	$Cr(3,4,7,8\text{-}Me_4phen)_3^{3+}$	H_2O/AN (24/1)	1 mol/L HCl	22	1.5×10^7	LP/LUM/SST; τ_0 = 0.64 ms; CD; τ_0 extrap'd to [S] = 0	81E458
	$Cr(3,4,7,8\text{-}Me_4phen)_3^{3+}$	H_2O/AN (24/1)	1 mol/L NaCl, BRbuf; pH 9.5	22	3.9×10^7	LP/LUM/SST; τ_0 = 0.62 ms; CD; τ_0 extrap'd to [S] = 0	81E458
4.5.2.	Fe^{2+}	H_2O	1 mol/L HCl	25	9.2×10^5	SS/LUM; τ_0^{air} = 26 μs (estd); RT	79E270

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.5. $Cr(3,4,7,8\text{-}Me_4phen)_3^{3+}$—Continued							
4.5.3.	I^-	H_2O	1 mol/L HCl	25	4.7×10^7	SS/LUM; τ_0^{air} = 26 μs (estd); RT?	79E270
4.5.4.	O_2	H_2O	1 mol/L HCl	25	1.5×10^8	SS/LUM; τ_0 = 0.47 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) × 10^{-4} mol/L; same k_q from same lab in 78A388	79E270
4.6. $Cr(4,7\text{-}Me_2phen)_3^{3+}$							
Inorganic Quenchers							
4.6.1.	$Cr(4,7\text{-}Me_2phen)_3^{3+}$	H_2O/AN (24/1)	1 mol/L HCl	22	1.0×10^7	LP/LUM/SST; τ_0 = 0.57 ms; CD; τ_0 extrap'd to [S] = 0	81E458
	$Cr(4,7\text{-}Me_2phen)_3^{3+}$	H_2O/AN (24/1)	1 mol/L NaCl, BRbuf; pH 9.5	22	1.4×10^7	LP/LUM/SST; τ_0 = 0.42 ms; CD; τ_0 extrap'd to [S] = 0	81E458
4.6.2.	Fe^{2+}	H_2O	1 mol/L H_2SO_4	25	8.9×10^5	SS/LUM; τ_0 = 0.64 ms (LP/LUM/AVE); RT	78F366
	Fe^{2+}	H_2O	1 mol/L HCl	25	6.0×10^6	SS/LUM; τ_0^{air} = 37 μs (LP/LUM/AVE); RT	79E270
4.6.3.	I^-	H_2O	1 mol/L HCl	25	1.5×10^8	SS/LUM; τ_0^{air} = 37 μs (LP/LUM/AVE); RT?	79E270
4.6.4.	O_2	H_2O	1 mol/L HCl	25	8.8×10^7	SS/LUM; τ_0 = 0.58 ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) × 10^{-4} mol/L	78F366
	O_2	H_2O	1 mol/L HCl	25	1.9×10^8	SS/LUM; τ_0 = 0.34 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) × 10^{-4} mol/L; same k_q from same lab in 78A388	79E270
4.7. $Cr(5\text{-}Mephen)_3^{3+}$							
Inorganic Quenchers							
4.7.1.	$Cr(5\text{-}Mephen)_3^{3+}$	H_2O	1 mol/L HCl	22	5.6×10^6	LP/LUM/SST; τ_0 = 0.42 ms; CD; τ_0 extrap'd to [S] = 0	81E458
	$Cr(5\text{-}Mephen)_3^{3+}$	H_2O	1 mol/L NaCl, BRbuf; pH 9.5	22	1.4×10^7	LP/LUM/SST; τ_0 = 0.27 ms; CD; τ_0 extrap'd to [S] = 0	81E458
4.7.2.	Fe^{2+}	H_2O	1 mol/L H_2SO_4	25	1.0×10^7	SS/LUM; τ_0 = 0.38 ms (LP/LUM/AVE); RT	78F366

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.7. $Cr(5\text{-}Mephen)_3^{3+}$—Continued							
4.7.3.	O_2	H_2O	1 mol/L HCl	25	6.4×10^7	SS/LUM; τ_0 = 0.31 ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) × 10^{-4} mol/L	78F365
4.8. $Cr(5,6\text{-}Me_2phen)_3^{3+}$							
Inorganic Quenchers							
4.8.1.	$Cr(5,6\text{-}Me_2phen)_3^{3+}$	H_2O/AN (24/1)	1 mol/L HCl	22	7.5×10^6	LP/LUM/SST; τ_0 = 0.42 ms; CD; τ_0 extrap'd to [S] = 0	81E458
	$Cr(5,6\text{-}Me_2phen)_3^{3+}$	H_2O/AN (24/1)	1 mol/L NaCl, BRbuf; pH 9.5	22	1.7×10^7	LP/LUM/SST; τ_0 = 0.29 ms; CD; τ_0 extrap'd to [S] = 0	81E458
4.9. $Cr(NH_3)_5(CN)^{2+}$							
Inorganic Quenchers							
4.9.1.	$Cr(CN)_5^{3-}$	DMF		20	1.7×10^9	SS/LUM; τ_0 = 19 μs (LP/LUM/SST); ET; [Q] = (1-20) × 10^{-5} mol/L	84E097
	$Cr(CN)_5^{3-}$	H_2O	5 × 10^{-4} mol/L $HClO_4$	20	6.2×10^8	LP/LUM/SST; τ_0 = 22 μs; ET; [Q] ≤ 2.5 × 10^{-4} mol/L	84E097
4.9.2.	OH^-	H_2O		20	6.2×10^9	LP/LUM/SST; τ_0 = 22 μs; PT?; [Q] ≤ 3.3 × 10^{-5} mol/L	84E097
4.10. *trans*-$Cr(NH_3)_4(CN)_2^+$							
Inorganic Quenchers							
4.10.1.	OH^-	H_2O		20	2.0×10^9	LP/LUM/SST; τ_0 = 42 μs; PT?; [Q] ≤ 2.5 × 10^{-5} mol/L	84E097
4.11. $Cr(4,4'\text{-}Ph_2bpy)_3^{3+}$							
Inorganic Quenchers							
4.11.1.	$Cr(4,4'\text{-}Ph_2bpy)_3^{3+}$	H_2O/MeOH (1.5/1)	1 mol/L NaCl, BRbuf; pH 9.5	22	6.0×10^7	LP/LUM/SST; τ_0 = 53 μs; CD; τ_0 extrap'd to [S] = 0	81E458
	$Cr(4,4'\text{-}Ph_2bpy)_3^{3+}$	H_2O/AN (24/1)	1 mol/L HCl	22	1.4×10^8	LP/LUM/SST; τ_0 = 0.17 ms; CD; τ_0 extrap'd to [S] = 0	81E458
	$Cr(4,4'\text{-}Ph_2bpy)_3^{3+}$	H_2O/AN (24/1)	5 mol/L HCl	22	1.0×10^8	LP/LUM/SST; τ_0 = 0.19 ms; CD; τ_0 extrap'd to [S] = 0	81E458
4.11.2.	Fe^{2+}	H_2O	1 mol/L HCl	25	2.0×10^7	SS/LUM; τ_0^{air} = 17 μs (LP/LUM/AVE); RT	79E270

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.11. $Cr(4,4'\text{-}Ph_2bpy)_3^{3+}$—Continued							
4.11.3.	I^-	H_2O	1 mol/L HCl	25	2.2×10^9	SS/LUM; τ_0^{air} = 17 μs (LP/LUM/AVE); RT?	79E270
4.11.4.	O_2	H_2O	1 mol/L HCl	25	1.7×10^8	SS/LUM; τ_0 = 0.14 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) × 10^{-4} mol/L; same k_q from same lab in 78A388	79E270
4.12. $Cr(4,7\text{-}Ph_2phen)_3^{3+}$							
Inorganic Quenchers							
4.12.1.	$Cr(4,7\text{-}Ph_2phen)_3^{3+}$	H_2O/MeOH (1.5/1)	1 mol/L NaCl, BRbuf; pH 9.5	22	3×10^8	LP/LUM/SST; τ_0 = 89 μs; CD; τ_0 extrap'd to [S] = 0; same k_q with SS/QYP, see Mech. [5]	81E458
	$Cr(4,7\text{-}Ph_2phen)_3^{3+}$	H_2O/AN (24/1)	1 mol/L HCl	22	7.4×10^7	LP/LUM/SST; τ_0 = 0.57 ms; CD; τ_0 extrap'd to [S] = 0	81E458
4.12.2.	Fe^{2+}	H_2O	1 mol/L HCl	25	2.5×10^7	SS/LUM; τ_0^{air} = 16 μs (LP/LUM/AVE); RT	79E270
4.12.3.	I^-	H_2O	1 mol/L HCl	25	5.9×10^9	SS/LUM; τ_0^{air} = 16 μs (LP/LUM/AVE); RT?	79E270
4.12.4.	O_2	H_2O	1 mol/L HCl	25	3.1×10^8	SS/LUM; τ_0 = 0.37 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) × 10^{-4} mol/L; same k_q from same lab in 78A388	79E270
Organic Quenchers							
4.12.5.	1,4-Bis(*N,N*-dimethylamino)benzene	AN		~15	2.0×10^9	SS/LUM; τ_0 = 0.20 ms (LP/ABS/AVE); RT; f = 0.73	84E387
4.12.6.	4,4'-Bis(*N,N*-dimethylamino)biphenyl	AN		~15	6.7×10^9	SS/LUM; τ_0 = 0.20 ms (LP/ABS/AVE); RT; f = 0.21	84E387
4.12.7.	1,2-Diaminobenzene	AN		~15	1.5×10^{10}	LP/ABS/AVE; τ_0 = 0.20 ms; RT; f = 0.14	84E387
4.12.8.	1,4-Diaminobenzene	AN		~15	6.6×10^9	LP/ABS/AVE; τ_0 = 0.20 ms; RT; f = 0.50	84E387
4.12.9.	3,3'-Dimethyl-4,4'-diaminobiphenyl	AN		~15	6.6×10^9	LP/ABS/AVE; τ_0 = 0.20 ms; RT; f = 0.11	84E387
4.12.10.	Triphenylamine	AN		~15	9.2×10^9	LP/ABS/AVE; τ_0 = 0.20 ms; RT; f = 0.019	84E387

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.13. $Cr(5\text{-Phphen})_3^{3+}$							
Inorganic Quenchers							
4.13.1.	$Cr(5\text{-Phphen})_3^{3+}$	H_2O/AN (24/1)	1 mol/L HCl	22	5.7×10^7	LP/LUM/SST; τ_0 = 0.22 ms; CD; [Q] = [S] ≤ 0.0012 mol/L; τ_0 extrap'd to [S] = 0	81E458
	$Cr(5\text{-Phphen})_3^{3+}$	H_2O/AN (24/1)	1 mol/L NaCl, BRbuf; pH 9.5	22	9.3×10^7	LP/LUM/SST; τ_0 = 0.18 ms; CD; τ_0 extrap'd to [S] = 0; same k_q with SS/QYP, see Mech. [5]	81E458
4.14. $Cr(bpy)_3^{3+}$							
Inorganic Quenchers							
4.14.1.	$Co(acac)_3$	Acetone		~22	2.0×10^8	LP/LUM/SST; ET	83E223
4.14.2.	$Co(CN)_6^{3-}$	H_2O	0.5 mol/L NaCl	~20	$<2 \times 10^5$	SS/LUM; τ_0^{air} = 51 μs (SL/LUM/SPC)	78F263
	$Co(CN)_6^{3-}$	H_2O	1.5 mol/L $NaHSO_4$	25	$<1 \times 10^6$	SS/LUM; τ_0 = 70 μs (LP/LUM/SST); ET, RT	83F230
4.14.3.	*trans*-$Co(cyclam)Cl_2^+$	H_2O	1 mol/L $NaClO_4$; pH 2	25	2.5×10^7	FP/ABS/SST; ET, RT	83F230
4.14.4.	*trans*-$Co(cyclam)(H_2O)_2^{3+}$	H_2O	1 mol/L $NaClO_4$; pH 2	25	1.8×10^6	FP/ABS/SST; ET, RT	83F230
4.14.5.	*trans*-$Co(cyclam)(H_2O)(N_3)^{2+}$	H_2O	1 mol/L $NaClO_4$; pH 1	25	1.6×10^8	FP/ABS/SST; ET, RT	83F230
4.14.6.	$Co(DMG)_2(C_2H_5)(H_2O)$	H_2O	0.01 mol/L HCl	~22	1.4×10^9	LP/LUM/SST; ET	83E223
4.14.7.	$Co(en)_3^{3+}$	H_2O	0.1 mol/L H_2SO_4	22	1×10^6	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET	83E586
4.14.8.	*cis*-$Co(en)_2Cl_2^+$	H_2O	0.1 mol/L H_2SO_4	22	1.8×10^8	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET; [Q] = (1-8) × 10^{-4} mol/L	83E586
4.14.9.	*trans*-$Co(en)_2Cl_2^+$	H_2O	0.1 mol/L H_2SO_4	22	1.0×10^7	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET; [Q] = (1-9) × 10^{-4} mol/L	83E586
4.14.10.	*cis*-$Co(en)_2(H_2O)Cl^{2+}$	H_2O	0.1 mol/L H_2SO_4	22	2.2×10^7	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET	83E586
4.14.11.	*cis*-$Co(en)_2(NCS)_2^+$	H_2O	0.1 mol/L H_2SO_4	22	3.9×10^8	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET; [Q] = (1-5) × 10^{-4} mol/L	83E586
4.14.12.	*trans*-$Co(en)_2(NCS)_2^+$	H_2O	0.1 mol/L H_2SO_4	22	9.2×10^7	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET; [Q] = (1-8) × 10^{-4} mol/L	83E586

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.14.	**$Cr(bpy)_3^{3+}$**—Continued						
4.14.13.	*cis*-$Co(en)_2(NCS)Cl^+$	H_2O	0.1 mol/L H_2SO_4	22	3.6×10^8	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET; [Q] = (1-5) × 10^{-4} mol/L	83E586
4.14.14.	*trans*-$Co(en)_2(NCS)Cl^+$	H_2O	0.1 mol/L H_2SO_4	22	6.2×10^7	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET; [Q] = (1-8) × 10^{-4} mol/L	83E586
4.14.15.	*cis*-$Co(en)_2(NH_3)Cl^{2+}$	H_2O	0.1 mol/L H_2SO_4	22	3.2×10^7	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET	83E586
4.14.16.	$Co(NH_3)_6^{3+}$	H_2O	0.1 mol/L H_2SO_4	22	2×10^6	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET	83E586
	$Co(NH_3)_6^{3+}$	H_2O	1 mol/L HCl	25	4.3×10^6	FP/ABS/SST; ET, RT	83F230
4.14.17.	$Co(NH_3)_5(CN)^{2+}$	H_2O	1 mol/L HCl	25	5.0×10^6	FP/ABS/SST; ET, RT	83F230
4.14.18.	$Co(NH_3)_5Cl^{2+}$	H_2O	0.1 mol/L H_2SO_4	22	2.0×10^7	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET	83E586
4.14.19.	$Co(NH_3)_5F^{2+}$	H_2O	0.1 mol/L H_2SO_4	22	2×10^6	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET	83E586
	$Co(NH_3)_5F^{2+}$	H_2O	1.5 mol/L $NaHSO_4$	25	2.0×10^6	SS/LUM; τ_0 = 70 μs (LP/LUM/SST); ET, RT	83F230
4.14.20.	$Co(NH_3)_5(H_2O)^{3+}$	H_2O	0.1 mol/L H_2SO_4	22	1×10^6	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET	83E586
	$Co(NH_3)_5(H_2O)^{3+}$	H_2O	1 mol/L HCl	25	4.0×10^6	FP/ABS/SST; ET, RT	83F230
4.14.21.	$Co(NH_3)_5(N_3)^{2+}$	H_2O	1 mol/L $NaHSO_4$	25	1.6×10^8	FP/ABS/SST; ET, RT	83F230
4.14.22.	$Co(NH_3)_5(NCS)^{2+}$	H_2O	0.1 mol/L H_2SO_4	22	9.1×10^7	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET	83E586
	$Co(NH_3)_5(NCS)^{2+}$	H_2O	1 mol/L $NaHSO_4$	25	1.9×10^8	FP/ABS/SST; ET, RT	83F230
4.14.23.	$Co(NH_3)_5(NO_2)^{2+}$	H_2O	0.1 mol/L H_2SO_4	22	1.6×10^7	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET	83E586
4.14.24.	$Co(NH_3)_5[OC(O)H]^{2+}$	H_2O	0.1 mol/L H_2SO_4	22	3×10^6	SS/LUM; τ_0^{air} = 38 μs (LP/LUM/AVE); ET	83E586
4.14.25.	$Cr(bpy)_3^{3+}$	H_2O	1 mol/L NaCl, BRbuf; pH 10	14.9	1.6×10^6	LP/LUM/SST; τ_0 = 0.11 ms; CD; [Q] = [S] = (1-100) × 10^{-5} mol/L; τ_0 extrap'd to [S] = 0	83E317
	$Cr(bpy)_3^{3+}$	H_2O	5 mol/L HCl	22	1.3×10^6	LP/LUM/SST; τ_0 = 0.10 ms; CD; same k_q from same lab in 80E076; [Q] = [S] ≤ 0.012 mol/L; τ_0 extrap'd to [S] = 0	81E458

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.14.	**$Cr(bpy)_3^{3+}$**—Continued						
4.14.26.	$Cr(CN)_6^{3-}$	H_2O	0.5 mol/L NaCl	~20	4.1×10^9	SS/LUM; τ_0^{air} = 51 μs (SL/LUM/SPC); ET	78F263
4.14.27.	Fe^{2+}	H_2O	1 mol/L HCl	~15	4×10^7	LP/ABS/AVE; τ_0 = 60 μs; RT; f = 0.081; Q as Cl^- complex	84E387
	Fe^{2+}	H_2O	1 mol/L $HClO_4$	~15	7×10^6	LP/ABS/AVE; τ_0 = 60 μs; RT; f = 0.17	84E387
	Fe^{2+}	H_2O	1 mol/L HCl	25	3.7×10^7	SS/LUM; τ_0^{air} = 55 μs (LP/LUM/AVE); RT	79E270
	Fe^{2+}	H_2O	1 mol/L H_2SO_4	25	1.6×10^7	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); RT	78F366
	Fe^{2+}	H_2O	μ = 1		4.1×10^7	RT	767517
4.14.28.	$Fe(C_5H_5)_2$	AN/H_2O (2.3/1)		~15	6.2×10^9	LP/ABS/AVE; τ_0 = 60 μs; RT; f = 0.18; [Q] < 5×10^{-4} mol/L	84E387
4.14.29.	$Fe(C_5H_5)(C_5H_4COOH)$	AN/H_2O (2.3/1)		~15	7.3×10^9	LP/ABS/AVE; τ_0 = 60 μs; RT; f = 0.069; [Q] < 5×10^{-4} mol/L	84E387
4.14.30.	$Fe(CN)_6^{3-}$	H_2O	0.5 mol/L NaCl	~20	2.6×10^8	SS/LUM; τ_0^{air} = 51 μs (SL/LUM/SPC); OT?	78F263
4.14.31.	$Fe(CN)_6^{4-}$	H_2O	0.5 mol/L NaCl	~20	4.9×10^9	SS/LUM; τ_0^{air} = 51 μs (SL/LUM/SPC); RT	78F263
4.14.32.	H_2O	AN		22	1.3×10^3	LP/LUM/SST; τ_0 = 43 μs	83E110
4.14.33.	I^-	H_2O	μ = 1.0 (NaCl)	11	8.5×10^8	SS/LUM and SL/LUM/SPC; τ_0^{air} = 80 μs; RT?; [Q] = (1-12) × 10^{-5} mol/L	78F122
	I^-	H_2O	μ = 1.0 (NaCl)	22	1.2×10^9	LP/ABS/SST; τ_0 = 63 μs; RT?; same k_q from same lab in 776321	78F122
	I^-	H_2O	1 mol/L HCl	25	1.4×10^9	SS/LUM; τ_0^{air} = 55 μs (LP/LUM/AVE); RT?	79E270
4.14.34.	$Mo(CN)_8^{4-}$	H_2O	0.5 mol/L NaCl	~20	5.2×10^9	SS/LUM; τ_0^{air} = 51 μs (SL/LUM/SPC); RT	78F263
4.14.35.	$Ni(13\text{-}At)^+$	AN			2.6×10^8	SS/LUM; τ_0 = 0.12 ms; RT	81A335
4.14.36.	$Ni(CN)_4^{2-}$	H_2O	0.5 mol/L NaCl	~20	1.4×10^9	SS/LUM; τ_0^{air} = 51 μs (SL/LUM/SPC); RT	78F263
4.14.37.	$Ni(Me_6cyclam)^{2+}$	AN			1.2×10^6	SS/LUM; τ_0 = 0.12 ms; RT	81A335

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.14.	**$Cr(bpy)_3^{3+}$**—Continued						
4.14.38.	O_2	H_2O	μ = 1.0 (NaCl)	22	1.7×10^7	LP/ABS/SST; τ_0 = 63 μs; p_Q = (2, 10) × 10^4 Pa; same k_q from same lab in 776321	78F122
	O_2	H_2O	1 mol/L HCl	25	2.7×10^7	SS/LUM; τ_0 = 66 μs (LP/LUM/AVE); ET; [Q] = (2.5, 12) × 10^{-4} mol/L	78F366
	O_2	H_2O	1 mol/L HCl	25	1.7×10^7	SS/LUM; τ_0 = 63 μs (FP/ABS/SST); ET; [Q] = (2.5, 12) × 10^{-4} mol/L; same k_q from same lab in 78A388	79E270
4.14.39.	OH^-	H_2O		5	$\leq 2 \times 10^4$	LP/ABS/SST	78F122
4.14.40.	$Os(bpy)_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	1.5×10^9	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); RT	78F366
4.14.41.	$Os(bpy)_3^{3+}$	H_2O	1 mol/L H_2SO_4	25	$<1 \times 10^6$	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); [Q] = ~0.001 mol/L	78F366
4.14.42.	$PtBr_4^{2-}$	H_2O	μ = 2 ($HClO_4$)		2.0×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 65 μs; ET; [Q] ≤ 9 × 10^{-6} mol/L	83E719
4.14.43.	$PtBr_6^{2-}$	H_2O	μ = 2 ($HClO_4$)		2×10^7	LP/LUM/SST; τ_0^{air} = 60 μs; ET; [Q] ≤ 0.001 mol/L	83A403
4.14.44.	$Pt(CN)_4^{2-}$	H_2O	μ = 2 ($HClO_4$ or H_2SO_4)		$\sim 1 \times 10^5$	EMI; RT	85A469
4.14.45.	$Pt(C_2O_4)_2^{2-}$	H_2O	μ = 2 ($HClO_4$)		7.5×10^6	LP/LUM/SST, SS/LUM; τ_0^{air} = 65 μs; RT; [Q] ≤ 9 × 10^{-4} mol/L; same k_q from same lab in 85A469	83E719
4.14.46.	$PtCl_4^{2-}$	H_2O	μ = 2 ($HClO_4$)		1.4×10^7	LP/LUM/SST, SS/LUM; τ_0^{air} = 65 μs; ET; [Q] ≤ 9 × 10^{-4} mol/L	83E719
4.14.47.	$PtCl_6^{2-}$	H_2O	μ = 2 ($HClO_4$)		$<2 \times 10^5$	LP/LUM/SST; τ_0^{air} = 60 μs; ET; [Q] ≤ 0.001 mol/L	83A403
4.14.48.	$Pt(en)_2^{2+}$	H_2O	μ = 2 ($HClO_4$ or H_2SO_4)		6×10^5	EMI; RT	85A469
4.14.49.	PtF_6^{2-}	H_2O	μ = 2 ($HClO_4$)		$<2 \times 10^5$	LP/LUM/SST; τ_0^{air} = 60 μs; ET; [Q] ≤ 0.001 mol/L	83A403

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.14.	**$Cr(bpy)_3^{3+}$**—Continued						
4.14.50.	$Pt(NH_3)_4^{2+}$	H_2O	μ = 2 ($HClO_4$ or H_2SO_4)		4×10^5	EMI; RT	85A469
4.14.51.	$Pt(NO_2)_4^{2-}$	H_2O	μ = 2 ($HClO_4$ or H_2SO_4)		2×10^5	EMI; RT	85A469
4.14.52.	$Pt(SCN)_4^{2-}$	H_2O	μ = 2 ($HClO_4$)		1.3×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 65 μs; RT; [Q] ≤ 9 × 10^{-6} mol/L	83E719
4.14.53.	$Pt(SCN)_6^{2-}$	H_2O	μ = 2 ($HClO_4$)		1.5×10^8	LP/LUM/SST; τ_0^{air} = 60 μs; ET; [Q] ≤ 0.001 mol/L	83A403
4.14.54.	$Ru(bpy)_3^{2+}$	H_2O	μ = 0.2	23	4.0×10^8	SS/LUM; τ_0^{air} = 36 μs (SL/LUM/SST); RT	756325
	$Ru(bpy)_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	6.1×10^8	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); RT	78F366
4.14.55.	$Ru(bpy)_3^{3+}$	H_2O	1 mol/L H_2SO_4	25	6×10^6	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); ET?; [Q] = ~0.001 mol/L	78F366
4.14.56.	$Ru(CN)_6^{4-}$	H_2O	0.5 mol/L NaCl	~20	5.5×10^9	SS/LUM; τ_0^{air} = 51 μs (SL/LUM/SPC); RT	78F263
4.14.57.	$Ru(5\text{-Clphen})_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	6.1×10^8	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); RT	78F366
4.14.58.	$Ru(4,4'\text{-}Me_2bpy)_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	1.1×10^9	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); RT	78F366
4.14.59.	$Ru(3,4,7,8\text{-}Me_4phen)_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	1×10^9	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); RT	78F366
4.14.60.	$Ru(4,7\text{-}Me_2phen)_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	1.1×10^9	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); RT	78F366
4.14.61.	$Ru(5\text{-Mephen})_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	9.9×10^8	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); RT	78F366
4.14.62.	$Ru(NH_3)_6^{3+}$	H_2O	1.5 mol/L $NaHSO_4$	25	$<1 \times 10^6$	SS/LUM; τ_0 = 70 μs (LP/LUM/SST); ET, RT	83F230
4.14.63.	$Ru[5\text{-}(NO_2)phen]_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	1.3×10^8	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); RT	78F366
4.14.64.	$Ru(phen)_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	9.1×10^8	SS/LUM; τ_0 = 76 μs (LP/LUM/AVE); RT	78F366
	Organic Quenchers						
4.14.65.	1-Aminonaphthalene	AN	0.02 mol/L TEAP	~22	7.2×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.14.	**$Cr(bpy)_3^{3+}$**—Continued						
4.14.66.	2-Aminonaphthalene	AN	0.02 mol/L TEAP	~22	8.2×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.67.	*N*-(4-Aminophenyl)aniline	AN	0.02 mol/L TEAP	~22	9.4×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.68.	Aniline	AN	0.02 mol/L TEAP	~22	9.9×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.69.	1,4-Bis(*N,N*-dimethylamino)benzene	AN		~15	5.6×10^9	SS/LUM; τ_0 = 60 μs (LP/ABS/AVE); RT; f = 0.29	84E387
4.14.70.	4,4′-Bis(*N,N*-dimethylamino)biphenyl	AN		~15	3.5×10^9	SS/LUM; τ_0 = 60 μs (LP/ABS/AVE); RT; f = 0.12	84E387
	4,4′-Bis(*N,N*-dimethylamino)biphenyl	AN	0.02 mol/L TEAP	~22	1.1×10^{10}	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.71.	1,4-Bis(*N*-phenylamino)benzene	AN	0.02 mol/L TEAP	~22	7.2×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.72.	*tert*-Butylamine	AN	0.02 mol/L TEAP	~22	1.4×10^7	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.73.	1,2-Diaminobenzene	AN		~15	3.6×10^9	LP/ABS/AVE; τ_0 = 60 μs; RT; f = 0.05	84E387
4.14.74.	1,4-Diaminobenzene	AN		~15	4.6×10^9	LP/ABS/AVE; τ_0 = 60 μs; RT; f = 0.22	84E387
4.14.75.	4,4′-Diaminobiphenyl	AN	0.02 mol/L TEAP	~22	8.7×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.76.	Dibenzylamine	AN	0.02 mol/L TEAP	~22	1.0×10^7	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.77.	Dibutylamine	AN	0.02 mol/L TEAP	~22	1.6×10^8	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.78.	Dicyclohexylamine	AN	0.02 mol/L TEAP	~22	2.0×10^8	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.79.	Diethylamine	AN	0.02 mol/L TEAP	~22	8.9×10^7	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.80.	*N,N*-Diethylaniline	AN	0.02 mol/L TEAP	~22	6.4×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.81.	1,2-Dimethoxybenzene	AN	0.02 mol/L TEAP	~22	2.4×10^8	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.82.	1,4-Dimethoxybenzene	AN	0.02 mol/L TEAP	~22	1.1×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.14.	**$Cr(bpy)_3^{3+}$**—Continued						
4.14.83.	*N,N*-Dimethylbenzylamine	AN	0.02 mol/L TEAP	~22	2.5×10^8	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.84.	3,3′-Dimethyl-4,4′-diaminobiphenyl	AN		~15	3.2×10^9	LP/ABS/AVE; τ_0 = 60 μs; RT; f = 0.068	84E387
4.14.85.	Diphenylamine	AN		~15	3.3×10^9	LP/ABS/AVE; τ_0 = 60 μs; RT; f = 0	84E387
	Diphenylamine	AN	0.02 mol/L TEAP	~22	9.1×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.86.	Dipropylamine	AN	0.02 mol/L TEAP	~22	1.5×10^8	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.87.	*N*-Methylaniline	AN	0.02 mol/L TEAP	~22	1.1×10^{10}	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.88.	*cis*-1-Phenyl-2-(2-naphthyl)ethene	AN			5×10^7	SS/LUM, LP/LUM/SST; τ_0 = 48 μs; RT; [Q] = (1-20) × 10^{-4} mol/L	84F249
4.14.89.	*trans*-1-Phenyl-2-(2-naphthyl)ethene	AN			8×10^8	SS/LUM, LP/LUM/SST; τ_0 = 48 μs; RT; [Q] = (7-80) × 10^{-6} mol/L	84F249
4.14.90.	Tributylamine	AN	0.02 mol/L TEAP	~22	6.9×10^8	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.91.	Triethylamine	AN	0.02 mol/L TEAP	~22	7.4×10^8	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.92.	1,2,3-Trimethoxybenzene	AN	0.02 mol/L TEAP	~22	4.3×10^7	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.93.	1,2,4-Trimethoxybenzene	AN	0.02 mol/L TEAP	~22	2.8×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.94.	1,3,5-Trimethoxybenzene	AN	0.02 mol/L TEAP	~22	1.9×10^7	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518
4.14.95.	Triphenylamine	AN		~15	2.4×10^9	LP/ABS/AVE; τ_0 = 60 μs; RT; f = 0.006	84E387
	Triphenylamine	AN	0.02 mol/L TEAP	~22	7.3×10^9	SS/LUM; τ_0^{air} = 50 μs (LP/LUM/SST); RT	78E518

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.15. $Cr(en)_3^{3+}$							
Inorganic Quenchers							
4.15.1.	$CoCl^+$	H_2O	KCl or $MgCl_2$ ($[Cl^-]_{tot}$ = 2-5.2 mol/L)		5×10^6	SS/LUM, LP/LUM/SST; τ_0^{air} = 1.3 μs; ET; nonlinear S-V plots; k_q eval'd from best fit of k_{obs} at various $[Co^{II}]_{tot}$ and $[Cl^-]_{tot}$; $[Co^{II}]_{tot}$ = 0.1-1.6 mol/L	736183
4.15.2.	$CoCl_2$	H_2O	KCl or $MgCl_2$ ($[Cl^-]_{tot}$ = 2-5.2 mol/L)		8×10^7	SS/LUM, LP/LUM/SST; τ_0^{air} = 1.3 μs; ET; nonlinear S-V plots; k_q eval'd from k_{obs} at various $[Co^{II}]_{tot}$ and $[Cl^-]_{tot}$; $[Co^{II}]_{tot}$ = 0.1-1.6 mol/L	736183
4.15.3.	$CoCl_3^-$	H_2O	KCl or $MgCl_2$ ($[Cl^-]_{tot}$ = 2-5.2 mol/L)		$\sim 2 \times 10^8$	SS/LUM, LP/LUM/SST; τ_0^{air} = 1.3 μs; ET; nonlinear S-V plots; k_q eval'd from best fit of k_{obs} at various $[Co^{II}]_{tot}$ and $[Cl^-]_{tot}$; $[Co^{II}]_{tot}$ = 0.1-1.6 mol/L	736183
4.15.4.	$Co(H_2O)_6^{2+}$	H_2O	KCl or $MgCl_2$ ($[Cl^-]_{tot}$ = 2-5.2 mol/L)		1.5×10^5	SS/LUM, LP/LUM/SST; τ_0^{air} = 1.3 μs; ET; nonlinear S-V plots; k_q eval'd from k_{obs} at various $[Co^{II}]_{tot}$ and $[Cl^-]_{tot}$; $[Co^{II}]_{tot}$ = 0.1-1.6 mol/L	736183
4.16. *trans*-$Cr(en)_2(NCS)_2^+$							
Inorganic Quenchers							
4.16.1.	$Co(CN)_6^{3-}$	H_2O	pH 3	15	$<1 \times 10^5$	SS/LUM; τ_0^{air} = 11 μs (SL/LUM/SST)	776252
4.16.2.	$Co(NH_3)_5Cl^{2+}$	H_2O	pH 3	15	1.8×10^8	SS/LUM; τ_0^{air} = 11 μs (SL/LUM/SST); ET	776252
4.16.3.	$Cr(CN)_6^{3-}$	H_2O	pH 3	15	2.3×10^9	SS/LUM; τ_0^{air} = 11 μs (SL/LUM/SST); ET	776252
4.16.4.	I^-	H_2O	pH 3	15	$<1 \times 10^5$	SS/LUM; τ_0^{air} = 11 μs (SL/LUM/SST)	776252
4.16.5.	$Ni(gly)_2$	H_2O		15	7.5×10^7	SS/LUM; τ_0^{air} = 11 μs (SL/LUM/SST); ET	776252
4.16.6.	OH^-	H_2O	0.05 mol/L Pbuf	15	1.3×10^8	SS/LUM; τ_0^{air} = 11 μs (SL/LUM/SST); CR	776252

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.17.	***trans*-$Cr(en)_2(NH_3)F^{2+}$**						
Inorganic Quenchers							
4.17.1.	$Cr(CN)_6^{3-}$	H_2O	0.01 mol/L H_2SO_4	18	6×10^8	LP/LUM/SST; τ_0^{und} = 0.23 μs	82F278
4.18.	**$Cr(phen)_3^{3+}$**						
Inorganic Quenchers							
4.18.1.	$Co(acac)_3$	Acetone		~22	1.7×10^8	LP/LUM/SST; ET	83E223
4.18.2.	$Co(CN)_6^{3-}$	H_2O	1.5 mol/L $NaHSO_4$	25	$<2 \times 10^5$	SS/LUM; τ_0 = 90 μs (LP/LUM/SST); ET, RT	83F230
4.18.3.	*trans*-$Co(cyclam)Cl_2^+$	H_2O	1 mol/L $NaHSO_4$	15	5.4×10^7	LP/LUM/SST, SS/LUM; τ_0 = 0.40 ms; ET, RT	83F230
4.18.4.	*trans*-$Co(cyclam)(H_2O)_2^{3+}$	H_2O	1 mol/L $NaHSO_4$	15	1.1×10^8	LP/LUM/SST, SS/LUM; τ_0 = 0.40 ms; ET, RT	83F230
4.18.5.	*trans*-$Co(cyclam)(H_2O)Br^{2+}$	H_2O	1 mol/L $NaHSO_4$	15	2.4×10^7	SS/LUM; τ_0 = 0.40 ms (LP/LUM/SST); ET, RT	83F230
4.18.6.	*trans*-$Co(cyclam)(H_2O)Cl^{2+}$	H_2O	1 mol/L $NaHSO_4$	15	2.1×10^7	LP/LUM/SST, SS/LUM; τ_0 = 0.40 ms; ET, RT	83F230
4.18.7.	*trans*-$Co(cyclam)(H_2O)(N_3)^{2+}$	H_2O	1 mol/L $NaHSO_4$	15	1.2×10^8	LP/LUM/SST, SS/LUM; τ_0 = 0.40 ms; ET, RT	83F230
4.18.8.	*trans*-$Co(cyclam)(N_3)_2^+$	H_2O	1 mol/L $NaHSO_4$	15	4.3×10^8	LP/LUM/SST, SS/LUM; τ_0 = 0.40 ms; ET, RT	83F230
4.18.9.	*trans*-$Co(cyclam)(NCS)_2^+$	H_2O	1 mol/L $NaHSO_4$	15	1.6×10^8	LP/LUM/SST, SS/LUM; τ_0 = 0.40 ms; ET, RT	83F230
4.18.10.	*trans*-$Co(cyclam)(NCS)Cl^+$	H_2O	1 mol/L $NaHSO_4$	15	6.2×10^7	LP/LUM/SST, SS/LUM; τ_0 = 0.40 ms; ET, RT	83F230
4.18.11.	*trans*-$Co(cyclam)(NCS)(N_3)^+$	H_2O	1 mol/L $NaHSO_4$	15	3.0×10^8	LP/LUM/SST, SS/LUM; τ_0 = 0.40 ms; ET, RT	83F230
4.18.12.	*trans*-$Co(cyclam)(N_3)Cl^+$	H_2O	1 mol/L $NaHSO_4$	15	2.4×10^8	SS/LUM; τ_0 = 0.40 ms (LP/LUM/SST); ET, RT	83F230
4.18.13.	*trans*-$Co(cyclam)(NO_2)_2^+$	H_2O	1 mol/L $NaHSO_4$	15	5.4×10^7	LP/LUM/SST, SS/LUM; τ_0 = 0.40 ms; ET, RT	83F230
4.18.14.	$Co(DMG)_2(C_2H_5)(H_2O)$	H_2O	0.01 mol/L HCl	~22	1.7×10^9	LP/LUM/SST; ET; $[Q] \leq 1.6 \times 10^{-4}$ mol/L	83E223
4.18.15.	$Co(NH_3)_6^{3+}$	H_2O	1 mol/L HCl	25	3.5×10^6	SS/LUM (LP/LUM/SST); ET, RT	83F230
4.18.16.	$Co(NH_3)_5Br^{2+}$	H_2O	1 mol/L $NaHSO_4$	15	1.5×10^8	LP/LUM/SST; ET, RT	83F230
	$Co(NH_3)_5Br^{2+}$	H_2O	1 mol/L $NaHSO_4$	25	1.1×10^8	FP/ABS/SST; ET, RT	83F230

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.18.	**$Cr(phen)_3^{3+}$**—Continued						
4.18.17.	$Co(NH_3)_5Cl^{2+}$	H_2O	1 mol/L HCl	15	5.3×10^7	SS/LUM; τ_0 = 0.13 ms (LP/LUM/SST); ET, RT	83F230
	$Co(NH_3)_5Cl^{2+}$	H_2O	1 mol/L $NaHSO_4$	25	4.1×10^7	FP/ABS/SST; ET, RT	83F230
4.18.18.	$Co(NH_3)_5F^{2+}$	H_2O	1.5 mol/L $NaHSO_4$	25	1.6×10^6	SS/LUM; τ_0 = 88 μs (LP/LUM/SST); ET, RT	83F230
4.18.19.	$Co(NH_3)_5(H_2O)^{3-}$	H_2O	1 mol/L HCl	15	3.5×10^6	FP/ABS/SST; τ_0 = 0.13 ms; ET, RT	83F230
	$Co(NH_3)_5(H_2O)^{3+}$	H_2O	1 mol/L $NaHSO_4$	15	3.5×10^6	LP/LUM/SST; ET, RT	83F230
	$Co(NH_3)_5(H_2O)^{3+}$	H_2O	1 mol/L HCl	25	4.3×10^6	FP/ABS/SST; ET, RT	83F230
4.18.20.	$Co(NH_3)_5(N_3)^{2+}$	H_2O	1 mol/L HCl	15	3.2×10^8	SS/LUM; τ_0 = 0.13 ms (LP/LUM/SST); ET, RT	83F230
	$Co(NH_3)_5(N_3)^{2+}$	H_2O	1 mol/L $NaHSO_4$	15	2.4×10^8	LP/LUM/SST; ET, RT	83F230
4.18.21.	$Co(NH_3)_5(NCS)^{2+}$	H_2O	1 mol/L HCl	15	3.9×10^8	SS/LUM; τ_0 = 0.13 ms (LP/LUM/SST); ET, RT	83F230
	$Co(NH_3)_5(NCS)^{2+}$	H_2O	1 mol/L $NaHSO_4$	15	2.5×10^8	LP/LUM/SST; ET, RT	83F230
	$Co(NH_3)_5(NCS)^{2+}$	H_2O	1 mol/L HCl	25	2.6×10^8	SS/LUM; τ_0 = 0.11 ms (LP/LUM/SST); ET, RT	83F230
4.18.22.	$Co(NH_3)_5(NO_2)^{2+}$	H_2O	1 mol/L $NaHSO_4$	15	7.1×10^7	LP/LUM/SST; ET, RT	83F230
4.18.23.	$Cr(phen)_3^{3+}$	H_2O	1 mol/L NaCl, BRbuf; pH 10	13.5	4.0×10^6	LP/LUM/SST; τ_0 = 0.42 ms; CD; τ_0 extrap'd to [S] = 0	83E317
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L NaCl; 0.008 mol/L BRbuf; pH 10.5	15	1.6×10^7	LP/LUM/AVE; τ_0 = 0.25 ms; CD; [Q] = [S] ≤ 0.003 mol/L	83A192
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L HCl	22	2.3×10^6	LP/LUM/SST; τ_0 = 0.33 ms; CD; same k_q from same lab in 80E076; [Q] = [S] ≤ 0.0012 mol/L; τ_0 extrap'd to [S] = 0	81E458
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L $HClO_4$	22	4.7×10^6	LP/LUM/SST; τ_0 = 0.49 ms; CD; τ_0 extrap'd to [S] = 0	83E317
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L H_2SO_4	22	2.1×10^6	LP/LUM/SST; τ_0 = 0.36 ms; CD; τ_0 extrap'd to [S] = 0	83E317

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.18.	**$Cr(phen)_3^{3+}$**—Continued						
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L NaBr	22	3.3×10^6	LP/LUM/SST; τ_0 = 0.30 ms; CD; [Q] = [S] ≤ 0.001 mol/L; τ_0 extrap'd to [S] = 0	83E317
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L Na_2SO_4	22	2.9×10^6	LP/LUM/SST; τ_0 = 0.26 ms; CD; [Q] = [S] ≤ 0.001 mol/L; τ_0 extrap'd to [S] = 0	83E317
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L $NaBrO_3$	22	3.0×10^6	LP/LUM/SST; τ_0 = 0.25 ms; CD; τ_0 extrap'd to [S] = 0	83E317
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L KNO_3	22	4.1×10^6	LP/LUM/SST; τ_0 = 0.29 ms; CD; τ_0 extrap'd to [S] = 0	83E317
	$Cr(phen)_3^{3+}$	H_2O	5 mol/L HCl	22	3.0×10^6	LP/LUM/SST; τ_0 = 0.32 ms; CD; τ_0 extrap'd to [S] = 0	81E458
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L NaCl, BRbuf; pH 9.5	22	6.1×10^6	LP/LUM/SST; τ_0 = 0.23 ms; CD; τ_0 extrap'd [S] = 0	81E458
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L NaCl, BRbuf; pH 10	22.0	5.4×10^6	LP/LUM/SST; τ_0 = 0.25 ms; $\Delta H^{\ddagger}$ = 18 kJ/mol; $\Delta S^{\ddagger}$ = −38 J/mol·K; CD; τ_0 extrap'd to [S] = 0	83E317
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L NaCl, BRbuf; pH 10	29.2	6.5×10^6	LP/LUM/SST; τ_0 = 0.16 ms; CD; τ_0 extrap'd to [S] = 0	83E317
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L NaCl, BRbuf; pH 10	36.1	7.5×10^6	LP/LUM/SST; τ_0 = 0.10 ms; CD; τ_0 extrap'd to [S] = 0	83E317
	$Cr(phen)_3^{3+}$	H_2O	1 mol/L NaCl, BRbuf; pH 10	42.1	8.8×10^6	LP/LUM/SST; τ_0 = 71 μs; CD; τ_0 extrap'd to [S] = 0	83E317
	4.18.24. Cu^{II}-azurin	H_2O	0.027 mol/L Na_2HPO_4; 0.020 mol/L NaH_2PO_4; pH 7; μ = 0.1	25	1.0×10^8	LP/LUM/AVE; ET; [Q] ≤ 1×10^{-4} mol/L	85A362
	4.18.25. Cu^{II}-plastocyanin	H_2O	0.027 mol/L Na_2HPO_4; 0.020 mol/L NaH_2PO_4; pH 7; μ = 0.1	25	6.0×10^8	LP/LUM/AVE; ET; [Q] ≤ 5×10^{-5} mol/L	85A362

TABLE 4. Quenching of excited chromium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.18.	**$Cr(phen)_3^{3+}$**—Continued						
4.18.26.	Cu^{II}-stellacyanin	H_2O	0.027 mol/L Na_2HPO_4; 0.020 mol/L NaH_2PO_4; pH 7; μ = 0.1	25	4.9×10^7	LP/LUM/AVE; ET; [Q] ≤ 1.2×10^{-4} mol/L	85A362
4.18.27.	Fe^{2+}	H_2O	1 mol/L H_2SO_4	25	1.5×10^7	SS/LUM; τ_0 = 0.33 ms (LP/LUM/AVE); RT	78F366
	Fe^{2+}	H_2O	1 mol/L HCl	25	3.2×10^7	SS/LUM; τ_0^{air} = 71 μs (LP/LUM/AVE); RT	79E270
4.18.28.	Hg^{2+}	H_2O	1 mol/L $NaClO_4$; pH 1	25	$<1 \times 10^5$	FP/ABS/SST	83F230
4.18.29.	I^-	H_2O	1 mol/L NaCl; 0.008 mol/L BRbuf; pH 10.5	15	2.8×10^9	SS/LUM; τ_0^{air} = 30 μs (LP/LUM/AVE); RT?; [Q] ≤ 2×10^{-5} mol/L; τ_0^{air} is a function of [S]; τ_0^{air} for [S] = 0.0012 mol/L	83A192
	I^-	H_2O	1 mol/L HCl	25	2.1×10^9	SS/LUM; τ_0^{air} = 71 μs (LP/LUM/AVE); RT?	79E270
4.18.30.	O_2	H_2O	1 mol/L HCl	25	4.9×10^7	SS/LUM; τ_0 = 0.27 ms (LP/LUM/AVE); ET; [Q] = (2.5, 12) $\times 10^{-4}$ mol/L	78F366
	O_2	H_2O	1 mol/L HCl	25	2.7×10^7	SS/LUM; τ_0 = 0.27 ms (FP/ABS/SST); ET; [Q] = (2.5, 12) $\times 10^{-4}$ mol/L; same k_q from same lab in 78A388	79E270
4.18.31.	$Os(bpy)_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	1.5×10^9	SS/LUM; τ_0 = 0.33 ms (LP/LUM/AVE); RT	78F366
4.18.32.	$Rh(NH_3)_5Cl^{2+}$	H_2O	1.5 mol/L $NaHSO_4$	25	$<2 \times 10^5$	SS/LUM; τ_0 = 90 μs (LP/LUM/SST)	83F230
4.18.33.	$Ru(bpy)_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	8.3×10^8	SS/LUM; τ_0 = 0.33 ms (LP/LUM/AVE); RT	78F366
4.18.34.	$Ru(5\text{-Clphen})_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	8.1×10^8	SS/LUM; τ_0 = 0.33 ms (LP/LUM/AVE); RT	78F366
4.18.35.	$Ru(4,7\text{-Me}_2\text{phen})_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	1.4×10^6	SS/LUM; τ_0 = 0.33 ms (LP/LUM/AVE); RT	78F366
4.18.36.	$Ru(NH_3)_6^{3+}$	H_2O	1.5 mol/L $NaHSO_4$	25	$<2 \times 10^5$	SS/LUM; τ_0 = 90 μs (LP/LUM/SST)	83F230
4.18.37.	$Ru[5\text{-}(NO_2)\text{phen}]_3^{2+}$	H_2O	1 mol/L H_2SO_4	25	2.6×10^8	SS/LUM; τ_0 = 0.33 ms (LP/LUM/AVE); RT	78F366

TABLE 4. Quenching of excited chromium complexes—Continued

No.	*Quencher*	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
4.19. Cr(5,10,15,20-tetraphenylporphyrin)$^+$							
Organic Quenchers							
4.19.1.	1,4-Benzoquinone	EtOH			2×10^9	LP/ABS/SST; OT; f = <0.002	83F182

TABLE 5. Quenching of excited copper complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
5.1. $Cu(MePh_2P)_3Cl$							
Organic Quenchers							
5.1.1.	Norbornadiene	Benzene	[CuCl] = 0.001 mol/L; [$MePh_2P$] = 0.003 mol/L		8×10^7	SS/QYP; ET; [Q] = 0.1-1 mol/L; see Mech. [6]; other $Cu_x(MePh_2P)_yCl_x$ species present	85F395
5.2. $Cu(2,9\text{-}Me_2phen)_2^+$							
Inorganic Quenchers							
5.2.1.	$Co(acac)_3$	CH_2Cl_2		25	1.4×10^9	SS/LUM; τ_0^{und} = 54 ns (LP/LUM/SST); OT	80F403
5.2.2.	$Cr(acac)_3$	CH_2Cl_2		25	1×10^8	SS/LUM; τ_0^{und} = 54 ns (LP/LUM/SST); ET; [Q] ≤ 0.009 mol/L	80F403
Organic Quenchers							
5.2.3.	2-Chlorobenzonitrile	CH_2Cl_2		25	$<1 \times 10^9$	SS/LUM; τ_0^{und} = 54 ns (LP/LUM/SST); OT	80F403
5.2.4.	1,3-Dinitrobenzene	CH_2Cl_2		25	5.5×10^9	SS/LUM; τ_0^{und} = 54 ns (LP/LUM/SST); OT	80F403
5.2.5.	Hexachlorobenzene	CH_2Cl_2		25	$<1 \times 10^9$	SS/LUM; τ_0^{und} = 54 ns (LP/LUM/SST); OT	80F403
5.2.6.	1-Methoxy-4-nitrobenzene	CH_2Cl_2		25	2.3×10^9	SS/LUM; τ_0^{und} = 54 ns (LP/LUM/SST); OT	80F403
5.2.7.	4-Nitroaniline	CH_2Cl_2		25	2.1×10^9	SS/LUM; τ_0^{und} = 54 ns (LP/LUM/SST); OT	80F403
5.2.8.	Nitrobenzene	CH_2Cl_2		25	1.8×10^9	SS/LUM; τ_0^{und} = 54 ns (LP/LUM/SST); OT; [Q] ≤ 0.007 mol/L	80F403
5.2.9.	4-Nitrotoluene	CH_2Cl_2		25	1.4×10^9	SS/LUM; τ_0^{und} = 54 ns (LP/LUM/SST); OT	80F403
5.2.10.	py	1,2-$C_2H_4Cl_2$			1×10^9	SS/LUM	85E277
5.3. $Cu(2,9\text{-}Ph_2phen)_2^+$							
Inorganic Quenchers							
5.3.1.	$Cr(acac)_3$	CH_2Cl_2		20	1.0×10^7	LP/LUM/AVE; ET	85E063
5.3.2.	*cis*-$Cr(bzac)_3$	CH_2Cl_2		20	1.6×10^7	LP/LUM/AVE; ET	85E063
5.3.3.	*trans*-$Cr(bzac)_3$	CH_2Cl_2		20	2.8×10^7	LP/LUM/AVE; ET	85E063
5.3.4.	$Cr(dbm)_3$	CH_2Cl_2		20	6.5×10^7	LP/LUM/AVE; ET	85E063
5.3.5.	$Cr(hfac)_3$	CH_2Cl_2		20	7.7×10^9	LP/LUM/AVE; OT; Q is probably *trans*	85E063
5.3.6.	$Cr(hfac)(tfbzac)_2$	CH_2Cl_2		20	4.7×10^9	LP/LUM/AVE; OT	85E063

TABLE 5. Quenching of excited copper complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
5.3. Cu(2,9-Ph$_2$phen)$_2^+$—Continued							
5.3.7.	Cr(pdo)$_3$	CH_2Cl_2		20	3.9×10^7	LP/LUM/AVE; ET	85E063
5.3.8.	Cr(tfac)$_3$	CH_2Cl_2		20	9.5×10^7	LP/LUM/AVE; ET, OT; Q is probably *trans*	85E063
5.3.9.	Cr(tfbzac)$_3$	CH_2Cl_2		20	1.3×10^9	LP/LUM/AVE; OT; Q is probably *trans*	85E063
5.3.10.	Cr(tta)$_3$	CH_2Cl_2		20	2.0×10^9	LP/LUM/AVE; OT; Q is probably *trans*	85E063
Organic Quenchers							
5.3.11.	Anthracene-9-carboxylate ion	EtOH		40	1×10^9	SS/LUM; τ_0 = ~70 ns (assumed); ET	84S117
5.3.12.	1-Chloro-4-nitrobenzene	CH_2Cl_2		20	2.9×10^7	LP/LUM/AVE; OT	85E063
5.3.13.	1,3-Dinitrobenzene	CH_2Cl_2		20	3.2×10^9	LP/LUM/AVE; OT	85E063
5.3.14.	1,4-Dinitrobenzene	CH_2Cl_2		20	1.1×10^{10}	LP/LUM/AVE; OT	85E063
5.3.15.	4,4'-Dinitrobiphenyl	CH_2Cl_2		20	2.9×10^8	LP/LUM/AVE; OT	85E063
5.3.16.	MV^{2+}	EtOH		40	3×10^9	SS/LUM; τ_0 = ~70 ns (assumed); OT	84S117
5.3.17.	Nitrobenzene	CH_2Cl_2		20	2.4×10^8	LP/LUM/AVE; OT	85E063
5.4. Cu(etioporphyrin I)							
Organic Quenchers							
5.4.1.	Perylene	Toluene			5.5×10^9	EMI; τ_0 = 0.15 μs (72E321); ET; [Q] = (5-40) × 10^{-4} mol/L	74E520
5.5. Cu(mesoporphyrin IX dimethyl ester)							
Inorganic Quenchers							
5.5.1.	O_2	Toluene			6.4×10^9	LP/ABS/SST; τ_0 = 0.12 μs; ET; [Q] = 0.0011 mol/L	81E738
5.6. Cu(5,10,15,20-tetraphenylporphyrin)							
Organic Quenchers							
5.6.1.	1,4-Benzoquinone	EtOH			2×10^9	LP/ABS/SST; OT; f = <0.002	83F182

TABLE 6. Quenching of excited dysprosium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
6.1. Dy^{3+}							
Inorganic Quenchers							
6.1.1.	Nd^{3+}	H_2O	pH 5.9; μ = 0.6	22	9.3×10^4	LP/LUM/SST; ET	80E879
6.1.2.	O_3	H_2SO_4 (98%)		25	9.9×10^6	SS/LUM; τ_0 = 30 μs (LP/LUM/SST); [Q] ≤ 6 × 10^{-4} mol/L	77E799
Organic Quenchers							
6.1.3.	2-Acetylnaphthalene	Acetone		20	7.6×10^5	FP/LUM/SST, SS/LUM; τ_0 = 14 μs; ET	706153
6.1.4.	9-Fluorenone	Acetone		20	8.9×10^5	FP/LUM/SST, SS/LUM; τ_0 = 14 μs; ET	706153
6.2. Dy(anthranilato)$^{2+}$							
Inorganic Quenchers							
6.2.1.	$Nd(H_2O)_n^{3+}$	H_2O	pH 5.9; μ = 0.6; ([Dy]+[Nd])/[L] = 1000	22	2.1×10^5	LP/LUM/SST; ET	80E879
6.3. Dy(salicylato)$^{2+}$							
Inorganic Quenchers							
6.3.1.	$Nd(H_2O)_n^{3+}$	H_2O	pH 5.9; μ = 0.6; ([Dy]+[Nd])/[L] = 1000	22	6.0×10^6	LP/LUM/SST; ET	80E879
6.4. Dy(5-sulfosalicylato)$^{2+}$							
Inorganic Quenchers							
6.4.1.	$Nd(H_2O)_n^{3+}$	H_2O	pH 5.9; μ = 0.6; ([Dy]+[Nd])/[L] = 1000	22	1.0×10^7	LP/LUM/SST; ET	80E879

TABLE 7. Quenching of excited europium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
7.1. Eu^{3+}							
Inorganic Quenchers							
7.1.1.	$Co(CN)_6^{3-}$	H_2O	1 mol/L KCl		$<7 \times 10^5$	LP/LUM/SST	86E832
7.1.2.	$Cr(CN)_6^{3-}$	H_2O	1 mol/L KCl		1.0×10^8	LP/LUM/SST; ET	86E832
7.1.3.	$Fe(CN)_6^{4-}$	H_2O	1 mol/L KCl		6.0×10^8	LP/LUM/SST; RT	86E832
7.1.4.	Nd^{3+}	Acetone		20	1.3×10^5	FP/LUM/SST, SS/LUM; τ_0 = 0.39 ms; ET; same k_q from same lab in 68E121	69E237
7.1.5.	Pr^{3+}	Acetone		20	3.3×10^4	FP/LUM/SST, SS/LUM; τ_0 = 0.39 ms; ET; same k_q from same lab in 68E121	69E237
7.1.6.	$Ru(CN)_6^{4-}$	H_2O	1 mol/L KCl		3.0×10^8	LP/LUM/SST; RT	86E832
Organic Quenchers							
7.1.7.	1-Acetylanthracene	Acetone		20	4.7×10^6	FP/LUM/SST; τ_0 = 0.35 ms; ET	706153
7.1.8.	Acridine	Acetone		20	1.2×10^6	FP/LUM/SST; τ_0 = 0.35 ms; ET; $\{Q\} \leq 0.008$ mol/L	706153
7.1.9.	1-Aminonaphthalene	Acetone		20	4.4×10^5	FP/LUM/SST; τ_0 = 0.35 ms; RT; some SQ?	706153
7.1.10.	Aniline	Acetone		20	5.0×10^4	FP/LUM/SST; τ_0 = 0.35 ms; RT; $\{Q\} \leq 0.3$ mol/L; some SQ?	706153
7.1.11.	Anthracene	Acetone		20	1×10^5	FP/LUM/SST; τ_0 = 0.35 ms; ET	706153
7.1.12.	3-Chloroaniline	Acetone		20	1.1×10^4	FP/LUM/SST; τ_0 = 0.35 ms	706153
7.1.13.	*N,N*-Dimethylaniline	Acetone		20	5.3×10^5	FP/LUM/SST; τ_0 = 0.35 ms; RT; some SQ?	706153
7.1.14.	Diphenylamine	Acetone		20	4.2×10^5	FP/LUM/SST; τ_0 = 0.35 ms; RT; some SQ?	706153
7.1.15.	9,10-Diphenylanthracene cation radical	H_2SO_4 (95%)/DMF (5/1)		20	7.2×10^7	FP/LUM/SST; τ_0 = 1.2 ms; ET	73E368
7.1.16.	Diphenylmethylamine	Acetone		20	1.7×10^5	FP/LUM/SST; τ_0 = 0.35 ms; RT; some SQ?	706153
7.1.17.	Naphthacene cation radical	H_2SO_4 (95%)		20	2.9×10^7	FP/LUM/SST; τ_0 = 1.2 ms; ET	73E368
7.1.18.	Naphthacene, protonated	H_2SO_4 (95%)		20	3.7×10^7	FP/LUM/SST; τ_0 = 1.2 ms; ET	73E368

TABLE 7. Quenching of excited europium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
7.1. Eu^{3+}—Continued							
7.1.19.	Perylene cation radical	H_2SO_4 (95%)		20	5.7×10^7	FP/LUM/SST; τ_0 = 1.2 ms; ET	73E368
7.1.20.	Triphenylamine	Acetone		20	8.1×10^4	FP/LUM/SST; τ_0 = 0.35 ms; RT; some SQ?	706153
7.2. Eu(acetylacetonato)$_3$							
Organic Quenchers							
7.2.1.	1-Aminonaphthalene	Acetone		27	5.8×10^4	FP/LUM/SST; τ_0 = 0.16 ms; RT	746333
7.2.2.	Anthracene	Acetone		27	5.9×10^6	FP/LUM/SST; τ_0 = 0.16 ms; ET; [Q] ≤ 0.0028 mol/L; larger K_{SV} with SS/LUM	746333
7.3. Eu(crypt)$^{3+}$							
Inorganic Quenchers							
7.3.1.	$Co(CN)_6^{3-}$	H_2O	1 mol/L KCl		$<4 \times 10^5$	LP/LUM/SST	86E832
7.3.2.	$Cr(CN)_6^{3-}$	H_2O	1 mol/L KCl		$\sim 2 \times 10^6$	LP/LUM/SST; ET	86E832
7.3.3.	$Fe(CN)_6^{4-}$	H_2O	1 mol/L KCl		5.0×10^8	LP/LUM/SST; RT; k_q = 7.5×10^8 L mol^{-1} s^{-1} at 22 °C and with SS/LUM and τ_0^{air} = 0.22 ms from same lab in 84F176; ion-pairing at high [S] and [Q]	86E832
7.3.4.	$Os(CN)_6^{4-}$	H_2O	1 mol/L KCl	22	7.8×10^8	SS/LUM; τ_0^{air} = 0.22 ms (LP/LUM/AVE); RT; ion-pairing at high [S] and [Q]	84F176
7.3.5.	$Ru(CN)_6^{4-}$	H_2O	1 mol/L KCl		2.0×10^8	LP/LUM/SST; RT; k_q = 2.2×10^8 L mol^{-1} s^{-1} at 22 °C and with SS/LUM and τ_0^{air} = 0.22 ms from same lab in 84F176; ion-pairing at high [S] and [Q]	86E832
7.4. Eu(1,3-diphenyl-1,3-propanedionato)$_4^-$							
Organic Quenchers							
7.4.1.	1-Aminonaphthalene	Acetone		27	1.2×10^5	FP/LUM/SST, SS/LUM; τ_0 = 0.11 ms; RT; [Q] ≤ 0.009 mol/L; S may be present as *tris* complex	746333
7.4.2.	Anthracene	Acetone		27	1.8×10^6	FP/LUM/SST; τ_0 = 0.11 ms; ET; S may be present as *tris* complex	746333

TABLE 7. Quenching of excited europium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
7.5. Eu(phen)$_3^{3+}$							
Organic Quenchers							
7.5.1.	Anthracene	Acetone		20	2×10^6	FP/LUM/SST, SS/LUM; ET	706153
7.5.2.	Fluorene	Acetone		20	1×10^3	FP/LUM/SST, SS/LUM; ET	706153
7.5.3.	Naphthalene	Acetone		20	1×10^3	FP/LUM/SST, SS/LUM; ET	706153
7.5.4.	Triphenylamine	AN	0.01 mol/L TBAP		3.7×10^7	SS/LUM; $\tau_0 = 0.74$ ms (FP/LUM/SST); RT	767009
7.6. Eu(phen)(1-thienyl-4,4,4-trifluoro-1,3-butanedionato)$_3$							
Organic Quenchers							
7.6.1.	Anthracene	AN		20	1.5×10^7	FP/LUM/SST, SS/LUM; ET	706153
	Anthracene	Toluene		20	6.8×10^6	FP/LUM/SST; ET; also EQ	706153
7.6.2.	*N,N*-Dimethylaniline	Acetone		20	9.0×10^3	FP/LUM/SST, SS/LUM; RT	706153
7.6.3.	Diphenylamine	Acetone		20	4.0×10^3	FP/LUM/SST, SS/LUM; RT	706153
7.7. Eu(1-phenyl-1,3-butanedionato)$_4^-$							
Organic Quenchers							
7.7.1.	1-Acetylanthracene	Acetone		20	8.0×10^5	FP/LUM/SST, SS/LUM; ET; S may be present as *tris* complex	706153
7.7.2.	Anthracene	Toluene		20	8.8×10^5	FP/LUM/SST, SS/LUM; ET; S may be present as *tris* complex	706153
7.7.3.	*N,N*-Dimethylaniline	Acetone		20	1×10^3	FP/LUM/SST, SS/LUM; RT; S may be present as *tris* complex	706153
7.8. Eu(1-phenyl-4,4,4-trifluoro-1,3-butanedionato)$_4^-$							
Organic Quenchers							
7.8.1.	Anthracene	Toluene		20	2.3×10^6	FP/LUM/SST, SS/LUM; ET; S may be present as *tris* complex	706153
7.9. Eu(1-thienyl-4,4,4-trifluoro-1,3-butanedionato)$_4^-$							
Organic Quenchers							
7.9.1.	Anthracene	AN		20	2.5×10^6	FP/LUM/SST, SS/LUM; ET; S may be present as *tris* complex	706153

TABLE 7. Quenching of excited europium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
7.9.	**Eu(1-thienyl-4,4,4-trifluoro-1,3-butanedionato)$_4^-$**—Continued						
	Anthracene	Toluene		20	3.3×10^6	FP/LUM/SST, SS/LUM; ET; S may be present as *tris* complex	706153

TABLE 8. Quenching of excited indium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
8.1. In(phthalocyanine)Cl							
Inorganic Quenchers							
8.1.1.	$Co(bpy)_3^{3+}$	DMA/H_2O (2.3/1)		~15	2.2×10^8	LP/ABS/AVE; OT; f = 0.55; [Q] < 2×10^{-4} mol/L	84A122
8.1.2.	$Co(phen)_3^{3+}$	DMA/H_2O (2.3/1)		~15	3.2×10^8	LP/ABS/AVE; OT; f = 0.62; [Q] < 2×10^{-4} mol/L	84A122
8.1.3.	$Co(terpy)_2^{3+}$	DMA/H_2O (2.3/1)		~15	5.4×10^8	LP/ABS/AVE; OT; f = 0.15; [Q] < 2×10^{-4} mol/L	84A122
8.2. In(5,10,15,20-tetraphenylporphyrin)$^+$							
Organic Quenchers							
8.2.1.	MV^{2+}	MeOH			3×10^7 (calc)	LP/ABS/SST; τ_0 = 56 μs; EX, OT?; [Q] ≤ 0.02 mol/L; nonlinear S-V plot, see Mech. [1]	85A013
8.3. In(5,10,15,20-tetraphenylporphyrin)(C_2H_5)							
Inorganic Quenchers							
8.3.1.	$Fe(C_5H_5)_2$	Benzene			2.1×10^9 (calc)	LP/ABS/SST; τ_0 = 70 μs; ET; [Q] ≤ 2.2×10^{-5} mol/L	86F247
Organic Quenchers							
8.3.2.	2,4,7-Trinitro-9-fluorenone	Benzene			3.1×10^8 (calc)	LP/ABS/SST; τ_0 = 70 μs; [Q] ≤ 4×10^{-5} mol/L	86F247
8.4. In(5,10,15,20-tetraphenylporphyrin)(OH)							
Organic Quenchers							
8.4.1.	1,4-Benzoquinone	$(C_2H_5)_2O$			1.2×10^9	FP/ABS/SST	81F368
	1,4-Benzoquinone	1,3-Xylene			4.6×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	1,4-Xylene			6.1×10^7	FP/ABS/SST	81F368
	1,4-Benzoquinone	3-Chloro-toluene			1.2×10^9	FP/ABS/SST	81F368
	1,4-Benzoquinone	Benzene			5.3×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	CH_2Cl_2			5.8×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Chlorobenzene			7.7×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Cumene			6.5×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Dodecane			1.6×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Ethyl acetate			6.3×10^8	FP/ABS/SST	81F368

TABLE 8. Quenching of excited indium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
8.4. In(5,10,15,20-tetraphenylporphyrin)(OH)—Continued							
	1,4-Benzoquinone	Ethylbenzene			6.9×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Fluorobenzene			8.0×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Heptane			1.6×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Hexane			1.5×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Isoamyl acetate			5.2×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Mesitylene			2.7×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Methyl ethyl ketone			9.1×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Nonane			1.9×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Octane			1.5×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Propyl acetate			6.3×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Tetradecane			1.6×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Toluene			4.4×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Tridecane			1.6×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	Undecane			1.6×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	*t*-Butyl-benzene			1.2×10^8	FP/ABS/SST	81F368
	1,4-Benzoquinone	py			3×10^7	FP/ABS/SST	81F368
8.4.2.	1,4-Naphthoquinone	1,2-Xylene			5.9×10^5	FP/ABS/SST	81F368
	1,4-Naphthoquinone	1,3-Xylene			6.6×10^5	FP/ABS/SST	81F368
	1,4-Naphthoquinone	1,4-Xylene			5.6×10^5	FP/ABS/SST	81F368
	1,4-Naphthoquinone	Benzene			1.9×10^6	FP/ABS/SST	81F368
	1,4-Naphthoquinone	Decane			5.1×10^6	FP/ABS/SST	81F368
	1,4-Naphthoquinone	Ethylbenzene			1.2×10^6	FP/ABS/SST	81F368
	1,4-Naphthoquinone	Hexane			6.7×10^6	FP/ABS/SST	81F368
	1,4-Naphthoquinone	Mesitylene			4.1×10^5	FP/ABS/SST	81F368
	1,4-Naphthoquinone	Tetradecane			4.1×10^6	FP/ABS/SST	81F368
	1,4-Naphthoquinone	Toluene			8.9×10^5	FP/ABS/SST	81F368
	1,4-Naphthoquinone	*t*-Butyl-benzene			1.2×10^6	FP/ABS/SST	81F368

TABLE 8. Quenching of excited indium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
8.5.	**In(5,10,15,20-tetraphenylporphyrin)(TEOA)$_2^+$**						
	Organic Quenchers						
8.5.1.	MV^{2+}	MeOH	0.5 mol/L TEOA		3.4×10^8	LP/ABS/SST; τ_0 = 48 μs; OT; [Q] ≤ 0.006 mol/L	85A013

TABLE 9. Quenching of excited iridium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
9.1.	***cis*-Ir(5,6-Me$_2$phen)$_2$Cl$_2$$^+$**						
	Organic Quenchers						
9.1.1.	Aniline	AN	0.1 mol/L TEAP	~22	7.7×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.2.	4,4'-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L TEAP	~22	8.1×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.3.	1,4-Bis(*N*-phenylamino)benzene	AN	0.1 mol/L TEAP	~22	9.4×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.4.	*tert*-Butylamine	AN	0.1 mol/L TEAP	~22	2.0×10^6	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.5.	4,4'-Diaminobiphenyl	AN	0.1 mol/L TEAP	~22	9.1×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.6.	Dibenzylamine	AN	0.1 mol/L TEAP	~22	4.6×10^7	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.7.	Dibutylamine	AN	0.1 mol/L TEAP	~22	7.0×10^8	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.8.	Dicyclohexylamine	AN	0.1 mol/L TEAP	~22	8.9×10^8	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.9.	Diethylamine	AN	0.1 mol/L TEAP	~22	4.1×10^8	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.10.	*N,N*-Diethylaniline	AN	0.1 mol/L TEAP	~22	9.1×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.11.	1,2-Dimethoxybenzene	AN	0.1 mol/L TEAP	~22	4.8×10^7	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.12.	1,4-Dimethoxybenzene	AN	0.1 mol/L TEAP	~22	2.4×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.13.	*N,N*-Dimethylaniline	AN	0.1 mol/L TEAP	~22	1.0×10^{10}	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.14.	*N,N*-Dimethylbenzylamine	AN	0.1 mol/L TEAP	~22	4.1×10^8	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.15.	Diphenylamine	AN	0.1 mol/L TEAP	~22	6.8×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.16.	Dipropylamine	AN	0.1 mol/L TEAP	~22	6.4×10^8	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.17.	*N*-Methylaniline	AN	0.1 mol/L TEAP	~22	5.8×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.18.	Tributylamine	AN	0.1 mol/L TEAP	~22	2.3×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.19.	Triethylamine	AN	0.1 mol/L TEAP	~22	1.4×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518

TABLE 9. Quenching of excited iridium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
9.1.	***cis*-Ir(5,6-Me$_2$phen)$_2$Cl$_2$$^+$—Continued**						
9.1.20.	1,2,3-Trimethoxybenzene	AN	0.1 mol/L TEAP	~22	6.4×10^7	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.21.	1,2,4-Trimethoxybenzene	AN	0.1 mol/L TEAP	~22	5.5×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.1.22.	Triphenylamine	AN	0.1 mol/L TEAP	~22	6.5×10^9	SS/LUM; τ_0^{air} = 0.49 μs (SL/LUM/SPC); RT	78E518
9.2.	**Ir(bpy)$_2$(C^2,N'-Hbpy)$^{3+}$**						
	Inorganic Quenchers						
9.2.1.	Br^-	H_2O	pH 1.5		2.4×10^7	LP/LUM/AVE; τ_0 = 0.70 μs; EX; [Q] = 0.003-0.25 mol/L	85F140
9.2.2.	Co^{2+}	H_2O	0.5 mol/L $HClO_4$	~23	6.1×10^6	SS/LUM, LP/LUM/SST; τ_0 = 12 μs; RT, ET?; [Q] ≤ 0.012 mol/L; pK_a* = 3.5; S designated as Ir(bpy)$_2$(-bpy)(H$_2$O)$^{3+}$	79F173
9.2.3.	$Co(NH_3)_5F^{2+}$	H_2O	pH 1.4; μ = 0.1	~20	1.8×10^7	SS/LUM; τ_0 = 13 μs (LP/LUM/SST); OT	86A057
9.2.4.	Eu^{2+}	H_2O	0.5 mol/L HNO_3	~23	$\sim 2 \times 10^8$	SS/LUM, LP/LUM/SST; τ_0 = 12 μs; RT?; pK_a* = 3.5; S designated as Ir(bpy)$_2$(-bpy)(H$_2$O)$^{3+}$	79F173
9.2.5.	Fe^{3+}	H_2O	pH 0.6 ($HClO_4$)	~20	1.7×10^7	SS/LUM and LP/LUM/SST; CR	86A057
	Fe^{3+}	H_2O	0.5 mol/L $HClO_4$	~23	3.7×10^7	SS/LUM, LP/LUM/SST; τ_0 = 12 μs; OT, ET?; [Q] ≤ 0.002 mol/L; pK_a* = 3.5; S designated as Ir(bpy)$_2$(-bpy)(H$_2$O)$^{3+}$	79F173
9.2.6.	Ni^{2+}	H_2O	0.5 mol/L $HClO_4$	~23	2.8×10^6	SS/LUM, LP/LUM/SST; τ_0 = 12 μs; RT, ET?; [Q] ≤ 0.024 mol/L; pK_a* = 3.5; S designated as Ir(bpy)$_2$(-bpy)(H$_2$O)$^{3+}$	79F173
9.2.7.	O_2	MeOH			3.4×10^8	SS/LUM; τ_0 = 2.4 μs (75F657); ET; S designated as Ir(bpy)$_3$$^{3+}$	777221
9.2.8.	$Pt(CN)_4^{2-}$	H_2O	μ = 0.01 ($HClO_4$ or H_2SO_4)		2×10^9	EMI; RT; S designated as Ir(bpy)$_3$$^{3+}$	85A469

TABLE 9. Quenching of excited iridium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
9.2.	**$Ir(bpy)_2(C^3,N'$-Hbpy$)^{3+}$**—Continued						
9.2.9.	$Pt(C_2O_4)_2^{2-}$	H_2O	μ = 0.01 ($HClO_4$ or H_2SO_4)		1×10^9	EMI; RT; S designated as $Ir(bpy)_3^{3+}$	85A469
9.2.10.	$Pt(en)_2^{2+}$	H_2O	μ = 0.01 ($HClO_4$ or H_2SO_4)		6×10^7	EMI; RT; S designated as $Ir(bpy)_3^{3+}$	85A469
9.2.11.	$Pt(NH_3)_4^{2+}$	H_2O	μ = 0.01 ($HClO_4$ or H_2SO_4)		5×10^7	EMI; RT; S designated as $Ir(bpy)_3^{3+}$	85A469
9.2.12.	$Pt(NH_3)_4Br_2^{2+}$	H_2O	μ = 0.01 ($HClO_4$ or H_2SO_4)		2×10^8	EMI; OT; S designated as $Ir(bpy)_3^{3+}$	85A469
9.2.13.	$Pt(NH_3)_5Br^{3+}$	H_2O	μ = 0.01 ($HClO_4$ or H_2SO_4)		4×10^7	EMI; OT; S designated as $Ir(bpy)_3^{3+}$	85A469
9.2.14.	$Pt(NH_3)_4Cl_2^{2+}$	H_2O	μ = 0.01 ($HClO_4$ or H_2SO_4)		1×10^8	EMI; OT; S designated as $Ir(bpy)_3^{3+}$	85A469
9.2.15.	$Pt(NH_3)_5Cl^{3+}$	H_2O	μ = 0.01 ($HClO_4$ or H_2SO_4)		1×10^7	EMI; OT; S designated as $Ir(bpy)_3^{3+}$	85A469
9.2.16.	$Pt(NO_2)_4^{2-}$	H_2O	μ = 0.01 ($HClO_4$ or H_2SO_4)		2×10^9	EMI; RT; S designated as $Ir(bpy)_3^{3+}$	85A469
9.2.17.	$S_2O_8^{2-}$	H_2O	pH 1.4; μ = 0.2	~20	7.8×10^7	SS/LUM and LP/LUM/SST; τ_0 = 13 μs; OT; [Q] = 0.002-0.05 mol/L	86A057
9.2.18.	Tl^{3+}	H_2O	0.5 mol/L $HClO_4$	~23	6×10^4	SS/LUM, LP/LUM/SST; τ_0 = 12 μs; OT?; [Q] ≤ 0.18 mol/L; pK_a^* = 3.5; S designated as $Ir(bpy)_2(\text{-bpy})(H_2O)^{3+}$	79F173
	Organic Quenchers						
9.2.19.	Biacetyl	H_2O	0.5 mol/L $HClO_4$	~23	2.6×10^8	SS/LUM, LP/LUM/SST; τ_0 = 12 μs; RT, ET?; [Q] ≤ 0.002 mol/L; pK_a^* = 3.5; S designated as $Ir(bpy)_2(\text{-bpy})(H_2O)^{3+}$	79F173
9.2.20.	MV^{2+}	H_2O	0.05 mol/L $Mg(NO_3)_2$; pH 1.4	~20	1.3×10^6	SS/LUM and LP/LUM/SST; τ_0 = 10 μs; OT; [Q] = 0.02-0.08 mol/L	86A057
9.3.	**$Ir(bpy)_2(C^3,N'$-bpy$)^{2+}$**						
	Inorganic Quenchers						
9.3.1.	Co^{2+}	H_2O	0.1 mol/L HAc, 0.08 mol/L NaAc; pH 4.7	~23	1.5×10^7	SS/LUM, LP/LUM/SST; τ_0 = 10 μs; RT, ET?; [Q] ≤ 0.012 mol/L; S designated as $Ir(bpy)_2(\text{-bpy})(OH)^{2+}$	79F173

TABLE 9. Quenching of excited iridium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
9.3.	**Ir(bpy)$_2$(C^3,N'-bpy)$^{2+}$**—Continued						
9.3.2.	$Cr(CN)_6^{3-}$	H_2O	0.05 mol/L $NaHCO_3$; pH 8.6	~23	8.9×10^9	SS/LUM, LP/LUM/SST; τ_0 = 10 μs; ET; [Q] ≤ 0.001 mol/L; S designated as Ir(bpy)$_2$(-bpy)(OH)$^{2+}$	79F173
9.3.3.	$Fe(OH)^{2+}$	H_2O	0.1 mol/L HAc, 0.08 mol/L NaAc; pH 4.7	~23	3.1×10^8	SS/LUM, LP/LUM/SST; τ_0 = 10 μs; OT, ET?; [Q] ≤ 0.002 mol/L; S designated as Ir(bpy)$_2$(-bpy)(OH)$^{2+}$	79F173
9.3.4.	Ni^{2+}	H_2O	0.1 mol/L HAc, 0.08 mol/L NaAc; pH 4.7	~23	4.2×10^6	SS/LUM, LP/LUM/SST; τ_0 = 10 μs; RT, ET?; [Q] ≤ 0.024 mol/L; S designated as Ir(bpy)$_2$(-bpy)(OH)$^{2+}$	79F173
9.3.5.	$Tl(OH)^{2+}$	H_2O	0.1 mol/L HAc, 0.08 mol/L NaAc; pH 4.7	~23	1.6×10^7	SS/LUM, LP/LUM/SST; τ_0 = 10 μs; OT?; [Q] ≤ 0.025 mol/L; S designated as Ir(bpy)$_2$(-bpy)(OH)$^{2+}$	79F173
	Organic Quenchers						
9.3.6.	Biacetyl	H_2O	0.1 mol/L HAc, 0.08 mol/L NaAc; pH 4.7	~23	2.8×10^8	SS/LUM, LP/LUM/SST; τ_0 = 10 μs; RT, ET?; [Q] ≤ 0.002 mol/L; S designated as Ir(bpy)$_2$(-bpy)(OH)$^{2+}$	79F173
9.3.7.	2,3-Diacetoxynorbornadiene	AN		25	$<1 \times 10^5$	LIF and SS/QYP; τ_0 = 10 μs; see Mech. [6]	86A158
9.3.8.	2,3-Diacetoxyquadricyclane	AN		25	1.0×10^7	LIF and SS/QYP; τ_0 = 10 μs; RT; see Mech. [6]	86A158
9.3.9.	Norbornadiene	AN		25	1.4×10^8	LIF and SS/QYP; τ_0 = 10 μs; RT; see Mech. [6]	86A158
9.3.10.	Quadricyclane	AN		25	3.3×10^9	LIF and SS/QYP; τ_0 = 10 μs; RT; see Mech. [6]	86A158
9.4.	**Ir(8-hydroxyquinolinato)$_3$**						
	Inorganic Quenchers						
9.4.1.	$Cr(CN)_6^{3-}$	DMF		25	5.5×10^7	SS/LUM; τ_0 = 2.5 μs (LP/LUM/SST); ET; see Mech. [6]	86E555
	Organic Quenchers						
9.4.2.	1-Chloro-4-nitrobenzene	AN		25	1.7×10^9	LP/LUM/SST; OT	86E555
9.4.3.	MV^{2+}	AN	0.01 mol/L TEAP	25	1.6×10^{10}	LP/LUM/SST; OT	86E555
9.4.4.	Nitrobenzene	AN		25	1.7×10^8	LP/LUM/SST; OT	86E555

TABLE 9. Quenching of excited iridium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
9.5. $Ir(phen)_3^{3+}$							
Inorganic Quenchers							
9.5.1.	O_2	MeOH			2.8×10^8	SS/LUM; τ_0 = 2.6 μs (75F657); ET	777221
9.6. $Ir_2(\mu\text{-pyrazolyl})_2(1,5\text{-cyclooctadiene})_2$							
Organic Quenchers							
9.6.1.	*N*-Benzyl-3-carbamyl-py$^+$	AN	μ = 0.1 (TBAF)	~22	5.5×10^9 (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.2.	1,2-Dichloroethane	Hexane			7.3×10^5	LP/LUM; τ_0 = 0.25 μs (84E152); OT	84F117
9.6.3.	Dichloromethane	Hexane			5.8×10^5	LP/LUM; τ_0 = 0.25 μs (84E152); OT	84F117
9.6.4.	*N*,4-Dimethyl-py$^+$	AN	μ = 0.1 (TBAF)	~22	6.6×10^8 (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.5.	*N*-Ethyl-4-(*tert*-butyl)-py$^+$	AN	μ = 0.1 (TBAF)	~22	6.5×10^8 (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.6.	*N*-Ethyl-4-carbamyl-py$^+$	AN	μ = 0.1 (TBAF)	~22	1.5×10^{10} (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.7.	*N*-Ethyl-py$^+$	AN	μ = 0.1 (TBAF)	~22	2.5×10^9 (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.8.	*N*-Methyl-4-acetoxy-py$^+$	AN	μ = 0.1 (TBAF)	~22	1.3×10^{10} (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.9.	*N*-Methyl-3-carbamyl-py$^+$	AN	μ = 0.1 (TBAF)	~22	6.2×10^9 (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.10.	*N*-Methyl-4-cyano-py$^+$	AN	μ = 0.1 (TBAF)	~22	2.0×10^{10} (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.11.	*N*-Methyl-2-methoxy-py$^+$	AN	μ = 0.1 (TBAF)	~22	8.1×10^8 (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.12.	MV^{2+}	AN	μ = 0.1 (TBAF)	~22	1.6×10^{10} (corr)	LP/LUM; τ_0 = 0.25 μs; OT; same k_q from same lab in 84E152	85E779
9.6.13.	*N*,2,3,6-Tetramethyl-py$^+$	AN	μ = 0.1 (TBAF)	~22	2.9×10^8 (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.14.	*N*,2,4,6-Tetramethyl-py$^+$	AN	μ = 0.1 (TBAF)	~22	2.2×10^7 (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.15.	*N*,2,6-Trimethyl-4-methoxy-py$^+$	AN	μ = 0.1 (TBAF)	~22	1.1×10^6 (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779
9.6.16.	*N*,2,6-Trimethyl-py$^+$	AN	μ = 0.1 (TBAF)	~22	5.8×10^8 (corr)	LP/LUM; τ_0 = 0.25 μs; OT	85E779

TABLE 10. Quenching of excited iron complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
10.1.	**$Fe(bpy)_3^{2+}$**						
	Inorganic Quenchers						
	10.1.1. Fe^{3+}	H_2O	μ = 0.5 (H_2SO_4)	25	$\leq 1 \times 10^7$	LP/LUM/SST; τ_0 = 0.81 ns; [Q] = 0.1 mol/L	80E040
10.2.	**$Fe(terpy)_2^{2+}$**						
	Inorganic Quenchers						
	10.2.1. Fe^{3+}	H_2O	μ = 0.5 (H_2SO_4)	25	$\leq 4 \times 10^6$	LP/LUM/SST; τ_0 = 2.5 ns; [Q] = 0.1 mol/L	80E040

TABLE 11. Quenching of excited magnesium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
11.1. Mg(etioporphyrin I)(pyridine)							
Organic Quenchers							
11.1.1.	*cis*-4-Nitrostilbene	Benzene	0.005 mol/L py		2×10^8	FP/ABS/SST; EX	707320
11.2. Mg(etioporphyrin I) [singlet]							
Organic Quenchers							
11.2.1.	Nitrobenzene	AN			1.4×10^{10}	SS/LUM; τ_0 = 11 ns (assumed); EX	68A001
	Nitrobenzene	Benzene			1.2×10^{10}	SS/LUM; τ_0 = 11 ns (assumed); EX	68A001
	Nitrobenzene	EtOH			1.2×10^{10}	SS/LUM; τ_0 = 11 ns (assumed); EX	68A001
	Nitrobenzene	MeCH			1.2×10^{10}	SS/LUM; τ_0 = 11 ns (assumed); EX; [Q] ≤ 0.20 mol/L	68A001
	Nitrobenzene	Piperidine			5.7×10^9	SS/LUM; τ_0 = 11 ns (assumed); EX; [Q] ≤ 0.10 mol/L	68A001
11.2.2.	*cis*-4-Nitrostilbene	Benzene			1.1×10^{10}	SS/LUM; τ_0 = 12 ns (LP/LUM/SST); EX; nonlinear S-V plot at high [Q]	707320
11.3. Mg(etioporphyrin I) [triplet]							
Organic Quenchers							
11.3.1.	1-Methoxy-4-nitrobenzene	Benzene		25	7×10^8	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]'s	747293
11.3.2.	Nitrobenzene	Benzene		25	1.8×10^9	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]'s	747293
11.3.3.	*cis*-4-Nitrostilbene	Benzene			1.7×10^9	FP/ABS/SST; EX	707320
11.3.4.	4-Nitrotoluene	Benzene		25	1.4×10^9	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; τ increases at higher [Q]'s	747293
11.4. Mg(2,3,7,8,12,13,17,18-octaethylporphyrin)							
Inorganic Quenchers							
11.4.1.	Mg(OEP)	1-PrOH		25	1.1×10^8	LP/ABS/SST; CD; also TT, see Mech. [10]	83A102
	Mg(OEP)	2-PrOH		25	8×10^7	LP/ABS/SST; CD; also TT, see Mech. [10]	83A102

TABLE 11. Quenching of excited magnesium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
11.4. Mg(2,3,7,8,12,13,17,18-octaethylporphyrin)—Continued							
	Mg(OEP)	DMSO		25	2.1×10^8	LP/ABS/SST; CD; also TT, see Mech. [10]	83A102
	Mg(OEP)	EtOH		25	1.1×10^8	LP/ABS/SST; CD; also TT, see Mech. [10]	83A102
	Mg(OEP)	MeOH		25	1.6×10^8	LP/ABS/SST; CD; [Q] = (4-45) $\times 10^{-6}$ mol/L; also TT, see Mech. [10]	83A102
11.5. Mg(phthalocyanine) [singlet]							
Organic Quenchers							
11.5.1.	1,4-Benzoquinone	Dioxane			2.7×10^{10}	SS/LUM; τ_0 = 6.5 ns (573002); OT; [Q] ≤ 0.1 mol/L; same k_q from same lab in 67A003	65A001
11.5.2.	1,3-Dinitrobenzene	Dioxane			4.3×10^9	SS/LUM; τ_0 = 6.5 ns (573002); OT; [Q] ≤ 0.2 mol/L; same k_q from same lab in 67A003	65A001
11.5.3.	Nitrobenzene	Dioxane			1.0×10^9	SS/LUM; τ_0 = 6.5 ns (573002); OT; [Q] ≤ 1 mol/L; same k_q from same lab in 67A003	65A001
11.5.4.	Trinitrobenzene	Dioxane			1.1×10^{10}	SS/LUM; τ_0 = 6.5 ns (573002); OT; [Q] ≤ 0.15 mol/L; same k_q from same lab in 67A003	65A001
11.6. Mg(phthalocyanine) [triplet]							
Inorganic Quenchers							
11.6.1.	Ag(TPP)	DMF			1.7×10^8	FP/ABS/SST; ET	76E693
	Ag(TPP)	Toluene			1.9×10^8	FP/ABS/SST; ET	76E693
11.6.2.	$Co(bpy)_3^{2+}$	DMA/H_2O (2.3/1)		~15	1.7×10^7	LP/ABS/AVE; ET?; [Q] < 0.001 mol/L	84A122
11.6.3.	$Co(bpy)_3^{3+}$	DMA/H_2O (2.3/1)		~15	2.8×10^8	LP/ABS/AVE; OT; f = 0.58; [Q] < 2×10^{-4} mol/L	84A122
11.6.4.	$Co(phen)_3^{2+}$	DMA/H_2O (2.3/1)		~15	3.6×10^7	LP/ABS/AVE; ET?; [Q] < 0.001 mol/L	84A122
11.6.5.	$Co(phen)_3^{3+}$	DMA/H_2O (2.3/1)		~15	4.0×10^8	LP/ABS/AVE; OT; f = 0.60; [Q] < 2×10^{-4} mol/L	84A122

TABLE 11. Quenching of excited magnesium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
11.6. Mg(phthalocyanine) [triplet]—Continued							
11.6.6.	$Co(terpy)_2^{2+}$	DMA/H_2O (2.3/1)		~15	1.3×10^8	LP/ABS/AVE; ET?; [Q] < 0.001 mol/L	84A122
11.6.7.	$Co(terpy)_2^{3+}$	DMA/H_2O (2.3/1)		~15	3.8×10^8	LP/ABS/AVE; OT; f = 0.57; [Q] < 2×10^{-4} mol/L	84A122
11.6.8.	Ni(etioporphyrin I)	1-PrOH			1.3×10^9	FP/ABS/SST; ET	74E520
11.6.9.	Pd(etioporphyrin I)	1-PrOH			$<1 \times 10^8$	FP/ABS/SST; ET	74E520
Organic Quenchers							
11.6.10.	1,4-Benzoquinone	Dioxane			4.0×10^7	FP/ABS/SST; τ_0 = 0.1 ms; OT; same k_q from same lab in 67A003	65A001
11.6.11.	MV^{2+}	DMF/H_2O (9/1)			7.6×10^7	LP/ABS/AVE; τ_0 = 0.33 ms; OT; f = 0.71	84A272
11.6.12.	Nitrobenzene	Dioxane			1.7×10^6	FP/ABS/SST; τ_0 = 0.1 ms; OT; same k_q from same lab in 67A003	65A001
11.7. Mg[tetrakis(4-*tert*-butyl)phthalocyanine]							
Organic Quenchers							
11.7.1.	1,4-Naphthoquinone	Toluene			6×10^6 (calc)	FP/ABS/SST; τ_0 = 0.56 ms; EX; biexponential decay, see Mech. [2]	82E636
11.7.2.	OrgQue13	Toluene			3.4×10^6	FP/ABS/SST; τ_0 = 0.38 ms; OT; [Q] = 0.002-0.02 mol/L	84E308
11.7.3.	OrgQue14	Toluene			1.3×10^6	FP/ABS/SST; τ_0 = 0.38 ms; OT; [Q] = 0.002-0.02 mol/L; nonlinear S-V plot, see Mech. [1]	84E308
11.8. Mg[tetrakis(*N*-methylaza)phthalocyanine]$^{4+}$ [singlet]							
Organic Quenchers							
11.8.1.	MV^{2+}	H_2O	μ = 0 (extrap'd, NaCl)		4.5×10^7	SS/LUM; τ_0 = 8.2 ns; OT; [Q] = 0.001-0.2 mol/L	81A188
11.9. Mg[tetrakis(*N*-methylaza)phthalocyanine]$^{4+}$ [triplet]							
Organic Quenchers							
11.9.1.	MV^{2+}	H_2O			$<2 \times 10^3$	FP/ABS/SST; τ_0 = 0.28 ms; [Q] = 0.001-0.2 mol/L	81A188

TABLE 11. Quenching of excited magnesium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
11.10. Mg(tetramethoxyphthalocyanine)							
Organic Quenchers							
11.10.1.	MV^{2+}	DMF/H_2O (9/1)			~7 × 10^7	LP/ABS/AVE; τ_0^{und} = ~0.24 ms; OT; S possibly a mixture of isomers	86S089
11.11. Mg(5,10,15,20-tetraphenylporphyrin)							
Inorganic Quenchers							
11.11.1.	Eu^{3+}	AN			2.1 × 10^6	FP/ABS/SST; OT; [Q] ≤ 0.0018 mol/L; some Eu^{2+} present	79A220
Organic Quenchers							
11.11.2.	1,4-Benzoquinone	EtOH			3.1 × 10^9	LP/ABS/SST; OT; f = 0.28; ϕ = 0.85 (82E428)	83F182
	1,4-Benzoquinone	Toluene			2 × 10^8 (calc)	FP/ABS/SST; τ_0 = 0.30 ms; EX; same k_q from same lab in 81E718; biexponential decay, see Mech. [2]	82E636
11.12. Mg(5,10,15,20-tetraphenylporphyrin)(pyridine)							
Organic Quenchers							
11.12.1.	1-Bromo-2-nitrobenzene	Toluene			2 × 10^6 (calc)	FP/ABS/SST; τ_0 = 0.5 ms; EX; biexponential decay, see Mech. [2]	83E101
11.12.2.	1-Chloro-2-nitrobenzene	Toluene			3 × 10^7 (calc)	FP/ABS/SST; τ_0 = 0.5 ms; EX; biexponential decay, see Mech. [2]	83E101
11.12.3.	1,2-Dinitrobenzene	Toluene			<1 × 10^8 (calc)	FP/ABS/SST; τ_0 = 0.5 ms; EX; biexponential decay, see Mech. [2]	83E101
11.12.4.	1,4-Dinitrobenzene	Toluene			9 × 10^7 (calc)	FP/ABS/SST; τ_0 = 0.5 ms; EX; biexponential decay, see Mech. [2]	83E101
11.12.5.	2-Nitroaniline	Toluene			8 × 10^6 (calc)	FP/ABS/SST; τ_0 = 0.5 ms; EX; biexponential decay, see Mech. [2]; see also 85A155	83E101
11.12.6.	3-Nitroaniline	Toluene			6 × 10^6 (calc)	FP/ABS/SST; τ_0 = 0.5 ms; EX; biexponential decay, see Mech. [2]	83E101

TABLE 11. Quenching of excited magnesium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
11.12. Mg(5,10,15,20-tetraphenylporphyrin)(pyridine)—Continued							
11.12.7.	1-Nitronaphthalene	Toluene			$<5 \times 10^8$ (calc)	FP/ABS/SST; τ_0 = 0.5 ms; EX; biexponential decay, see Mech. [2]	83E101
11.12.8.	1,3,5-Trimethyl-2,4,6-trinitrobenzene	Toluene			$<5 \times 10^8$ (calc)	FP/ABS/SST; τ_0 = 0.5 ms; EX; biexponential decay, see Mech. [2]	83E101

TABLE 12. Quenching of excited molybdenum complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
12.1. $Mo_6Cl_{14}^{2-}$							
Inorganic Quenchers							
12.1.1.	$PW_{12}O_{40}^{3-}$	H_2O	2 mol/L HCl	27	$\sim 7 \times 10^8$	SS/LUM; τ_0 = 20 μs (81E076); OT; τ_0 in 6 mol/L HCl and 6 mol/L LiCl	83F069
12.1.2.	$SiW_{12}O_{40}^{4-}$	H_2O	2 mol/L HCl	27	$\sim 2 \times 10^8$	SS/LUM; τ_0 = 20 μs (81E076); OT; τ_0 in 6 mol/L HCl and 6 mol/L LiCl	83F069
Organic Quenchers							
12.1.3.	*N,N'*-Eis(2-sulfonatoethyl)-(vio^{2+}) zwitterion	H_2O	2 mol/L HCl	27	3.8×10^6	SS/LUM; τ_0 = 20 μs (81E076); OT; τ_0 in 6 mol/L HCl and 6 mol/L LiCl	83F069
12.1.4.	*N,N'*-Eis(3-sulfonato-1-propyl)-(vio^{2+}) zwitterion	H_2O	2 mol/L HCl	27	$\sim 3 \times 10^6$	SS/LUM; τ_0 = 20 μs (81E076); OT; τ_0 in 6 mol/L HCl and 6 mol/L LiCl	83F069
12.1.5.	Tetracyanoethene	AN		27	2.5×10^9	SS/LUM; τ_0 = 0.18 ms (LP/LUM/SST); OT	83F069

TABLE 13. Quenching of excited neodymium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
13.1. Nd^{3+}							
Inorganic Quenchers							
13.1.1.	H_2O	CCl_4/dTBP (4/1)		20	7.4×10^6	LP/LUM/SST; τ_0 = 12 μs; ET; [Q] ≤ 0.02 mol/L; S forms 1:3 complex with dTBP	75E542
	H_2O	CCl_4/TBP (4/1)		20	7.4×10^6	LP/LUM/SST; τ_0 = 3 μs; ET; [Q] ≤ 0.05 mol/L; S forms 1:3 complex with TBP	75E542
	H_2O	TBP		20	1.9×10^6	LP/LUM/SST; τ_0 = 3 μs; ET; [Q] ≤ 0.13 mol/L; S forms 1:3 complex with TBP	75E542

TABLE 14. Quenching of excited osmium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.1. Os(5-Clphen)$_3^{2+}$							
Inorganic Quenchers							
14.1.1.	$Co(bpy)_3^{2+}$	H_2O	0.16 mol/L Na_2SO_4, Pbuf; pH 7.8; μ = 0.5; $[Co^{II}]/[L]$ = 0.2	25	5.5×10^8	SS/LUM; τ_0 = 78 ns (78E887); OT, ET	85S022
14.1.2.	Eu^{2+}	H_2O	pH 1.3; μ = 0.5 (NaCl)	25	7.9×10^6	LP/LUM/SST; τ_0 = 78 ns; [Q] ≤ 0.005 mol/L	80E040
14.1.3.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4		3.2×10^9	FP/PCM/SST; τ_0 = 78 ns (78E887); OT, ET?; [Q] ≤ 0.01 mol/L; same k_q from same lab in 78A186; $[Fe^{2+}]$ = $[Fe^{3+}]$; see Mech. [8]	80E224
14.1.4.	$Fe(bpy)_3^{2+}$	H_2O	μ = 0.5 (NaCl)	25	2.3×10^9	LP/LUM/SST; τ_0 = 78 ns; ET; [Q] ≤ 0.005 mol/L	80E040
14.1.5.	$Fe(CN)_6^{4-}$	H_2O	μ = 0.001 (NaCl)	25	1.7×10^{10}	SS/LUM; τ_0 = 66 ns (LP/LUM/AVE); RT; [Q] ≤ 0.005 mol/L; some SQ, see Mech. [11]	81A250
	$Fe(CN)_6^{4-}$	H_2O	μ = 0.1 (NaCl)	25	3.2×10^9	SS/LUM; τ_0 = 66 ns (LP/LUM/AVE); RT; [Q] ≤ 0.006 mol/L; some SQ, see Mech. [11]	81A250
	$Fe(CN)_6^{4-}$	H_2O	μ = 1.0 (NaCl)	25	2.8×10^8	LP/LUM/SST; τ_0 = 78 ns; [Q] ≤ 0.005 mol/L	80E040
14.1.6.	$Fe(phen)_3^{2+}$	H_2O	μ = 0.5 (NaCl)	25	1.4×10^9	LP/LUM/SST; τ_0 = 78 ns; ET, OT?; [Q] ≤ 0.005 mol/L	80E040
14.1.7.	$Eu(NH_3)_6^{2+}$	H_2O	μ = 0.5 (NaCl)	25	1.1×10^9	LP/LUM/SST; τ_0 = 78 ns; [Q] ≤ 0.005 mol/L; same k_q from same lab in 78E887	80E040
14.1.8.	$Eu(terpy)_2^{2+}$	H_2O	μ = 1.0 (Na_2SO_4)	25	$\leq 1 \times 10^8$	LP/LUM/SST; τ_0 = 78 ns; [Q] ≤ 0.005 mol/L; same k_q from same lab in 78E887	80E040
14.1.9.	$Eu(TPTZ)_2^{2+}$	H_2O	μ = 0.5 (NaCl)	25	2.6×10^9	LP/LUM/SST; τ_0 = 78 ns; OT; [Q] ≤ 0.005 mol/L	80E040
14.2. Os(5,6-Me$_2$phen)$_3^{2+}$							
Inorganic Quenchers							
14.2.1.	$Co(bpy)_3^{2+}$	H_2O	0.16 mol/L Na_2SO_4, Pbuf; pH 7.8; μ = 0.5; $[Co^{II}]/[L]$ = 0.2	25	1.5×10^9	SS/LUM; τ_0 = 63 ns (78E887); OT, ET	85S022

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.2. $Os(5,6\text{-}Me_2phen)_3^{2+}$—Continued							
14.2.2.	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	2.1×10^8	SS/LUM; τ_0 = 63 ns (C. Creutz, unpub. obs.); OT	78A090
14.3. $Os(3,4,7,8\text{-}Me_4phen)_2[cis\text{-}1,2\text{-bis(diphenylphosphino)ethene}]^{2+}$							
Organic Quenchers							
14.3.1.	*N*-Benzyl-3-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.9×10^7	SS/LUM; τ_0 = 3.5 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.3.2.	*N,N*-Dibenzyl-vio^{2+}	AN	0.1 mol/L $LiClO_4$	~23	1.9×10^9	SS/LUM; τ_0 = 3.5 μs (LP/LUM/AVE); OT	85E347
14.3.3.	*N*-Ethyl-3-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	2.9×10^6	SS/LUM; τ_0 = 3.5 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.3.4.	*N*-Ethyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	8.6×10^8	SS/LUM; τ_0 = 3.5 μs (LP/LUM/AVE); OT	85E347
14.3.5.	*N*-Methyl-3-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	3.2×10^6	SS/LUM; τ_0 = 3.5 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.3.6.	*N*-Methyl-4-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	3.1×10^8	SS/LUM; τ_0 = 3.5 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.3.7.	*N*-Methyl-4-cyano-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	2.2×10^9	SS/LUM; τ_0 = 3.5 μs (LP/LUM/AVE); OT	85E347
14.4. $Os(bpy)_3^{2+}$							
Inorganic Quenchers							
14.4.1.	$Co(CN)_6^{3-}$	H_2O	0.5 mol/L NaCl	~20	1.3×10^8	SS/LUM; τ_0^{air} = 21 ns (SL/LUM/SPC); OT	78F263
14.4.2.	$Co(NH_3)_5Br^{2+}$	H_2O	0.166 mol/L Na_2SO_4; 0.013 mol/L $NaHSO_4$; μ = 0.5	23-24	9×10^8	SS/QYP, SS/LUM; τ_0 = 19 ns (766014); OT; [Q] ≤ 0.008 mol/L; see Mech. [7]	78A058
14.4.3.	$Co(NH_3)_5(CO_3)^+$	H_2O	0.166 mol/L Na_2SO_4; 0.013 mol/L $NaHSO_4$; μ = 0.5	23-24	$\sim 1 \times 10^8$	SS/QYP; τ_0 = 19 ns (766014); OT; f = ~1; see Mech. [7]	78A058

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.4.	**$Os(bpy)_3^{2+}$**—Continued						
14.4.4.	$Co(NH_3)_5Cl^{2+}$	H_2O	0.166 mol/L Na_2SO_4; 0.013 mol/L $NaHSO_4$; μ = 0.5	23-24	6×10^8	SS/QYP, SS/LUM; τ_0 = 19 ns (766014); OT; [Q] ≤ 0.008 mol/L; see Mech. [7]	73A058
14.4.5.	$Co(NH_3)_5(H_2O)^{3+}$	H_2O	0.166 mol/L Na_2SO_4; 0.013 mol/L $NaHSO_4$; μ = 0.5	23-24	$\sim 2 \times 10^8$	SS/QYP; τ_0 = 19 ns (766014); OT; f = ~1; [Q] ≤ 0.02 mol/L; see Mech. [7]	73A058
14.4.6.	$Co(NH_3)_5(N_3)^{2+}$	H_2O	0.166 mol/L Na_2SO_4; 0.013 mol/L $NaHSO_4$; μ = 0.5	23-24	4×10^8	SS/QYP; τ_0 = 19 ns (766014); OT; f = ~1; [Q] ≤ 0.008 mol/L; see Mech. [7]	73A058
14.4.7.	$Co(NH_3)_5(SO_4)^{+}$	H_2O	0.166 mol/L Na_2SO_4; 0.013 mol/L $NaHSO_4$; μ = 0.5	23-24	$\sim 2 \times 10^8$	SS/QYP; τ_0 = 19 ns (766014); OT; f = ~1; see Mech. [7]	73A058
14.4.8.	$Co(phen)_3^{3+}$	H_2O	0.5 mol/L NaCl	25	5.7×10^9	SS/LUM; τ_0 = 19 ns (SL/LUM/SPC); OT; [Q] ≤ 0.004 mol/L	766014
14.4.9.	$Cr(CN)_6^{3-}$	H_2O	0.5 mol/L NaCl	~20	2.5×10^9	SS/LUM; τ_0^{air} = 21 ns (SL/LUM/SPC); ET	78F263
14.4.10.	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	2×10^8	SS/LUM; τ_0 = 19 ns (766014); OT	78A090
14.4.11.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4		5.5×10^9	FP/PCM/SST; τ_0 = 19 ns (766014); OT, ET?; $[Fe^{2+}]$ = $[Fe^{3+}]$; see Mech. [8]	80E224
14.4.12.	$Fe(CN)_6^{3-}$	H_2O	0.5 mol/L NaCl	~20	9.4×10^9	SL/LUM/SPC; τ_0^{air} = 21 ns; OT	78F263
	$Fe(CN)_6^{3-}$	H_2O	0.5 mol/L NaCl	25	1.3×10^{10}	SS/LUM; τ_0 = 19 ns (SL/LUM/SPC); OT; [Q] ≤ 0.01 mol/L	766014
14.4.13.	$Fe(CN)_6^{4-}$	H_2O	0.5 mol/L NaCl	~20	3.8×10^8	SS/LUM; τ_0^{air} = 21 ns (SL/LUM/SPC); RT	78F263
14.4.14.	Fe^{III}(cytochrome c)	H_2O	Pbuf; pH 7		$>5 \times 10^9$	LP/ABS/AVE; τ_0 = 19 ns (80E040); OT; [Q] = (1-10) × 10^{-5} mol/L; 10.6% of Q as Fe^{II}	84A306
14.4.15.	$Mo(CN)_8^{4-}$	H_2O	0.5 mol/L NaCl	~20	2.8×10^8	SS/LUM; τ_0^{air} = 21 ns (SL/LUM/SPC); RT	78F263

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.4.	***Os(bpy)$_3^{2+}$***—Continued						
14.4.16.	$Ni(CN)_4^{2-}$	H_2O	0.5 mol/L NaCl	~20	9×10^7	SS/LUM; τ_0^{air} = 21 ns (SL/LUM/SPC); OT	78F263
14.4.17.	O_2	H_2O		25	5.2×10^9	SS/LUM; τ_0 = 19 ns (SL/LUM/SPC); [Q] ≤ 0.0015 mol/L	766014
	O_2	MeOH			4.5×10^9	SS/LUM; τ_0 = 49 ns (75F657); ET	777221
14.4.18.	$PtBr_4^{2-}$	H_2O	μ = 2 ($HClO_4$)		3.0×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 20 ns; ET	83E719
14.4.19.	$PtBr_6^{2-}$	H_2O	μ = 2 ($HClO_4$)		2.5×10^{10}	SS/LUM; τ_0^{air} = 21 ns (LP/LUM/SST); OT	83A403
14.4.20.	$Pt(C_2O_4)_2^{2-}$	H_2O	μ = 2 ($HClO_4$)		$<3 \times 10^8$	LP/LUM/SST, SS/LUM; τ_0^{air} = 20 ns	83E719
14.4.21.	$PtCl_4^{2-}$	H_2O	μ = 2 ($HClO_4$)		5.0×10^8	LP/LUM/SST, SS/LUM; τ_0^{air} = 20 ns; ET	83E719
14.4.22.	$PtCl_6^{2-}$	H_2O	μ = 2 ($HClO_4$)		1.4×10^{10}	SS/LUM; τ_0^{air} = 21 ns (LP/LUM/SST); OT	83A403
14.4.23.	PtF_6^{2-}	H_2O	μ = 2 ($HClO_4$)		2.3×10^9	SS/LUM; τ_0^{air} = 21 ns (LP/LUM/SST); OT	83A403
14.4.24.	$Pt(NH_3)_4Br_2^{2+}$	H_2O	μ = 0.02 ($HClO_4$ or H_2SO_4)		3×10^9	EMI; OT	85A469
14.4.25.	$Pt(NH_3)_5Br^{3+}$	H_2O	μ = 0.1 ($HClO_4$ or H_2SO_4)		4×10^9	EMI; OT	85A469
14.4.26.	$Pt(NH_3)_4Cl_2^{2+}$	H_2O	μ = 0.02 ($HClO_4$ or H_2SO_4)		2×10^9	EMI; OT	85A469
14.4.27.	$Pt(NH_3)_5Cl^{3+}$	H_2O	μ = 0.1 ($HClO_4$ or H_2SO_4)		3×10^9	EMI; OT	85A469
14.4.28.	$Pt(SCN)_4^{2-}$	H_2O	μ = 4 ($HClO_4$)		$<3 \times 10^8$	LP/LUM/SST, SS/LUM; τ_0^{air} = 20 ns	83E719
14.4.29.	$Pt(SCN)_6^{2-}$	H_2O	μ = 2 ($HClO_4$)		1.0×10^{10}	SS/LUM; τ_0^{air} = 21 ns (LP/LUM/SST); OT	83A403
14.4.30.	$Ru(CN)_6^{4-}$	H_2O	0.5 mol/L NaCl	~20	1.3×10^8	SS/LUM; τ_0^{air} = 21 ns (SL/LUM/SPC); RT	78F263
14.4.31.	$Ru(NH_3)_6^{3+}$	H_2O	0.5 mol/L NaCl	25	4.8×10^9	SS/LUM, SL/LUM/SPC; τ_0 = 19 ns (SL/LUM/SPC); OT; [Q] ≤ 0.02 mol/L	766014

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.5. *cis*-Os(bpy)$_2$(CH$_3$CN)$_2$$^{2+}$							
Inorganic Quenchers							
14.5.1.	$HgCl_2$	H_2O	0.01 mol/L HNO_3; 0.1 mol/L $NaNO_3$	25	9×10^7	LP/LUM/SST; τ_0 = 0.55 μs; OT	84N050
	$HgCl_2$	H_2O	0.01 mol/L HNO_3; 0.1 mol/L $NaNO_3$; 0.01 mol/L SLS	25	2.7×10^6	LP/LUM/SST; τ_0 = 0.64 μs; OT	84N050
14.6. Os(bpy)[1,2-bis(dimethylarsino)benzene]$_2$$^{2+}$							
Inorganic Quenchers							
14.6.1.	O_2	AN			1.2×10^6	LP/LUM/SST; τ_0 = 1.6 μs; ET; $p_Q = 2 \times 10^4$ Pa	86S121
Organic Quenchers							
14.6.2.	4,4′-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L $LiClO_4$	~23	9.3×10^6	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); RT	85E347
14.6.3.	4-Bromo-*N,N*-dimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	1.6×10^6	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); RT	85E347
14.6.4.	*N,N*′-Dibenzyl-vio^{2+}	AN	0.1 mol/L $LiClO_4$	~23	1.2×10^6	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); OT	85E347
14.6.5.	*N*-Ethyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.4×10^8	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); OT	85E347
14.6.6.	*N*-Methyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.3×10^8	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); OT	85E347
14.6.7.	*N*-Methyl-4-cyano-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	5.4×10^8	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); OT	85E347
14.6.8.	MV^{2+}	AN	0.1 mol/L $LiClO_4$	~23	1.1×10^6	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); OT	85E347
14.6.9.	Phenothiazine	AN	0.1 mol/L $LiClO_4$	~23	9.4×10^6	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); RT	85E347
14.6.10.	Phenoxathiin	AN	0.1 mol/L $LiClO_4$	~23	5.9×10^6	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); RT	85E347
14.6.11.	Triphenylamine	AN	0.1 mol/L $LiClO_4$	~23	9.8×10^8	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); RT	85E347
14.6.12.	Tris(4-bromophenyl)amine	AN		23	1.0×10^8	SS/LUM; τ_0 = 1.6 μs; RT	82S130
	Tris(4-bromophenyl)amine	AN	0.1 mol/L $LiClO_4$	~23	2.0×10^8	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); RT	85E347
14.7. Os(bpy)[*cis*-1,2-bis(diphenylphosphino)ethene]$_2$$^{2+}$							
Organic Quenchers							
14.7.1.	*N,N*′-Dibenzyl-vio^{2+}	AN	0.1 mol/L $LiClO_4$	~23	3.0×10^8	SS/LUM; τ_0 = 1.7 μs (LP/LUM/AVE); OT	85E347

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.7. Os(bpy)[*cis*-1,2-bis(diphenylphosphino)ethene]$_2^{2+}$—Continued							
14.7.2.	*N*-Ethyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.4×10^6	SS/LUM; τ_0 = 1.7 μs (LP/LUM/AVE); OT	85E347
14.7.3.	*N*-Methyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.5×10^6	SS/LUM; τ_0 = 1.7 μs (LP/LUM/AVE); OT	85E347
14.7.4.	*N*-Methyl-4-cyano-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.7×10^7	SS/LUM; τ_0 = 1.7 μs (LP/LUM/AVE); OT	85E347
14.7.5.	MV^{2+}	AN	0.1 mol/L $LiClO_4$	~23	1.7×10^8	SS/LUM; τ_0 = 1.7 μs (LP/LUM/AVE); OT	85E347
14.8. Os(bpy)$_2$[bis(diphenylphosphino)methane]$^{2+}$							
Organic Quenchers							
14.8.1.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	0.1 mol/L $LiClO_4$	~23	9.5×10^9	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); RT	85E347
14.8.2.	4,4'-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L $LiClO_4$	~23	5.3×10^9	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); RT	85E347
14.8.3.	4-Eromo-*N,N*-dimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	6.3×10^7	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); RT	85E347
14.8.4.	2-Chlorophenothiazine	AN	0.1 mol/L $LiClO_4$	~23	1.5×10^9	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); RT	85E347
14.8.5.	*N,N'*-Dibenzyl-vio^{2+}	AN	0.1 mol/L $LiClO_4$	~23	1.4×10^9	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); OT	85E347
14.8.6.	*N*-Ethyl-3-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.5×10^6	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.8.7.	*N*-Ethyl-4-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	7.4×10^6	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.8.8.	*N*-Methyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.4×10^8	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); OT	85E347
14.8.9.	*N*-Methyl-4-cyano-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	2.4×10^8	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); OT	85E347
14.8.10.	MV^{2+}	AN	0.1 mol/L $LiClO_4$	~23	1.1×10^9	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); OT	85E347
14.8.11.	Phenothiazine	AN	0.1 mol/L $LiClO_4$	~23	3.4×10^9	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); RT	85E347
14.8.12.	2-(Trifluoromethyl)phenothiazine	AN	0.1 mol/L $LiClO_4$	~23	4.7×10^8	SS/LUM; τ_0 = 0.30 μs (LP/LUM/AVE); RT	85E347

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.9.	***cis*-Os(bpy)$_2$(dimethylsulfoxide)$_2^{2+}$**						
	Organic Quenchers						
14.9.1.	4-Bromo-*N,N*-dimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	6.7×10^9	SS/LUM; τ_0 = 1.5 μs (LP/LUM/AVE); RT	85E347
14.9.2.	*N,N'*-Dibenzyl-vio^{2+}	AN	0.1 mol/L $LiClO_4$	~23	5.5×10^8	SS/LUM; τ_0 = 1.5 μs (LP/LUM/AVE); OT	85E347
14.9.3.	*N*-Ethyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	3.8×10^6	SS/LUM; τ_0 = 1.5 μs (LP/LUM/AVE); OT	85E347
14.9.4.	*N*-Methyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	4.6×10^6	SS/LUM; τ_0 = 1.5 μs (LP/LUM/AVE); OT	85E347
14.9.5.	*N*-Methyl-4-cyano-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	7.9×10^7	SS/LUM; τ_0 = 1.5 μs (LP/LUM/AVE); OT	85E347
14.9.6.	*N*-Methylphenothiazine	AN	0.1 mol/L $LiClO_4$	~23	6.6×10^9	SS/LUM; τ_0 = 1.5 μs (LP/LUM/AVE); RT	85E347
14.9.7.	MV^{2+}	AN	0.1 mol/L $LiClO_4$	~23	5.4×10^8	SS/LUM; τ_0 = 1.5 μs (LP/LUM/AVE); OT	85E347
14.9.8.	Phenothiazine	AN	0.1 mol/L $LiClO_4$	~23	9.2×10^9	SS/LUM; τ_0 = 1.5 μs (LP/LUM/AVE); RT	85E347
14.9.9.	Phenoxathiin	AN	0.1 mol/L $LiClO_4$	~23	6.2×10^8	SS/LUM; τ_0 = 1.5 μs (LP/LUM/AVE); RT	85E347
14.9.10.	Triphenylamine	AN	0.1 mol/L $LiClO_4$	~23	5.4×10^9	SS/LUM; τ_0 = 1.5 μs (LP/LUM/AVE); RT	85E347
14.10.	**Os(phen)$_3^{2+}$**						
	Inorganic Quenchers						
14.10.1.	Co(bpy)$_3^{2+}$	H_2O	0.16 mol/L Na_2SO_4, Pbuf; pH 7.8; μ = 0.5; [Co^{II}]/[L] = 0.2	25	7.4×10^8	SS/LUM; τ_0 = 84 ns (78E887); OT, ET	85S022
14.10.2.	Co(en)$_3^{3+}$	H_2O	0.1 mol/L H_2SO_4	~22	1.0×10^8	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.3.	*cis*-Co(en)$_2$Cl$_2^+$	H_2O	0.1 mol/L H_2SO_4	~22	2.3×10^9	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.4.	*trans*-Co(en)$_2$Cl$_2^+$	H_2O	0.1 mol/L H_2SO_4	~22	2.7×10^9	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.5.	*cis*-Co(en)$_2$(H$_2$O)Cl^{2+}	H_2O	0.1 mol/L H_2SO_4	~22	9.6×10^8	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.6.	*cis*-Co(en)$_2$(NCS)$_2^+$	H_2O	0.1 mol/L H_2SO_4	~22	1.9×10^9	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.10.	**$Os(phen)_3^{2+}$**—Continued						
14.10.7.	*trans*-$Co(en)_2(NCS)_2^+$	H_2O	0.1 mol/L H_2SO_4	~22	1.7×10^9	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.8.	*cis*-$Co(en)_2(NCS)Cl^+$	H_2O	0.1 mol/L H_2SO_4	~22	2.1×10^9	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.9.	*trans*-$Co(en)_2(NCS)Cl^+$	H_2O	0.1 mol/L H_2SO_4	~22	1.6×10^9	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.10.	*cis*-$Co(en)_2(NH_3)Cl^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	9.3×10^8	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/SST); OT	84A255
14.10.11.	$Co(NH_3)_6^{3+}$	H_2O	0.1 mol/L H_2SO_4	~22	1.0×10^8	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.12.	$Co(NH_3)_5Cl^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	9.3×10^8	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.13.	$Co(NH_3)_5F^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	2.9×10^8	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.14.	$Co(NH_3)_5(H_2O)^{3+}$	H_2O	0.1 mol/L H_2SO_4	~22	3.7×10^8	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.15.	$Co(NH_3)_5(NCS)^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	6.8×10^8	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.16.	$Co(NH_3)_5[OC(O)H]^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	4.1×10^8	SS/LUM; τ_0^{air} = 75 ns (LP/LUM/AVE); OT	84A255
14.10.17.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4		4.0×10^9	FP/PCM/SST; τ_0 = 84 ns (78Z170); OT, ET?; [Q] ≤ 0.027 mol/L; $[Fe^{2+}] = [Fe^{3+}]$, see Mech. [8]	80E224
14.10.18.	Fe^{III}(cytochrome c)	H_2O	Pbuf; pH 7		$>7 \times 10^8$	LP/ABS/AVE; τ_0 = 84 ns (80E040); OT; [Q] = (1-10) × 10^{-5} mol/L; 10.6% of Q as Fe^{II}	84A306
14.10.19.	$HgCl_2$	H_2O	0.01 mol/L HNO_3; 0.1 mol/L $NaNO_3$; 0.01 mol/L SLS	25	$<1.1 \times 10^7$	LP/LUM/SST, SS/LUM; τ_0 = 0.14 μs; OT	84N050
14.10.20.	O_2	MeOH			5.7×10^9	SS/LUM; τ_0 = 0.18 μs (75F657); ET	777221
	Organic Quenchers						
14.10.21.	*N*-Benzyl-3-carbamyl-py^+	AN	0.1 mol/L $LiClO_4$	~23	1.6×10^7	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.10. Os(phen)$_3^{2+}$—Continued							
14.10.22.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	0.1 mol/L $LiClO_4$	~23	2.1×10^9	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); RT	85E347
14.10.23.	4,4'-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L $LiClO_4$	~23	1.1×10^9	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); RT	85E347
14.10.24.	*N*-Ethyl-3-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	2.4×10^6	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.10.25.	*N*-Ethyl-4-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	9.4×10^8	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.10.26.	*N*-Ethyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	2.0×10^9	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); OT	85E347
14.10.27.	4-Methoxy-*N,N*-dimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	2.7×10^7	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); RT	85E347
14.10.28.	*N*-Methyl-3-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	2.8×10^6	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.10.29.	*N*-Methyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.1×10^9	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); OT	85E347
14.10.30.	*N*-Methyl-4-cyano-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	2.9×10^9	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); OT	85E347
14.10.31.	MV^{2+}	AN	0.1 mol/L $LiClO_4$	~23	3.1×10^9	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); OT	85E347
14.10.32.	Phenothiazine	AN	0.1 mol/L $LiClO_4$	~23	8.3×10^6	SS/LUM; τ_0 = 0.26 μs (LP/LUM/AVE); RT	85E347
14.11. *cis*-Os(phen)$_2$(CH$_3$CN)$_2^{2+}$							
Organic Quenchers							
14.11.1.	*N*-Benzyl-3-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.2×10^7	SS/LUM; τ_0 = 0.49 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.11.2.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	0.1 mol/L $LiClO_4$	~23	5.9×10^9	SS/LUM; τ_0 = 0.49 μs (LP/LUM/AVE); RT	85E347
14.11.3.	4,4'-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L $LiClO_4$	~23	2.7×10^9	SS/LUM; τ_0 = 0.49 μs (LP/LUM/AVE); RT	85E347

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.11. *cis*-**Os(phen)$_2$(CH$_3$CN)$_2$$^{2+}$**—Continued							
14.11.4.	2-Chlorophenothiazine	AN	0.1 mol/L $LiClO_4$	~23	1.3×10^7	SS/LUM; τ_0 = 0.49 μs (LP/LUM/AVE); RT	85E347
14.11.5.	*N,N*-Dimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	1.2×10^5	SS/LUM; τ_0 = 0.49 μs (LP/LUM/AVE); RT	85E347
14.11.6.	*N*-Ethyl-4-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	4.4×10^8	SS/LUM; τ_0 = 0.49 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.11.7.	4-Methoxy-*N,N*-dimethylariliine	AN	0.1 mol/L $LiClO_4$	~23	1.6×10^8	SS/LUM; τ_0 = 0.49 μs (LP/LUM/AVE); RT	85E347
14.11.8.	3-Methoxyphenothiazine	AN	0.1 mol/L $LiClO_4$	~23	5.4×10^8	SS/LUM; τ_0 = 0.49 μs (LP/LUM/AVE); RT	85E347
14.11.9.	*N*-Methyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.4×10^9	SS/LUM; τ_0 = 0.49 μs (LP/LUM/AVE); OT	85E347
14.11.10.	*N*-Methyl-4-cyano-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	2.2×10^9	SS/LUM; τ_0 = 0.49 μs (LP/LUM/AVE); OT	85E347
14.11.11.	MV^{2+}	AN	0.1 mol/L $LiClO_4$	~23	2.4×10^9	SS/LUM; τ_0 = 0.49 μs (LP/LUM/AVE); OT	85E347
14.12. *cis*-**Os(phen)$_2$(CO)Cl$^+$**							
Inorganic Quenchers							
14.12.1.	$HgCl_2$	H_2O	0.01 mol/L HNO_3; 0.1 mol/L $NaNO_3$	25	6.9×10^8	LP/LUM/SST; τ_0 = 0.22 μs; OT	84N050
	$HgCl_2$	H_2O	0.01 mol/L HNO_3; 0.1 mol/L $NaNO_3$; 0.01 mol/L SLS	25	4.5×10^7	LP/LUM/SST; τ_0 = 0.25 μs; OT	84N050
14.13. Os(phen)$_2$[4,7-(PhSO$_3$)$_2$phen]							
Inorganic Quenchers							
14.13.1.	O_2	MeOH			6.8×10^9	SS/LUM; τ_0 = 93 ns (75F657); ET	777221
14.14. Os(phen)$_2$[4,7-Ph$_2$phen)$^{2+}$							
Inorganic Quenchers							
14.14.1.	O_2	MeOH			4.6×10^9	SS/LUM; τ_0 = 0.21 μs (75F657); ET	777221
14.15. Os(phen)$_2$[*cis*-1,2-bis(diphenylphosphino)ethene]$^{2+}$							
Inorganic Quenchers							
14.15.1.	$HgCl_2$	H_2O	0.01 mol/L HNO_3; 0.1 mol/L $NaNO_3$	25	3.3×10^8	LP/LUM/SST; τ_0 = 1.0 μs; OT	84N050

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.15.	**$Os(phen)_2$[*cis*-1,2-bis(diphenylphosphino)ethene]$^{2+}$**—Continued						
	$HgCl_2$	H_2O	0.01 mol/L HNO_3; 0.1 mol/L $NaNO_3$; 0.01 mol/L SLS	25	3.3×10^6	LP/LUM/SST, SS/LUM; τ_0 = 0.90 μs; OT	84N050
Organic Quenchers							
14.15.2.	4,4'-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L $LiClO_4$	~23	1.2×10^{10}	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); RT	85E347
14.15.3.	4-Bromo-*N,N*-dimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	2.3×10^8	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); RT	85E347
14.15.4.	*N,N'*-Dibenzyl-vio^{2+}	AN	0.1 mol/L $LiClO_4$	~23	1.3×10^9	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); OT	85E347
14.15.5.	*N*-Ethyl-3-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	4.6×10^6	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.15.6.	*N*-Ethyl-4-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.7×10^7	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.15.7.	*N*-Methyl-4-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.3×10^7	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.15.8.	*N*-Methyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	2.8×10^8	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); OT	85E347
14.15.9.	*N*-Methyl-4-cyano-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	8.4×10^8	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); OT	85E347
14.15.10.	*N*-Methylphenothiazine	AN	0.1 mol/L $LiClO_4$	~23	1.9×10^9	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); RT	85E347
14.15.11.	MV^{2+}	AN	0.1 mol/L $LiClO_4$	~23	9.8×10^8	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); OT	85E347
14.15.12.	Phenothiazine	AN	0.1 mol/L $LiClO_4$	~23	4.8×10^9	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); RT	85E347
14.15.13.	Triphenylamine	AN	0.1 mol/L $LiClO_4$	~23	5.6×10^7	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); RT	85E347

TABLE 14. Quenching of excited iridium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.16. Os(phen)$_2$[bis(diphenylphosphino)methane]$^{2+}$							
Inorganic Quenchers							
14.16.1.	$HgCl_2$	H_2O	0.01 mol/L HNO_3; 0.1 mol/L $NaNO_3$	25	6.9×10^8	LP/LUM/SST; τ_0 = 0.55 μs; OT; [Q] ≤ 0.007 mol/L; k_q = ~8×10^8 with SS/LUM	84N050
	$HgCl_2$	H_2O	0.01 mol/L HNO_3; 0.1 mol/L $NaNO_3$; 0.01 mol/L SLS	25	5.3×10^6	LP/LUM/SST; τ_0 = 0.60 μs; OT; [Q] ≤ 0.014 mol/L; k_q = 6.4×10^6 with SS/LUM	84N050
Organic Quenchers							
14.16.2.	4,4′-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L $LiClO_4$	~23	6.2×10^9	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); RT	85E347
14.16.3.	4-Bromo-*N,N*-dimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	1.0×10^8	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); RT	85E347
14.16.4.	*N,N′*-Dibenzyl-vio^{2+}	AN	0.1 mol/L $LiClO_4$	~23	9.1×10^8	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); OT	85E347
14.16.5.	*N*-Ethyl-4-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	6.8×10^7	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.16.6.	*N*-Ethyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	5.8×10^3	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); OT	85E347
14.16.7.	*N*-Methyl-4-cyano-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.2×10^9	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); OT	85E347
14.16.8.	*N*-Methylphenothiazine	AN	0.1 mol/L $LiClO_4$	~23	1.4×10^9	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); RT	85E347
14.16.9.	MV^{2+}	AN	0.1 mol/L $LiClO_4$	~23	1.6×10^9	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); OT	85E347
14.16.10.	Phenothiazine	AN	0.1 mol/L $LiClO_4$	~23	3.6×10^9	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); RT	85E347
14.16.11.	Triphenylamine	AN	0.1 mol/L $LiClO_4$	~23	2.1×10^7	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); RT	85E347
14.17. *cis*-Os(phen)$_2$(dimethylphenylphosphine)$_2^{2+}$							
Organic Quenchers							
14.17.1.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	0.1 mol/L $LiClO_4$	~23	6.0×10^9	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); RT	85E347
14.17.2.	4,4′-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L $LiClO_4$	~23	3.6×10^9	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); RT	85E347

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.17.	***cis*-Os(phen)$_2$(dimethylphenylphosphine)$_2^{2+}$**—Continued						
14.17.3.	*N,N'*-Dibenzyl-vio^{2+}	AN	0.1 mol/L $LiClO_4$	~23	2.9×10^9	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); OT	85E347
14.17.4.	*N,N*-Dimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	5.1×10^5	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); RT	85E347
14.17.5.	*N*-Ethyl-4-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.2×10^8	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.17.6.	*N*-Ethyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	7.7×10^8	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); OT	85E347
14.17.7.	4-Methoxy-*N,N*-dimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	3.5×10^8	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); RT	85E347
14.17.8.	*N*-Methyl-4-carbamyl-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.2×10^8	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); OT; Q designated as "carbamido" compound	85E347
14.17.9.	*N*-Methyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	7.2×10^8	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); OT	85E347
14.17.10.	*N*-Methyl-4-cyano-py$^+$	AN	0.1 mol/L $LiClO_4$	~23	1.9×10^9	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); OT	85E347
14.17.11.	*N*-Methylphenothiazine	AN	0.1 mol/L $LiClO_4$	~23	2.8×10^7	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); RT	85E347
14.17.12.	MV^{2+}	AN	0.1 mol/L $LiClO_4$	~23	2.3×10^9	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); OT	85E347
14.17.13.	Phenothiazine	AN	0.1 mol/L $LiClO_4$	~23	4.4×10^8	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); RT	85E347
14.17.14.	4,*N,N*-Trimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	1.8×10^8	SS/LUM; τ_0 = 0.39 μs (LP/LUM/AVE); RT	85E347
14.18.	**Os(terpy)$_2^{2+}$**						
	Inorganic Quenchers						
14.18.1.	$Co(NH_3)_5Cl^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	8.7×10^8	LP/LUM/AVE; τ_0 = 0.14 μs; OT; f = ~1	85A077
14.18.2.	$HgCl_2$	H_2O	0.01 mol/L HNO_3; 0.1 mol/L $NaNO_3$	25	6.6×10^7	LP/LUM/SST; τ_0 = 0.14 μs; OT	84N050
	$HgCl_2$	H_2O	0.01 mol/L HNO_3; 0.1 mol/L $NaNO_3$; 0.01 mol/L SLS	25	1.0×10^7	LP/LUM/SST; τ_0 = 0.18 μs; OT	84N050

TABLE 14. Quenching of excited osmium complexes—Continued

No.	Quencher	Solvent	Solution Medium	$T/°C$	k_q /L mol^{-1} s^{-1}	Comments	Ref.
14.18. Os(terpy)$_2^{2+}$—Continued							
Organic Quenchers							
14.18.3.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	0.1 mol/L $LiClO_4$	~23	7.4×10^9	SS/LUM; τ_0 = 0.27 μs (LP/LUM/AVE); RT	85E347
14.18.4.	4,4′-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L $LiClO_4$	~23	2.9×10^9	SS/LUM; τ_0 = 0.27 μs (LP/LUM/AVE); RT	85E347
14.18.5.	2-Chlorophenothiazine	AN	0.1 mol/L $LiClO_4$	~23	1.8×10^7	SS/LUM; τ_0 = 0.27 μs (LP/LUM/AVE); RT	85E347
14.18.6.	4-Methoxy-*N,N*-dimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	2.4×10^8	SS/LUM; τ_0 = 0.27 μs (LP/LUM/AVE); RT	85E347
14.18.7.	3-Methoxyphenothiazine	AN	0.1 mol/L $LiClO_4$	~23	9.5×10^8	SS/LUM; τ_0 = 0.27 μs (LP/LUM/AVE); RT	85E347
14.18.8.	*N*-Methylphenothiazine	AN	0.1 mol/L $LiClO_4$	~23	9.6×10^6	SS/LUM; τ_0 = 0.27 μs (LP/LUM/AVE); RT	85E347
14.19. Os(terpy)[*cis*-1,2-bis(diphenylphosphino)ethene]Cl$^+$							
Organic Quenchers							
14.19.1.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	0.1 mol/L $LiClO_4$	~23	5.4×10^9	SS/LUM; τ_0 = 0.10 μs (LP/LUM/AVE); RT	85E347
14.19.2.	4,4′-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L $LiClO_4$	~23	1.7×10^9	SS/LUM; τ_0 = 0.10 μs (LP/LUM/AVE); RT	85E347
14.19.3.	2-Chlorophenothiazine	AN	0.1 mol/L $LiClO_4$	~23	4.6×10^7	SS/LUM; τ_0 = 0.10 μs (LP/LUM/AVE); RT	85E347
14.19.4.	4-Methoxy-*N,N*-dimethylaniline	AN	0.1 mol/L $LiClO_4$	~23	1.1×10^8	SS/LUM; τ_0 = 0.10 μs (LP/LUM/AVE); RT	85E347
14.19.5.	3-Methoxyphenothiazine	AN	0.1 mol/L $LiClO_4$	~23	4.9×10^8	SS/LUM; τ_0 = 0.10 μs (LP/LUM/AVE); RT	85E347
14.19.6.	*N*-Methylphenothiazine	AN	0.1 mol/L $LiClO_4$	~23	1.2×10^7	SS/LUM; τ_0 = 0.10 μs (LP/LUM/AVE); RT	85E347
14.19.7.	Phenothiazine	AN	0.1 mol/L $LiClO_4$	~23	1.9×10^8	SS/LUM; τ_0 = 0.10 μs (LP/LUM/AVE); RT	85E347

TABLE 15. Quenching of excited palladium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
15.1. Pd(etioporphyrin I)							
Inorganic Quenchers							
15.1.1.	Ag(TPP)	Toluene			2.5×10^9	FP/LUM/SST; ET	76E693
15.1.2.	Ni(etioporphyrin I)	Toluene			3.1×10^9	SS/LUM, FP/ABS/SST; ET	74E520
15.1.3.	Ni(TPP)	Toluene			3.2×10^9	SS/LUM, FP/ABS/SST; ET	74E520
15.1.4.	Yb(etioporphyrin I)$^+$	Toluene		20	1×10^9	FP/ABS/SST; ET; [Q] ≤ 4.5×10^{-5} mol/L	85F493
Organic Quenchers							
15.1.5.	Naphthacene	Toluene			5.3×10^9	SS/LUM, FP/ABS/SST; ET; [Q] = (2-7.5) × 10^{-6} mol/L	74E520
15.1.6.	Perylene	Toluene			5.8×10^9	SS/LUM, FP/ABS/SST; ET; [Q] = (1-10) × 10^{-6} mol/L	74E520
15.2. Pd(mesoporphyrin IX dimethyl ester)							
Inorganic Quenchers							
15.2.1.	O_2	Toluene			3.8×10^9	LP/ABS/SST; ET; [Q] = 0.0011 mol/L	81E738
15.3. Pd(octaethylchlorin)							
Inorganic Quenchers							
15.3.1.	Yb(etioporphyrin I)$^+$	Toluene			4.2×10^8	FP/ABS/SST; ET	76E693
15.4. Pd(2,3,7,8,12,13,17,18-octaethylporphyrin)							
Organic Quenchers							
15.4.1.	*cis*-α-Methylstilbene	Benzene			2.0×10^5	SS/LUM; τ_0 = 0.50 ms (FP/LUM/SST); EX; k_q = 9.7×10^4 with FP/LUM/SST	78A101
15.4.2.	*trans*-α-Methylstilbene	Benzene			6.8×10^5	SS/LUM; τ_0 = 0.50 ms (FP/LUM/SST); EX	78A101
15.4.3.	MV^{2+}	BuN			1.5×10^9	SS/LUM; τ_0 = 0.36 ms (FP/LUM/SST); OT	767009
15.4.4.	*cis*-Stilbene	Benzene			1.4×10^6	SS/LUM; τ_0 = 0.50 ms (FP/LUM/SST); EX	78A101
	cis-Stilbene	Pentane			3.3×10^6	SS/LUM; τ_0 = 0.56 ms (FP/LUM/SST); EX	78A101
15.4.5.	*trans*-Stilbene	Benzene			1.5×10^6	SS/LUM; τ_0 = 0.50 ms (FP/LUM/SST); EX; k_q = 5.3×10^5 with FP/LUM/SST	78A101

TABLE 15. Quenching of excited palladium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
15.4. Pd(2,3,7,8,12,13,17,18-octaethylporphyrin)—Continued							
	trans-Stilbene	Pentane			3.3×10^6	SS/LUM; τ_0 = 0.56 ms (FP/LUM/SST); EX	78A101
15.5. Pd(tetrabenzoporphyrin)							
Inorganic Quenchers							
15.5.1.	Ni(eticporphyrin I)	DMF			1.1×10^9	SS/LUM, FP/ABS/SST; ET	74E520
15.6. Pd[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$							
Inorganic Quenchers							
15.6.1.	$Co(NH_3)_5Cl^{2+}$	H_2O			1.4×10^8	FP/ABS/SST; τ_0 = 0.17 ms; OT	83A133
15.6.2.	Fe^{3+}	H_2O			6.9×10^7	FP/ABS/SST; τ_0 = 0.17 ms; OT	83A133
15.6.3.	$S_2O_8^{2-}$	H_2O			1.9×10^8	FP/ABS/SST; τ_0 = 0.17 ms; OT	83A133
Organic Quenchers							
15.6.4.	MV^{2+}	H_2O			3.5×10^4	FP/ABS/SST; τ_0 = 0.17 ms; OT	83A133
15.7. Pd[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$							
Organic Quenchers							
15.7.1.	*N,N'*-Dibenzyl-vio^{2+}	H_2O	0.05 mol/L NaCl		1.1×10^{10}	SS/LUM; τ_0 = 0.20 ms (FP/LUM/SST)	81N147
15.7.2.	MV^{2+}	H_2O			4.9×10^9	SS/LUM; τ_0 = 0.20 ms (FP/LUM/SST)	81N147
	MV^{2+}	H_2O			1.0×10^{10}	SS/LUM; τ_0 = 0.14 ms (LP/LUM/AVE); OT	85E552
	MV^{2+}	H_2O	0.05 mol/L NaCl		3.7×10^9	SS/LUM; τ_0 = 0.20 ms (FP/LUM/SST)	81N147
	MV^{2+}	H_2O	0.05% PVA		5.0×10^9	SS/LUM; τ_0 = 0.14 ms (LP/LUM/AVE); OT	85E552
	MV^{2+}	H_2O	0.5% PVA		2.8×10^9	SS/LUM; τ_0 = 0.15 ms (LP/LUM/AVE); OT	85E552
15.8. Pd(5,10,15,20-tetraphenylporphyrin)							
Organic Quenchers							
15.8.1.	1,4-Benzoquinone	EtOH			2.6×10^9	LP/ABS/SST, SS/LUM; OT; f = 0.05	83F182
15.8.2.	*N,N*-Dimethylaniline	py			1×10^5	SS/LUM and LIF; EX; nonlinear S-V plot, see Mech. [1]	79E349
15.8.3.	4-Methoxy-*N,N*-dimethylaniline	py			2.2×10^7	SS/LUM and LIF	79E349

TABLE 15. Quenching of excited palladium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
15.8.	**Pd(5,10,15,20-tetraphenylporphyrin)**—Continued						
15.8.4.	*cis*-Stilbene	Benzene			1.8×10^5	SS/LUM; τ_0 = 0.36 ms (FP/LUM/SST); EX	78A101
15.8.5.	*trans*-Stilbene	Benzene			1.0×10^5	SS/LUM; τ_0 = 0.36 ms (FP/LUM/SST); EX	78A101

TABLE 16. Quenching of excited platinum complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
16.1. $Pt(CN)_4^{2-}$							
Inorganic Quenchers							
16.1.1.	$Co(en)_3^{3+}$	H_2O		24.5	1.1×10^9	SS/LUM; τ_0 = 0.64 μs (LP/LUM/SST); [Q] = 0.081 mol/L; [S] = 0.40 mol/L, as K^+ salt; forms oligomers	82E553
16.1.2.	Cu^{II}-EDTA	H_2O	[Cu]/[L] = 1	24.5	3.3×10^8	SS/LUM; τ_0 = 0.64 μs (LP/LUM/SST); [Q] = 0.018 mol/L; [S] = 0.40 mol/L, as K^+ salt; forms oligomers	82E553
16.1.3.	Eu^{3+}	H_2O		24	2.1×10^9	SS/LUM; τ_0 = 0.45 μs (LP/LUM/SST); [Q] = 0.0040-0.0060 mol/L; [S] = 0.092 mol/L, as Ba^{2+} salt; forms oligomers	82E553
16.1.4.	$Fe(CN)_6^{3-}$	H_2O			5.0×10^7	SS/LUM; τ_0 = 0.66 μs (LP/LUM/SST); [Q] = 0.0083 mol/L; [S] = 0.44 mol/L, as K^+ salt; forms oligomers	82E553
16.1.5.	Fe^{III}-EDTA	H_2O	[Fe]/[L] = 1	24	1.8×10^9	SS/LUM; τ_0 = 0.45 μs (LP/LUM/SST); [Q] = ~9 × 10^{-4} mol/L; [S] = 0.092 mol/L, as Ba^{2+} salt; forms oligomers	82E553
16.1.6.	IO_3^-	H_2O		24	1.4×10^8	SS/LUM; τ_0 = 0.64 μs (LP/LUM/SST); [Q] = 0.0091 mol/L; [S] = 0.40 mol/L, as K^+ salt; forms oligomers	82E553
16.1.7.	NO_2^-	H_2O		20.5	2.3×10^8	SS/LUM; τ_0 = 0.64 μs (LP/LUM/SST); ET; [Q] = 0.001-0.1 mol/L; [S] = 0.40 mol/L, as K^+ salt; forms oligomers	82E553
	NO_2^-	H_2O		21	3.1×10^8	SS/LUM; τ_0 = 0.54 μs (LP/LUM/SST); ET; [Q] = 0.014-0.055 mol/L; [S] = 0.096 mol/L, as Ba^{2+} salt; forms oligomers	82E553

TABLE 16. Quenching of excited platinum complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
16.1.	**$Pt(CN)_4^{2-}$**—Continued						
16.1.8.	$Ni(CN)_4^{2-}$	H_2O		22.5	1.3×10^8	SS/LUM; τ_0 = 0.64 μs (LP/LUM/SST); [Q] = 0.046 mol/L; [S] = 0.40 mol/L, as K^+ salt; forms oligomers	82E553
16.1.9.	O_2	H_2O			3.0×10^9	LP/LUM/SST; τ_0 = 0.64 μs; ET; [Q] = (2.8-14) × 10^{-4} mol/L; [S] = 0.33 mol/L, as K^+ salt; forms oligomers	82E553
16.1.10.	$S_2O_8^{2-}$	H_2O		24	2.2×10^8	SS/LUM; τ_0 = 0.64 μs (LP/LUM/SST); [Q] = 0.0092 mol/L; [S] = 0.40 mol/L, as K^+ salt; forms oligomers	82E553
	Organic Quenchers						
16.1.11.	MV^{2+}	H_2O		23.5	5.6×10^9	SS/LUM; τ_0 = 0.54 μs (LP/LUM/SST); [Q] = (5.7-11) × 10^{-5} mol/L; [S] = 0.099 mol/L, as Ba^{2+} salt; forms oligomers	82E553
	MV^{2+}	H_2O		25	1.2×10^9	SS/LUM; τ_0 = 0.64 μs (LP/LUM/SST); [Q] = 0.0036 mol/L; [S] = 0.40 mol/L, as K^+ salt; forms oligomers	82E553
16.2.	**$Pt_2[\mu\text{-diphosphito(2-)-}P,P']_4^{4-}$**						
	Inorganic Quenchers						
16.2.1.	$Co(C_5H_4COOH)_2^+$	H_2O			1.5×10^9	LP/LUM/AVE; τ_0 = 9.5 μs; OT; [Q] = (5-50) × 10^{-5} mol/L	85A161
16.2.2.	O_2	H_2O			2.4×10^9	LP/LUM/AVE; τ_0 = 9.5 μs; ET	85A161
16.2.3.	$Rh(bpy)_3^{3+}$	H_2O			1.5×10^{10}	LP/LUM/AVE; τ_0 = 9.5 μs; OT; [Q] = (1-50) × 10^{-5} mol/L	85A161
16.2.4.	$Ru(bpy)_3^{2+}$	H_2O			1.8×10^{10}	LP/LUM/AVE; τ_0 = 9.5 μs; ET; [Q] = (1-20) × 10^{-5} mol/L	85A161
16.2.5.	$S_2O_8^{2-}$	H_2O			1.5×10^6	LP/LUM/AVE; τ_0 = 9.5 μs; OT; [Q] = 0.001-0.01 mol/L	85A161

TABLE 16. Quenching of excited platinum complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
16.2.	**$Pt_2[\mu$-diphosphito(2-)-$P,P']_4^{4-}$**—Continued						
	Organic Quenchers						
16.2.6.	Anthracene	MeOH			6.2×10^9	SS/LUM; τ_0 = 9.4 μs (LP/LUM/AVE); ET; [Q] = (1-10) × 10^{-4} mol/L	85A161
16.2.7.	Azulene	MeOH			3.5×10^9	LP/LUM/AVE; τ_0 = 9.4 μs; ET; [Q] = (5-50) × 10^{-5} mol/L	85A161
16.2.8.	Biphenyl	MeOH			$<1 \times 10^6$	LP/LUM/AVE; τ_0 = 9.4 μs; [Q] = 0.001-0.01 mol/L	85A161
16.2.9.	1,4-Bis(*N,N*-dimethylamino)benzene	MeOH		~25	1.2×10^{10}	SS/LUM; τ_0 = 7.1 μs (LP/LUM); RT	84E074
	1,4-Bis(*N,N*-dimethylamino)benzene	MeOH			1.3×10^{10}	LP/LUM/AVE; τ_0 = 9.4 μs; RT; [Q] = 0.001 mol/L	85A161
16.2.10.	4,4'-Bis(*N,N*-dimethylamino)biphenyl	MeOH		~25	3.0×10^9	SS/LUM; τ_0 = 7.1 μs (LP/LUM); RT	84E074
	4,4'-Bis(*N,N*-dimethylamino)biphenyl	MeOH			6.7×10^8	SS/LUM; τ_0 = 9.4 μs (LP/LUM/AVE); RT; [Q] = (1-10) × 10^{-4} mol/L	85A161
16.2.11.	*N,N'*-Bis(2-sulfonatoethyl)-(vio^{2+}) zwitterion	H_2O	0.1 mol/L $NaClO_4$	25	5.5×10^9	EMI; τ_0 = 9.8 μs; OT	81A344
16.2.12.	*N,N'*-Bis(1-sulfonato-2-propyl)-(vio^{2+}) zwitterion	H_2O			4.5×10^9	LP/LUM/AVE; τ_0 = 9.5 μs; OT; [Q] = (2-50) × 10^{-5} mol/L	85A161
16.2.13.	Carbon tetrachloride	AN			2×10^9	SS/LUM; OT	86F089
16.2.14.	Chloroform	AN			6×10^7	SS/LUM; OT	86F089
16.2.15.	*N,N*-Dimethylaniline	MeOH		~25	1.2×10^7	SS/LUM; τ_0 = 7.1 μs (LP/LUM); RT	84E074
	N,N-Dimethylaniline	MeOH			1.2×10^7	LP/LUM/AVE; τ_0 = 9.4 μs; RT; [Q] = 0.005-0.07 mol/L	85A161
16.2.16.	Diphenylamine	MeOH			$\leq 1 \times 10^6$	SS/LUM; τ_0 = 9.4 μs (LP/LUM/AVE); [Q] = 0.001-0.01 mol/L	85A161
16.2.17.	Diphenylmethanol	AN		~22	1×10^5	HA	85E779
16.2.18.	*N*-Methylphenothiazine	MeOH			8.0×10^7	LP/LUM/AVE; τ_0 = 9.4 μs; RT; [Q] = (5-50) × 10^{-5} mol/L	85A161
16.2.19.	MV^{2+}	H_2O			1.7×10^{10}	LP/LUM/AVE; τ_0 = 9.5 μs; OT; [Q] = (1-10) × 10^{-4} mol/L	85A161

TABLE 16. Quenching of excited platinum complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
16.2.	**$Pt_2[\mu$-diphosphito(2-)-$P,P']_4^{4-}$**—Continued						
16.2.20.	Naphthalene	MeOH			1.2×10^8	LP/LUM/AVE; τ_0 = 9.4 μs; ET; [Q] = 0.001-0.03 mol/L	85A161
16.2.21.	2-Propanol	AN		~22	1×10^3	HA	85E779
16.2.22.	Toluene	AN		~22	1×10^4	HA	85E779
16.2.23.	Triethylamine	MeOH			$<1 \times 10^6$	SS/LUM; τ_0 = 9.4 μs (LP/LUM/AVE); [Q] = 0.01-0.08 mol/L	85A161
16.2.24.	4,*N*,*N*-Trimethylaniline	MeOH		~25	3.9×10^7	SS/LUM; τ_0 = 7.1 μs (LP/LUM); RT	84E074
16.2.25.	Triphenylamine	MeOH		~25	1.5×10^6	SS/LUM; τ_0 = 7.1 μs (LP/LUM); RT	84E074
16.3.	**Pt(8-hydroxyquinolinato)$_2$**						
Inorganic Quenchers							
16.3.1.	$Co(acac)_3$	Acetone		~22	8.9×10^8	LP/LUM/SST; ET	83E223
16.3.2.	$Co(DMG)_2(C_2H_5)(H_2O)$	Acetone		~22	3.6×10^9	LP/LUM/SST; ET	83E223
16.3.3.	$Cr(CN)_6^{3-}$	DMF		25	9.2×10^7	SS/LUM; τ_0 = 2.7 μs (LP/LUM/SST); ET; see Mech. [6]	86E555
Organic Quenchers							
16.3.4.	1,4-Benzoquinone	AN		25	2.1×10^{10}	LP/LUM/SST; OT	86E555
16.3.5.	1-Bromo-4-nitrobenzene	AN		25	3.2×10^8	LP/LUM/SST; OT	86E555
16.3.6.	1-Chloro-4-nitrobenzene	AN		25	1.8×10^8	LP/LUM/SST; OT	86E555
16.3.7.	1,2-Dinitrobenzene	AN		25	1.1×10^{10}	LP/LUM/SST; OT	86E555
16.3.8.	1,3-Dinitrobenzene	AN		25	7.4×10^9	LP/LUM/SST; OT	86E555
16.3.9.	1-Fluoro-4-nitrobenzene	AN		25	2.8×10^7	LP/LUM/SST; OT	86E555
16.3.10.	MV^{2+}	AN	0.01 mol/L TEAP	25	1.1×10^{10}	LP/LUM/SST; OT	86E555
16.3.11.	3-Nitrobenzaldehyde	AN		25	1.1×10^9	LP/LUM/SST; OT	86E555
16.3.12.	4-Nitrobenzaldehyde	AN		25	1.2×10^{10}	LP/LUM/SST; OT	86E555
16.3.13.	Nitrobenzene	AN		25	5.5×10^6	LP/LUM/SST; OT	86E555
16.3.14.	3-Nitrobenzonitrile	AN		25	4.8×10^9	LP/LUM/SST; OT	86E555
16.3.15.	4-Nitrobenzonitrile	AN		25	1.0×10^{10}	LP/LUM/SST; OT	86E555
16.3.16.	4-Nitrotoluene	AN		25	1.9×10^6	LP/LUM/SST; OT	86E555
16.3.17.	9,10-Phenanthrenequinone	AN		25	1.7×10^{10}	LP/LUM/SST; OT	86E555
16.3.18.	Tetracyanoethene	AN		25	2.4×10^{10}	LP/LUM/SST; OT	86E555

TABLE 16. Quenching of excited platinum complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
16.4.	**Pt(5,10,15,20-tetraphenylporphyrin)**						
	Organic Quenchers						
16.4.1.	*cis*-Stilbene	Benzene			6.7×10^5	SS/LUM; τ_0 = 54 μs (FP/LUM/SST); EX	78A101
16.4.2.	*trans*-Stilbene	Benzene			5.0×10^5	SS/LUM; τ_0 = 54 μs (FP/LUM/SST); EX	78A101

TABLE 17. Quenching of excited rhenium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
17.1. *fac*-Re(CO)$_3$(5-Clphen)Cl							
Organic Quenchers							
17.1.1.	Anthracene	CH_2Cl_2		25	$>1.4 \times 10^9$	SS/LUM; τ_0 = <0.65 μs (SL/LUM/AVE); ET; [Q] ≤ 0.005 mol/L	746021
17.1.2.	*trans*-Stilbene	CH_2Cl_2		25	$>1.4 \times 10^8$	SS/LUM; τ_0 = <0.65 μs (SL/LUM/AVE); ET	746021
17.2. *fac*-Re(CO)$_3$(4,7-Ph$_2$phen)Cl							
Organic Quenchers							
17.2.1.	Aniline	AN	0.1 mol/L TBAP	25	2.0×10^8	SS/LUM; τ_0 = 0.45 μs (SL/LUM/AVE); RT	78E397
17.2.2.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	0.1 mol/L TBAP	25	8.7×10^9	SS/LUM; τ_0 = 0.45 μs (SL/LUM/AVE); RT	78E397
17.2.3.	*N,N'*-Dibenzyl-vio^{2+}	AN	0.1 mol/L TBAP	25	3.3×10^9	SS/LUM; τ_0 = 0.45 μs (SL/LUM/AVE); OT	78E397
17.2.4.	1,4-Dimethoxybenzene	AN	0.1 mol/L TBAP	25	$<2 \times 10^6$	SS/LUM; τ_0 = 0.45 μs (SL/LUM/AVE); RT	78E397
17.2.5.	MV^{2+}	AN	0.1 mol/L TBAP	25	3.5×10^9	SS/LUM; τ_0 = 0.45 μs (SL/LUM/AVE); OT	78E397
17.2.6.	4,*N,N*-Trimethylaniline	AN	0.1 mol/L TBAP	25	3.9×10^9	SS/LUM; τ_0 = 0.45 μs (SL/LUM/AVE); RT	78E397
17.3. *fac*-Re(CO)$_3$(4-acetylpyridine)$_2$I							
Organic Quenchers							
17.3.1.	Triethylamine	CH_2Cl_2/C_6H_6 (1/1)		25	$\sim 1 \times 10^9$	SS/LUM; τ_0 = ~0.5 μs; RT; [Q] ≤ 0.007 mol/L	80F316
17.4. *fac*-Re(CO)$_3$(4-benzoylpyridine)$_2$Cl							
Organic Quenchers							
17.4.1.	Triethylamine	CH_2Cl_2/C_6H_6 (1/1)		25	$\sim 1 \times 10^9$	SS/LUM; τ_0 = ~0.5 μs; RT; [Q] ≤ 0.007 mol/L	80F316
17.5. *fac*-Re(CO)$_3$(bpy)Br							
Organic Quenchers							
17.5.1.	Triethanolamine	DMF	CO_2 satd	25	3.4×10^7	SS/LUM; RT (83S051)	86F230
17.6. *fac*-Re(CO)$_3$(phen)Cl							
Organic Quenchers							
17.6.1.	Aniline	AN	0.1 mol/L TBAP	25	5.8×10^7	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); RT	78E397
17.6.2.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	0.1 mol/L TBAP	25	5.7×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); RT	78E397
17.6.3.	1,4-Bis(*N*-phenylamino)benzene	AN	0.1 mol/L TBAP	25	3.7×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); RT	78E397

TABLE 17. Quenching of excited rhenium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
17.6.	***fac*-Re(CO)$_3$(phen)Cl—Continued**						
17.6.4.	4-Bromoaniline	AN	0.1 mol/L TBAP	25	5.4×10^7	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); RT	78E397
17.6.5.	1-Chloro-4-nitrobenzene	AN	0.1 mol/L TBAP	25	2.4×10^8	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT	78E397
17.6.6.	*N,N'*-Dibenzyl-vio^{2+}	AN	0.1 mol/L TBAP	25	2.7×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT; [Q] ≤ 0.002 mol/L	78E397
17.6.7.	1,4-Dimethoxybenzene	AN	0.1 mol/L TBAP	25	$<2 \times 10^6$	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); RT	78E397
17.6.8.	*N,N*-Dimethylaniline	AN	0.1 mol/L TBAP	25	9.8×10^8	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); RT	78E397
17.6.9.	*N,N*-Dimethylbenzylamine	AN	0.1 mol/L TBAP	25	$<2 \times 10^6$	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); RT	78E397
17.6.10.	4,4'-Dinitrobiphenyl	AN	0.1 mol/L TBAP	25	1.9×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT	78E397
17.6.11.	Diphenylamine	AN	0.1 mol/L TBAP	25	4.0×10^8	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); RT	78E397
17.6.12.	DQ^{2+}	AN	0.1 mol/L TBAP	25	3.6×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT	78E397
17.6.13.	*N*-Methyl-4-carbomethoxy-py$^+$	AN	0.1 mol/L TBAP	25	1.7×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT	78E397
17.6.14.	*N*-Methyl-4-cyano-py$^+$	AN	0.1 mol/L TBAP	25	2.3×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT	78E397
17.6.15.	*N*-Methylphenothiazine	AN	0.1 mol/L TBAP	25	1.7×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); RT	78E397
17.6.16.	MV^{2+}	AN	0.1 mol/L TBAP	25	3.1×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT; [Q] ≤ 0.0024 mol/L	78E397
17.6.17.	3-Nitrobenzaldehyde	AN	0.1 mol/L TBAP	25	6.4×10^8	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT	78E397
17.6.18.	4-Nitrobenzaldehyde	AN	0.1 mol/L TBAP	25	2.6×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT	78E397
17.6.19.	4-Nitrotoluene	AN	0.1 mol/L TBAP	25	$<2 \times 10^7$	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT	78E397
17.6.20.	Tetracyanoethene	AN	0.1 mol/L TBAP	25	7.4×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT	78E397
17.6.21.	4,*N,N*-Trimethylaniline	AN	0.1 mol/L TBAP	25	2.1×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); RT	78E397

TABLE 17. Quenching of excited rhenium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
17.6.	***fac*-Re(CO)$_3$(phen)Cl**—Continued						
17.6.22.	*N,N*-(Trimethylene)-phen^{2+}	AN	0.1 mol/L TBAP	25	3.3×10^9	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); OT	73E397
17.6.23.	Triphenylamine	AN	0.1 mol/L TBAP	25	3.3×10^8	SS/LUM; τ_0 = 0.50 μs (SL/LUM/AVE); RT	73E397
17.7.	***fac*-Re(CO)$_3$(4-phenylpyridine)$_2$Cl**						
	Organic Quenchers						
17.7.1.	Naphthalene	CH_2Cl_2		25	$\sim 1 \times 10^9$	SS/LUM; τ_0 = 1.5 μs (SL/LUM/AVE)	79E269
17.7.2.	*trans*-Stilbene	CH_2Cl_2		25	2.4×10^9	SS/LUM; τ_0 = 1.5 μs (SL/LUM/AVE); ET	79E269
17.8.	**$Re_2Cl_8^{2-}$**						
	Organic Quenchers						
17.8.1.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	μ = 0.1 (TBAP)	25	5.4×10^9	SS/LUM; τ_0 = 0.14 μs (767006); RT	81A315
17.8.2.	4,4′-Bis(*N,N*-dimethylamino)biphenyl	AN	μ = 0.1 (TBAP)	25	2.2×10^9	SS/LUM; τ_0 = 0.14 μs (767006); RT	81A315
17.8.3.	*N,N*-Bis(4-methoxyphenyl)amine	AN	μ = 0.1 (TBAP)	25	1.1×10^9	SS/LUM; τ_0 = 0.14 μs (767006); RT	81A315
17.8.4.	*N,N*-Diethylaniline	AN	μ = 0.1 (TBAP)	25	2.2×10^6	SS/LUM; τ_0 = 0.14 μs (767006); RT	81A315
17.8.5.	*N,N*-Dimethylaniline	AN	μ = 0.1 (TBAP)	25	1.5×10^6	SS/LUM; τ_0 = 0.14 μs (767006); RT	81A315
17.8.6.	Diphenylamine	AN	μ = 0.1 (TBAP)	25	6.1×10^6	SS/LUM; τ_0 = 0.14 μs (767006); RT	81A315
17.8.7.	*N*-Methylphenothiazine	AN	μ = 0.1 (TBAP)	25	9.5×10^6	SS/LUM; τ_0 = 0.14 μs (767006); RT	81A315
17.8.8.	Phenothiazine	AN	μ = 0.1 (TBAP)	25	8.4×10^8	SS/LUM; τ_0 = 0.14 μs (767006); RT	81A315
17.8.9.	4,*N,N*-Trimethylaniline	AN	μ = 0.1 (TBAP)	25	1.3×10^7	SS/LUM; τ_0 = 0.14 μs (767006); RT	81A315

TABLE 18. Quenching of excited rhodium complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
18.1. $Rh(ND_3)_6^{3+}$							
Inorganic Quenchers							
18.1.1.	OD^-	D_2O		9	1.1×10^{10}	LP/LUM/AVE; τ_0 = 89 ns; PT	85F123
18.2. $Rh(ND_3)_5Cl^{2+}$							
Inorganic Quenchers							
18.2.1.	OH^-	H_2O		5	8.1×10^9	SS/LUM or LP/LUM/SST; PT	82E073
18.3. $Rh(NH_3)_6^{3+}$							
Inorganic Quenchers							
18.3.1.	OH^-	H_2O		9	1.6×10^{10}	LP/LUM/AVE; τ_0 = 40 ns; PT	85F123
18.4. $Rh(NH_3)_5Br^{2+}$							
Inorganic Quenchers							
18.4.1.	OH^-	H_2O		5	2.7×10^{10}	SS/QYP, SS/LUM or LP/LUM/SST; τ_0 = 24 ns; PT; see Mech. [5]	82E073
18.5. $Rh(NH_3)_5Cl^{2+}$							
Inorganic Quenchers							
18.5.1.	CO_3^{2-}	H_2O	CAbuf; pH 10.1	4	8.3×10^9	SS/LUM or LP/LUM/SST; τ_0^{und} = 30 ns; PT; [Q] ≤ 0.005 mol/L	80E074
18.5.2.	OH^-	H_2O		4	2.1×10^{10}	SS/LUM or LP/LUM/SST; τ_0^{und} = 30 ns; PT; [Q] ≤ 0.0025 mol/L	80E074
	OH^-	H_2O		25	9.8×10^{10}	SS/QYP; τ_0 = 14 ns (79E417); PT; τ_0 at pH 3; see Mech. [5]	84A141
18.6. $Rh(NH_3)_5I^{2+}$							
Inorganic Quenchers							
18.6.1.	OH^-	H_2O		25	1.9×10^{10}	LP/LUM/SPC; τ_0 = 1.3 ns; PT; τ_0 at pH 3	84A141
18.7. $Rh(4,7\text{-}Ph_2phen)_3^{3+}$							
Organic Quenchers							
18.7.1.	1,2-Diaminobenzene	AN/H_2O			8.1×10^9	LP/ABS/SST; τ_0 = 73 μs; RT; f = 0.64	85F184
18.7.2.	1,4-Diaminobenzene	AN/H_2O			6.3×10^9	LP/ABS/SST; τ_0 = 73 μs; RT; f = 0.78	85F184
18.7.3.	1,4-Dimethoxybenzene	AN/H_2O			4.0×10^9	LP/ABS/SST; τ_0 = 73 μs; RT; f = 0.48	85F184

TABLE 18. Quenching of excited rhodium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
18.7. Rh(4,7-Ph$_2$phen)$_3^{3+}$—Continued							
18.7.4.	3,3′-Dimethyl-4,4′-diaminobiphenyl	AN/H$_2$O			8.4×10^9	LP/ABS/SST; τ_0 = 73 μs; RT; f = 0.55	85F184
18.7.5.	Diphenylamine	AN/H$_2$O			9.7×10^9	LP/ABS/SST; τ_0 = 73 μs; RT; f = 0.38	85F184
18.7.6.	1,3,5-Trimethoxybenzene	AN/H$_2$O			4.0×10^9	LP/ABS/SST; τ_0 = 73 μs; RT; f = 0.45	85F184
18.8. *cis*-Rh(4,7-Ph$_2$phen)$_2$Cl$_2^+$							
Organic Quenchers							
18.8.1.	1,4-Dimethoxybenzene	AN			4.4×10^8	LP/ABS/SST; τ_0 = 1.0 μs; RT; f = 0.38	85F184
18.8.2.	1,2,4-Trimethoxybenzene	AN			2.9×10^9	LP/ABS/SST; τ_0 = 1.0 μs; RT; f = 0.34	85F184
18.8.3.	1,3,5-Trimethoxybenzene	AN			$<1 \times 10^8$	LP/ABS/SST; τ_0 = 1.0 μs; RT	85F184
18.9. *cis*-Rh(bpy)$_2$Cl$_2^+$							
Inorganic Quenchers							
18.9.1.	OH$^-$	H$_2$O		11	$<1 \times 10^7$	SS/LUM or LP/LUM/SST; τ_0^{und} = 52 ns	80E074
18.10. *trans*-Rh(cyclam)(CN)$_2^+$							
Inorganic Quenchers							
18.10.1.	Cr(CN)$_6^{3-}$	H$_2$O	pH 5.9; μ = 0.5	22	9.4×10^7	LP/LUM/AVE; τ_0 = 8.0 μs; ET?; [Q] ≤ 0.004 mol/L	83E674
18.10.2.	OH$^-$	H$_2$O		22	1.6×10^{10}	LP/LUM/AVE; τ_0 = 8.0 μs; PT?; [Q] ≤ 5×10^{-5} mol/L	83E674
18.11. Rh$_2$(1,3-diisocyanopropane)$_4^{2+}$ [singlet]							
Organic Quenchers							
18.11.1.	Benzophenone	AN			5.9×10^8	SS/LUM; τ_0 = 1.3 ns (80A270); OT; same k_q from same lab in 83C021	83F105
18.11.2.	1,4-Benzoquinone	AN			4.0×10^{10}	SS/LUM; τ_0 = 1.3 ns (80A270); OT	83F105
18.11.3.	Butyl iodide	AN			2.6×10^8	SS/LUM; τ_0 = 1.3 ns (80A270); OT	83F105
18.11.4.	1-Chloro-4-nitrobenzene	AN			1.2×10^{10}	SS/LUM; τ_0 = 1.3 ns (80A270); OT; same k_q from same lab in 83C021	83F105

TABLE 18. Quenching of excited rhodium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
18.11. Rh_2(1,3-diisocyanopropane)$_4^{2+}$ [singlet]—Continued							
18.11.5.	1,4-Dicyanobenzene	AN			1.9×10^9	SS/LUM; τ_0 = 1.3 ns (78E003); OT	83C021
18.11.6.	Diethyl fumarate	AN			6.8×10^9	SS/LUM; τ_0 = 1.3 ns (80A270); OT; same k_q from same lab in 83C021	83F105
18.11.7.	1,3-Dinitrobenzene	AN			1.5×10^{10}	SS/LUM; τ_0 = 1.3 ns (80A270); OT; same k_q from same lab in 83C021	83F105
18.11.8.	1,4-Dinitrobenzene	AN			1.8×10^{10}	SS/LUM; τ_0 = 1.3 ns (80A270); OT; same k_q from same lab in 83C021	83F105
18.11.9.	1-Methoxy-2-nitrobenzene	AN			7.7×10^9	SS/LUM; τ_0 = 1.3 ns (78E003); OT	83C021
18.11.10.	Methyl 4-nitrobenzoate	AN			1.4×10^{10}	SS/LUM; τ_0 = 1.3 ns (80A270); OT; same k_q from same lab in 83C021	83F105
18.11.11.	2-Nitroaniline	AN			1.2×10^{10}	SS/LUM; τ_0 = 1.3 ns (78E003); OT	83C021
18.11.12.	4-Nitroaniline	AN			8.3×10^9	SS/LUM; τ_0 = 1.3 ns (78E003); OT	83C021
18.11.13.	3-Nitrobenzaldehyde	AN			1.3×10^{10}	SS/LUM; τ_0 = 1.3 ns (80A270); OT; same k_q from same lab in 83C021	83F105
18.11.14.	Nitrobenzene	AN			1.3×10^{10}	SS/LUM; τ_0 = 1.3 ns (80A270); OT; same k_q from same lab in 83C021	83F105
18.11.15.	Tetrachloro-1,4-benzoquinone	AN			1.6×10^{10}	SS/LUM; τ_0 = 1.3 ns (80A270); OT	83F105
18.12. Rh_2(1,3-diisocyanopropane)$_4^{2+}$ [triplet]							
Organic Quenchers							
18.12.1.	Anthracene	AN		21	3.4×10^6	LP/LUM/SST; τ_0 = 8.5 μs; ET	80A270
18.12.2.	Azulene	AN		21	6.3×10^6	LP/LUM/SST; τ_0 = 8.5 μs; ET	80A270
18.12.3.	1,4-Bis(*N,N*-dimethylamino)benzene	AN		21	8.7×10^8	LP/LUM/SST; τ_0 = 8.5 μs; RT	80A270
18.12.4.	1,4-Diazabicyclo[2.2.2]octane	AN		21	3.3×10^6	LP/LUM/SST; τ_0 = 8.5 μs; RT	80A270

TABLE 18. Quenching of excited rhodium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
18.12. Rh_2(1,3-diisocyanopropane)$_4^{2+}$ [triplet]—Continued							
18.12.5.	9,10-Dichloroanthracene	AN		21	7.3×10^8	LP/LUM/SST; τ_0 = 8.5 μs; ET	80A270
18.12.6.	*N,N*-Dimethylaniline	AN		21	$<1 \times 10^5$	LP/LUM/SST; τ_0 = 8.5 μs; RT	80A270
18.12.7.	*N*-Methyl-4-carbomethoxy-py$^+$	AN	μ = 0.0068 (TBAS)	21	1.0×10^9	LP/LUM/SST; τ_0 = 8.5 μs; OT	80A270
18.12.8.	*N*-Methylnicotinamide	AN	μ = 0.0067 (TBAS)	21	6.3×10^8	LP/LUM/SST; τ_0 = 8.5 μs; OT	80A270
18.12.9.	MV^{2+}	AN	μ = 0.013 (TBAS)	21	1.1×10^9	LP/LUM/SST; τ_0 = 8.5 μs; OT	80A270
18.12.10.	Nicotinamide	AN		21	$<1 \times 10^5$	LP/LUM/SST; τ_0 = 8.5 μs	80A270
18.12.11.	*trans*-Stilbene	AN		21	$\leq 4 \times 10^5$	LP/LUM/SST; τ_0 = 8.5 μs; ET	80A270
18.13. Rh(phen)$_3^{3+}$							
Inorganic Quenchers							
18.13.1.	Fe^{2+}	H_2O	μ = 1		4.0×10^9	LP/ABS/SST; τ_0 = 0.25 μs; RT; f = 1	84B055
Organic Quenchers							
18.13.2.	1,4-Dimethoxybenzene	H_2O			4.0×10^9	LP/ABS/SST; τ_0 = 0.41 μs; RT; f = 0.34	85F184
18.13.3.	1,2,4-Trimethoxybenzene	H_2O			4.0×10^9	LP/ABS/SST; τ_0 = 0.41 μs; RT; f = 0.30	85F184
18.14. *cis*-Rh(phen)$_2$Cl$_2^+$							
Organic Quenchers							
18.14.1.	1,2,4-Trimethoxybenzene	AN			4.1×10^8	LP/ABS/SST; τ_0 = 0.70 μs; RT; f = 0.065	85F184
18.15. Rh(5,10,15,20-tetraphenylporphyrin)Cl							
Organic Quenchers							
18.15.1.	MV^{2+}	EtOH			3.0×10^9	LP/ABS/SST; τ_0 = 38 μs; OT; f = 0.2; [Q] ≤ 3 × 10^{-4} mol/L	86A325
18.16. Rh(5,10,15,20-tetraphenylporphyrin)[OC(O)CH$_3$]							
Organic Quenchers							
18.16.1.	MV^{2+}	H_2O/DMF (1/1)		20	1.3×10^6	LP/LUM/SST; τ_0 = 0.14 ms; OT; [Q] = 0.0045-0.053 mol/L; $k_q = 8.8 \times 10^6$ with SS/LUM	82F217

TABLE 18. Quenching of excited rhodium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
18.17. Rh(5,10,15,20-tetraphenylporphyrin)(pyridine)Cl							
Organic Quenchers							
18.17.1.	MV^{2+}	EtOH	0.025 mol/L py		3.1×10^9	LP/ABS/SST; τ_0 = 0.37 μs; OT; [Q] ≤ 0.0013 mol/L	86A325

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.1. $Ru(5\text{-}Brphen)_3^{2+}$							
Inorganic Quenchers							
19.1.1.	$Co(AZAMEsar)^{3+}$	H_2O	μ = 0.2 (LiCl)	25	2.0×10^8	SS/LUM or LP/LUM/AVE; τ_0 = 1.0 μs (766404); ET, OT	84A238
19.1.2.	$Co(diAMsar)^{3+}$	H_2O	0.16 mol/L LiCl, 0.05 mol/L EtMO; pH 7.5	25	1.5×10^8	SS/LUM or LP/LUM/AVE; τ_0 = 1.0 μs (766404); ET, OT	84A238
19.1.3.	$Co(diAMsarH_2)^{5+}$	H_2O	0.1 mol/L HCl, 0.1 mol/L LiCl	25	5.9×10^8	SS/LUM or LP/LUM/AVE; τ_0 = 1.0 μs (766404); ET, OT	84A238
19.1.4.	$Co(sep)^{3+}$	H_2O	0.2 mol/L LiCl	25	2.8×10^8	SS/LUM; τ_0 = 1.0 μs (766404); ET, OT	84A238
	$Co(sep)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	2.2×10^8	SS/LUM; τ_0 = 1.0 μs (766404); ET, OT	84A238
19.1.5.	Cr^{3+}	H_2O	0.04 mol/L H_2SO_4; μ = 1.0 ($MgCl_2$)	25	1.3×10^7	SS/LUM; τ_0 = 1.0 μs (LP/LUM/AVE); ET	766404
19.1.6.	Cu^{2+}	H_2O	0.25 mol/L H_2SO_4; μ = 0.8-1	25	3.4×10^7	SL/LUM/SPC; τ_0 = 0.94 μs; $\Delta H^{\ddagger}$ = 11 kJ/mol; $\Delta S^{\ddagger}$ = −64 J/mol·K (20-80°C); OT	80A308
	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	4.2×10^7	SS/LUM; τ_0 = 1.0 μs (766404); OT; f = 0.30	78A090
19.1.7.	Eu^{3+}	H_2O	0.025 mol/L HCl, $[MgCl_2] + [Eu^{3+}]$ = 0.9 mol/L	25	$\leq 5 \times 10^4$	SS/LUM; τ_0 = 1.0 μs (LP/LUM/AVE); Q mainly as $EuCl^{2+}$	766404
19.1.8.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4	25	2.3×10^9	SS/LUM; τ_0 = 1.0 μs (LP/LUM/AVE); OT	766404
19.1.9.	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.09 mol/L $NaNO_3$		4.7×10^8	LP/LUM/AVE; τ_0 = 1.3 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.99 mol/L $NaNO_3$		5.8×10^8	LP/LUM/AVE; τ_0 = 1.3 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.01 mol/L SLS		2.9×10^6	LP/LUM/SST; τ_0 = 2.2 μs; OT	84N034
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		1.1×10^6	LP/LUM/SST; τ_0 = 2.2 μs; OT	84N034

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.1. $Ru(5\text{-}Brphen)_3^{2+}$—Continued							
19.1.10.	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, $[NaNO_3]$ + [NaCl] = 0.99 mol/L		1.8×10^9	LP/LUM/AVE; τ_0 = 1.3 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		~5×10^5	LP/LUM/SST; τ_0 = 2.2 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84N034
19.1.11.	$HgCl_4^{2-}$	H_2O	0.01 mol/L HNO_3, $[NaNO_3]$ + [NaCl] = 0.99 mol/L		2.5×10^8	LP/LUM/AVE; τ_0 = 1.3 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
19.1.12.	O_2	H_2O		25	4.0×10^9	SS/LUM; τ_0 = 1.0 μs (LP/LUM/AVE); OT?	766404
Organic Quenchers							
19.1.13.	Ascorbate ion	H_2O	pH 5; μ = 0.7 (Na_2SO_4)	25	9.7×10^8	SS/LUM; τ_0 = 1.0 μs (766404); RT	82A278
19.2. $Ru(4,4'\text{-}Bu_2bpy)_3^{2+}$							
Organic Quenchers							
19.2.1.	*N*-(4-Aminophenyl)aniline	AN	$\mu = 2 \times 10^{-4}$		3.0×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.11 μs; RT	85A248
19.2.2.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	$\mu = 2 \times 10^{-4}$		5.9×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.11 μs; RT	85A248
19.2.3.	1,4-Bis(*N*-phenylamino)benzene	AN	$\mu = 2 \times 10^{-4}$		1.9×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.11 μs; RT	85A248
19.2.4.	*N,N*-Dimethylaniline	AN	$\mu = 2 \times 10^{-4}$		1×10^5	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.11 μs; RT	85A248
19.2.5.	MV^{2+}	H_2O	μ = 0.5	20	7.1×10^8	SS/LUM; τ_0^{air} = 0.40 μs (SL/LUM/SPC); OT	82S159
19.2.6.	Phenothiazine	AN	$\mu = 2 \times 10^{-4}$		1.1×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.11 μs; RT	85A248
19.2.7.	4,*N,N*-Trimethylaniline	AN	$\mu = 2 \times 10^{-4}$		4.0×10^7	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.11 μs; RT	85A248
19.3. $Ru[4,4'\text{-}(COOBz)_2bpy]_3^{2+}$							
Organic Quenchers							
19.3.1.	*N,N*-Dimethylaniline	AN	0.1 mol/L TEAP	25	4.7×10^9	SS/LUM; τ_0 = 1.9 μs; RT	77F920
	N,N-Dimethylaniline	AN			4.7×10^9	EMI; τ_0 = 1.9 μs (SL/LUM/SPC); RT	776441
19.3.2.	1,2-Dinitrobenzene	AN	0.1 mol/L TEAP	25	2.3×10^6	SS/LUM; τ_0 = 1.9 μs; OT	77F920
19.3.3.	1,4-Dinitrobenzene	AN	0.1 mol/L TEAP	25	7.1×10^7	SS/LUM; τ_0 = 1.9 μs; OT	77F920
19.3.4.	Tetracyanoethene	AN	0.1 mol/L TEAP	25	4.0×10^9	SS/LUM; τ_0 = 1.9 μs; OT	77F920

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.4. $Ru[4,4'-(COOchl)_2bpy]_3^{2+}$							
Organic Quenchers							
19.4.1.	*N,N*-Dimethylaniline	AN	0.1 mol/L TEAP	25	2.3×10^9	SS/LUM; τ_0 = 2.1 μs; RT; τ in BuN	77F920
	N,N-Dimethylaniline	AN/BuN (3/1)			2.3×10^9	EMI; τ_0 = 2.1 μs (SL/LUM/SPC); RT	776441
19.4.2.	1,2-Dinitrobenzene	AN	0.1 mol/L TEAP	25	1.8×10^6	SS/LUM; τ_0 = 2.1 μs; OT; τ in BuN	77F920
19.4.3.	1,4-Dinitrobenzene	AN	0.1 mol/L TEAP	25	5.5×10^7	SS/LUM; τ_0 = 2.1 μs; OT; τ in BuN	77F920
19.4.4.	MV^{2+}	AN/BuN (3/1)			1.7×10^7	EMI; τ_0 = 2.1 μs (SL/LUM/SPC); OT	776441
	MV^{2+}	AN/BuN (1/1)	0.1 mol/L TEAP	25	1.7×10^7	SS/LUM; τ_0 = 2.1 μs; OT; τ in BuN	77F920
19.4.5.	Tetracyanoethene	AN	0.1 mol/L TEAP	25	3.1×10^9	SS/LUM; τ_0 = 2.1 μs; OT; τ in BuN	77F920
19.4.6.	Triphenylamine	AN	0.1 mol/L TEAP	25	3.5×10^9	SS/LUM; τ_0 = 2.1 μs; RT; τ in BuN	77F920
19.5. $Ru[4,4'-(COOcyc)_2bpy]_3^{2+}$							
Organic Quenchers							
19.5.1.	*N,N*-Dimethylaniline	AN	0.1 mol/L TEAP	25	4.5×10^9	SS/LUM; τ_0 = 2.2 μs; RT	77F920
	N,N-Dimethylaniline	AN			4.5×10^9	EMI; τ_0 = 2.2 μs (SL/LUM/SPC); RT	776441
19.5.2.	1,2-Dinitrobenzene	AN	0.1 mol/L TEAP	25	1.9×10^6	SS/LUM; τ_0 = 2.2 μs; OT	77F920
19.5.3.	1,4-Dinitrobenzene	AN	0.1 mol/L TEAP	25	6.0×10^7	SS/LUM; τ_0 = 2.2 μs; OT	77F920
19.5.4.	MV^{2+}	AN			1.7×10^8	EMI; τ_0 = 2.2 μs (SL/LUM/SPC); OT	776441
	MV^{2+}	AN/BuN (1/1)	0.1 mol/L TEAP	25	1.7×10^8	SS/LUM; τ_0 = 2.2 μs; OT; τ in AN	77F920
19.5.5.	Tetracyanoethene	AN	0.1 mol/L TEAP	25	8.8×10^9	SS/LUM; τ_0 = 2.2 μs; OT	77F920
19.5.6.	Triphenylamine	AN	0.1 mol/L TEAP	25	1.5×10^9	SS/LUM; τ_0 = 2.2 μs; RT	77F920
19.6. $Ru[4,4'-(COOdec)_2bpy]_3^{2+}$							
Organic Quenchers							
19.6.1.	*N,N*-Dimethylaniline	AN	0.1 mol/L TEAP	25	4.3×10^9	SS/LUM; τ_0 = 2.2 μs; RT	77F920
	N,N-Dimethylaniline	AN			4.3×10^9	EMI; τ_0 = 2.2 μs (SL/LUM/SPC); RT	776441
19.6.2.	1,2-Dinitrobenzene	AN	0.1 mol/L TEAP	25	2.0×10^6	SS/LUM; τ_0 = 2.2 μs; OT	77F920
19.6.3.	1,4-Dinitrobenzene	AN	0.1 mol/L TEAP	25	5.0×10^7	SS/LUM; τ_0 = 2.2 μs; OT	77F920

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.6. $Ru[4,4'\text{-}(COOdec)_2bpy]_3^{2+}$—Continued							
19.6.4.	Tetracyanoethene	AN	0.1 mol/L TEAP	25	7.1×10^9	SS/LUM; τ_0 = 2.2 μs; OT	77F920
19.7. $Ru[4,4'\text{-}(COOet)_2bpy]_3^{2+}$							
Organic Quenchers							
19.7.1.	OrgQue11	AN?			1.3×10^6	RT	86F005
19.7.2.	OrgQue12	AN?			1.4×10^6	RT	86F005
19.8. $Ru[4,4'\text{-}(COOnap)_2bpy]_3^{2+}$							
Organic Quenchers							
19.8.1.	*N,N*-Dimethylaniline	AN	0.1 mol/L TEAP	25	4.1×10^9	SS/LUM; τ_0 = 2.2 μs; RT	77F920
	N,N-Dimethylaniline	AN			4.1×10^9	EMI; τ_0 = 2.2 μs (SL/LUM/SPC); RT	776441
19.8.2.	1,2-Dinitrobenzene	AN	0.1 mol/L TEAP	25	2.5×10^6	SS/LUM; τ_0 = 2.2 μs; OT	77F920
19.8.3.	1,4-Dinitrobenzene	AN	0.1 mol/L TEAP	25	6.0×10^7	SS/LUM; τ_0 = 2.2 μs; OT	77F920
19.8.4.	MV^{2+}	AN			1.6×10^8	EMI; τ_0 = 2.2 μs (SL/LUM/SPC); OT	776441
	MV^{2+}	AN/BuN (1/1)	0.1 mol/L TEAP	25	1.6×10^8	SS/LUM; τ_0 = 2.2 μs; OT; τ in AN	77F920
19.8.5.	Tetracyanoethene	AN	0.1 mol/L TEAP	25	8.8×10^9	SS/LUM; τ_0 = 2.2 μs; OT	77F920
19.9. $Ru[4,4'\text{-}(COOpr)_2bpy]_3^{2+}$							
Organic Quenchers							
19.9.1.	Benzophenone-2-diazonium cation	AN			2.5×10^{10}	SS/LUM; OT	84F440
19.9.2.	*N,N*-Dimethylaniline	AN	0.1 mol/L TEAP	25	3.7×10^9	SS/LUM; τ_0 = 2.4 μs; RT	77F920
	N,N-Dimethylaniline	AN			3.7×10^9	EMI; τ_0 = 2.4 μs (SL/LUM/SPC); RT	776441
19.9.3.	1,4-Dinitrobenzene	AN	0.1 mol/L TEAP	25	8.1×10^7	SS/LUM; τ_0 = 2.4 μs; OT	77F920
19.9.4.	MV^{2+}	AN			1.2×10^8	EMI; τ_0 = 2.4 μs (SL/LUM/SPC); OT	776441
	MV^{2+}	AN/BuN (1/1)	0.1 mol/L TEAP	25	1.2×10^8	SS/LUM; τ_0 = 2.4 μs; OT; τ in AN	77F920
19.9.5.	OrgQue9	AN	0.1 mol/L TBAP		4.2×10^8	SS/LUM; OT	84F159
19.9.6.	Triethylamine	AN	0.1 mol/L TEAP	25	1.4×10^8	SS/LUM; τ_0 = 2.4 μs; RT	77F920
19.10. $Ru(4,4'\text{-}Cl_2bpy)_3^{2+}$							
Organic Quenchers							
19.10.1.	MV^{2+}	H_2O/AN (20/1)	μ = 0.5	20	7.5×10^8	SS/LUM; τ_0^{air} = 0.33 μs (SL/LUM/SPC); OT	82S159

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.11. $Ru(5\text{-Clphen})_3^{2+}$							
Inorganic Quenchers							
19.11.1.	$Co(AMMEsarH)^{4+}$	H_2O	0.1 mol/L HCl, 0.1 mol/L LiCl	25	2.3×10^8	SS/LUM or LP/LUM/AVE; τ_0 = 0.94 μs (766404); ET, OT	84A238
19.11.2.	$Co(bpy)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	2.7×10^7	SS/LUM; τ_0 = 0.94 μs (766404); OT	85S022
19.11.3.	$Co(bpy)_3^{2+}$	H_2O	0.16 mol/L Na_2SO_4, Pbuf; pH 7.8; μ = 0.5; $[Co^{II}]/[L]$ = 0.2	25	1.3×10^9	SS/LUM; τ_0 = 0.94 μs (766404); OT, ET	85S022
	$Co(bpy)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	7.9×10^7	SS/LUM; τ_0 = 0.94 μs (766404); OT, ET	85S022
19.11.4.	$Co(5\text{-Clphen})^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	1.7×10^8	SS/LUM; τ_0 = 0.94 μs (766404); OT	85S022
19.11.5.	$Co(5\text{-Clphen})_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	1.3×10^8	SS/LUM; τ_0 = 0.94 μs (766404); OT	85S022
19.11.6.	$Co(diAMsar)^{3+}$	H_2O	0.16 mol/L LiCl, 0.05 mol/L EtMC; pH 7.5	25	1.4×10^8	SS/LUM or LP/LUM/AVE; τ_0 = 0.94 μs (766404); ET, OT; f = 0.30 at pH 8.1	84A238
19.11.7.	$Co(en)_3^{3+}$	H_2O	ACbuf; pH 4.7; μ = 0.01 (NaCl)	25	4.8×10^7	SS/LUM; τ_0 = 0.94 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
19.11.8.	$Co(4,7\text{-Me}_2\text{phen})^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	2.4×10^8	SS/LUM; τ_0 = 0.94 μs (766404); OT	85S022
19.11.9.	$Co(4,7\text{-Me}_2\text{phen})_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	1.2×10^8	SS/LUM; τ_0 = 0.94 μs (766404); OT	85S022
19.11.10.	$Co(NH_3)_6^{3+}$	H_2O	ACbuf; pH 4.7; μ = 0.01 (NaCl)	25	3.2×10^7	SS/LUM; τ_0 = 0.94 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
19.11.11.	$Co(phen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	6.4×10^7	SS/LUM; τ_0 = 0.94 μs (766404); OT	85S022

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.11. $Ru(5\text{-}Clphen)_3^{2+}$—Continued							
19.11.12.	$Co(phen)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	9.8×10^7	SS/LUM; τ_0 = 0.94 μs (766404); OT	85S022
19.11.13.	$Co(sep)^{3+}$	H_2O	0.2 mol/L LiCl	25	2.7×10^8	SS/LUM; τ_0 = 0.94 μs (766404); ET, OT; f = 0.35	84A238
	$Co(sep)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	2.0×10^8	SS/LUM; τ_0 = 0.94 μs (766404); ET, OT	84A238
19.11.14.	Cr^{3+}	H_2O	0.04 mol/L H_2SO_4; μ = 1.0 ($MgCl_2$)	25	1.2×10^9	SS/LUM; τ_0 = 0.94 μs (LP/LUM/AVE); ET	766404
19.11.15.	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	4.0×10^7	SS/LUM; τ_0 = 0.94 μs (766404); OT; f = 0.31	78A090
19.11.16.	Eu^{2+}	H_2O	0.05 mol/L HCl; μ = 0.5 (NaCl)	25	1.0×10^8	SS/LUM; τ_0 = 0.94 μs (766404); RT; [Q] = 0.01-0.09 mol/L	78A087
19.11.17.	Eu^{3+}	H_2O	0.025 mol/L HCl, $[MgCl_2] + [Eu^{3+}]$ = 0.9 mol/L	25	$\leq 5 \times 10^4$	SS/LUM; τ_0 = 0.94 μs (LP/LUM/AVE); Q mainly as $EuCl^{2+}$	766404
19.11.18.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4	25	2.3×10^9	SS/LUM; τ_0 = 0.94 μs (LP/LUM/AVE); OT	766404
19.11.19.	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.063 ($NaNO_3$)	~23	6.1×10^7	LP/LUM/AVE; τ_0 = 1.1 μs; OT	84A148
	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.5 ($NaNO_3$)	~23	2.6×10^8	LP/LUM/AVE; τ_0 = 1.1 μs; OT	84A148
19.11.20.	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.09 mol/L $NaNO_3$		3.9×10^8	SS/LUM, LP/LUM/AVE; τ_0 = 1.2 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.99 mol/L $NaNO_3$		5.8×10^8	SS/LUM, LP/LUM/AVE; τ_0 = 1.2 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.01 mol/L SLS		2.5×10^6	LP/LUM/AVE; τ_0 = 2.1 μs; OT	84N034
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		1.4×10^6	LP/LUM/AVE; τ_0 = 2.2 μs; OT	84N034
19.11.21.	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, $[NaNO_3] + [NaCl]$ = 0.99 mol/L		2.5×10^9	LP/LUM/AVE; τ_0 = 1.2 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.11.	**$Ru(5\text{-}Clphen)_3^{2+}$**—Continued						
	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		$<9 \times 10^4$	LP/LUM/AVE; τ_0 = 2.2 μs; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84N034
19.11.22.	$HgCl_4^{2-}$	H_2O	0.01 mol/L HNO_3, $[NaNO_3]$ + $[NaCl]$ = 0.99 mol/L		1.1×10^8	LP/LUM/AVE; τ_0 = 1.2 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
19.11.23.	O_2	H_2O		25	3.4×10^9	SS/LUM; τ_0 = 0.94 μs (LP/LUM/AVE); OT?	766404
19.11.24.	$Os(bpy)_3^{2+}$	H_2O	μ = 1.0 (Na_2SO_4)	25	2.5×10^9	LP/LUM/SST; τ_0 = 0.94 μs; ET, RT; [Q] ≤ 0.005 mol/L	80E040
19.11.25.	$Os(NH_3)_6^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	$\leq 9 \times 10^6$	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.11.26.	$Os(NH_3)_5Cl^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	$\leq 2 \times 10^7$	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.11.27.	$Os(NH_3)_5(H_2O)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	$\leq 5 \times 10^6$	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.11.28.	$Os(NH_3)_5I^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	3.2×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.11.29.	$Os(NH_3)_5(N_2)^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	5.2×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); RT; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.11.30.	$Rh(bpy)_3^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	4.1×10^8	SS/LUM or LP/LUM/SST; OT	81N003
	$Rh(bpy)_3^{3+}$	H_2O	0.5 mol/L NaOH; μ = 0.5	25	2.8×10^8	SS/LUM or LP/LUM/SST; OT	81N003
	$Rh(bpy)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	2.1×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); OT	82A145
19.11.31.	*cis*-$Rh(bpy)_2(H_2O)_2^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	2.9×10^8	SS/LUM or LP/LUM/SST; OT	81N003

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.11. $Ru(5\text{-}Clphen)_3^{2+}$—Continued							
19.11.32.	*cis*-$Rh(bpy)_2(OH)_2^+$	H_2O	0.5 mol/L NaOH; μ = 0.5	25	1.1×10^7	SS/LUM or LP/LUM/SST; ET	81N003
19.11.33.	$Rh(4,4'\text{-}Me_2bpy)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1×10^6	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); OT	82A145
19.11.34.	$Rh(5\text{-}Mephen)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.6×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); OT	82A145
19.11.35.	$Rh(phen)_3^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	5.7×10^8	SS/LUM or LP/LUM/SST; OT	81N003
19.11.36.	Ti^{3+}	H_2O	1.5 mol/L HCl; μ = 3.0 (LiCl)	25	6.2×10^6	LP/LUM/SST; τ_0 = 0.72 μs; ET; 20-60% Ti^{3+} coordinated by Cl^-	79A183
Organic Quenchers							
19.11.37.	Ascorbate ion	H_2O	pH 5; μ = 0.7 (Na_2SO_4)	25	1.1×10^9	SS/LUM; τ_0 = 0.94 μs (766404); RT	82A278
19.11.38.	$bpyH_2^{2+}$	H_2O	μ = 0.5 (HCl, NaCl)	25	1.7×10^9	SS/LUM; τ_0 = 0.94 μs (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; k_q from pH dependence of K_{SV}	83C017
19.11.39.	*N,N'*-Dibenzyl-vio^{2+}	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.9×10^9	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); OT; [Q] = (3-50) $\times 10^{-4}$ mol/L	82A145
19.11.40.	4,4'-Dimethyl-$bpyH_2^{2+}$	H_2O	μ = 0.5 (HCl, NaCl)	25	1.8×10^9	SS/LUM; τ_0 = 0.94 μs (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; k_q from pH dependence of K_{SV}	83C017
19.11.41.	DQ^{2+}	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.9×10^9	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); OT; [Q] = (3-50) $\times 10^{-4}$ mol/L	82A145
	DQ^{2+}	H_2O	μ = 0.5 (HCl, NaCl)	25	3.1×10^9	SS/LUM; τ_0 = 0.94 μs; [Q] = (5-50) $\times 10^{-4}$ mol/L	83C017
19.11.42.	*N,N'*-Ethylene-4,4'-dimethyl-bpy^{2+}	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.5×10^9	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); OT; [Q] = (3-50) $\times 10^{-4}$ mol/L	82A145
19.11.43.	MV^{2+}	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.3×10^9	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); OT; [Q] = (3-50) $\times 10^{-4}$ mol/L	82A145
19.11.44.	$phenH^+$	H_2O	μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	2.3×10^7	SS/LUM; τ_0 = 0.94 μs (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; k_q from pH dependence of K_{SV}	83C017

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.11.	**$Ru(5\text{-}Clphen)_3^{2+}$**—Continued						
	$phenH^+$	H_2O	μ = 0.5 (HCl, NaCl)	25	3×10^7	SS/LUM; τ_0 = 0.94 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.11.45.	$phenH_2^{2+}$	H_2O	μ = 0.5 (HCl, NaCl)	25	6.4×10^8	SS/LUM; τ_0 = 0.94 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.11.46.	*N,N'*-(Tetramethylene)-bpy^{2+}	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	4.2×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.94 μs (766404); OT	82A145
19.12.	**$Ru[4\text{-}(Et_3P)bpy]_3^{5+}$**						
	Inorganic Quenchers						
19.12.1.	$Co(bpy)_3^{3+}$	H_2O	0.33 mol/L Na_2SO_4; 0.028 mol/L $NaHSO_4$; μ = 1.0		1.8×10^8	SS/LUM; τ_0 = 0.76 μs (LP/LUM/SST); OT	82F048
19.12.2.	$Co[4\text{-}(NO_2)bpy]_3^{3+}$	H_2O	0.33 mol/L Na_2SO_4; 0.028 mol/L $NaHSO_4$; μ = 1.0		6.6×10^7	SS/LUM; τ_0 = 0.76 μs (LP/LUM/SST); OT	82F048
19.12.3.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4		1.5×10^9	SS/LUM; τ_0 = 0.76 μs (LP/LUM/SST); OT	82F048
	Organic Quenchers						
19.12.4.	bpy	H_2O	0.33 mol/L Na_2SO_4; 0.028 mol/L $NaHSO_4$; μ = 1.0		4×10^6	SS/LUM; τ_0 = 0.76 μs (LP/LUM/SST); OT	82F048
19.12.5.	4-Nitro-bpy	H_2O	0.33 mol/L Na_2SO_4; 0.028 mol/L $NaHSO_4$; μ = 1.0		5.7×10^8	SS/LUM; τ_0 = 0.76 μs (LP/LUM/SST); OT	82F048
19.12.6.	4-(Triethylphosphonio)-bpy cation	H_2O	0.33 mol/L Na_2SO_4; 0.028 mol/L $NaHSO_4$; μ = 1.0		2.7×10^7	SS/LUM; τ_0 = 0.76 μs (LP/LUM/SST); OT	82F048
19.13.	**$Ru(3,3'\text{-}Me_2bpy)_3^{2+}$**						
	Inorganic Quenchers						
19.13.1.	$Eu(crypt)^{2+}$	H_2O	1 mol/L KCl	~22	1.3×10^9	SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L	86E195

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.13. $Ru(3,3'\text{-}Me_2bpy)_3^{2+}$—Continued							
19.13.2.	$Eu(crypt)^{3+}$	H_2O	1 mol/L KCl	~22	5.6×10^7	SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L	86E195
19.14. $Ru(4,4'\text{-}Me_2bpy)_3^{2+}$							
Inorganic Quenchers							
19.14.1.	$Co(AMcapten)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.3×10^9	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.13	85F222
19.14.2.	$Co(AMMEsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	8.0×10^7	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.10	85F222
19.14.3.	$Co(AZAcapten)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.5×10^9	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT	85F222
19.14.4.	$Co(AZAMEsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	9.0×10^7	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.14	85F222
19.14.5.	$Co(bpy)_3^{2+}$	H_2O	0.16 mol/L Na_2SO_4, Pbuf; pH 7.8; μ = 0.5; $[Co^{II}]/[L]$ = 0.2	25	1.2×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT, ET	85S022
19.14.6.	$Co(CLHOsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	3.7×10^8	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.19	85F222
19.14.7.	$Co(CLNOsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	5.8×10^8	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.18	85F222
19.14.8.	$Co(CLsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	2.4×10^8	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.25	85F222
19.14.9.	$Co(CMMEabsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	5×10^7	LP/LUM/SST; τ_0 = 0.35 μs; ET	85F222
19.14.10.	*lel*$_3$-$Co(diAMchar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.9×10^8	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.39	85F222
19.14.11.	$Co(diAMsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.1×10^8	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.17	85F222
19.14.12.	*lel*$_3$-$Co(diAZAchar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	2.5×10^8	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.11	85F222
19.14.13.	$Co(diCLsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	4.6×10^8	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.18	85F222
19.14.14.	$Co(diNOsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	7.7×10^8	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.20	85F222
19.14.15.	$Co(EFMEoxosar\text{-}H)^{2+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	7×10^7	LP/LUM/SST; τ_0 = 0.35 μs; ET	85F222
19.14.16.	$Co(MENOsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	3.8×10^8	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT	85F222

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.14. $Ru(4,4'\text{-}Me_2bpy)_3^{2+}$—Continued							
19.14.17.	$Co(NH_3)_6^{3+}$	H_2O	0.1 mol/L H_2SO_4	~22	9×10^6	SS/LUM; τ_0^{air} = 0.24 μs (LP/LUM/AVE); OT	84A255
19.14.18.	$Co(sar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	5.9×10^7	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.056	85F222
19.14.19.	$Co(sep)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	2.4×10^8	LP/LUM/SST; τ_0 = 0.35 μs; ET, OT; f = 0.10	85F222
	$Co(sep)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	4.5×10^8	SS/LUM; τ_0 = 0.33 μs (766404); ET, OT	84A238
19.14.20.	Cr^{3+}	H_2O	0.04 mol/L H_2SO_4; μ = 1.0 ($MgCl_2$)	25	1.0×10^7	SS/LUM; τ_0 = 0.33 μs (LP/LUM/AVE); ET	766404
19.14.21.	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	9.7×10^7	SS/LUM; τ_0 = 0.33 μs (766404); OT; f = 0.94	78A090
19.14.22.	Eu^{2+}	H_2O	0.05 mol/L HCl; μ = 0.5 (NaCl)	25	1.5×10^6	LP/LUM/SST; τ_0 = 0.33 μs (766404); RT; [Q] = 0.01-0.09 mol/L	78A087
19.14.23.	Eu^{3+}	H_2O	0.025 mol/L HCl, [$MgCl_2$] + [Eu^{3+}] = 0.9 mol/L	25	$\sim 5 \times 10^5$	SS/LUM; τ_0 = 0.33 μs (LP/LUM/AVE); OT; Q mainly as $EuCl^{2+}$	766404
19.14.24.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4	25	2.9×10^9	SS/LUM; τ_0 = 0.33 μs (LP/LUM/AVE); OT	766404
	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4		3.3×10^9	FP/PCM/SST; τ_0 = 0.33 μs (766404); OT, ET?; [Q] = 0.005 mol/L; [Fe^{2+}] = [Fe^{3+}]; see Mech. [8]	80E224
19.14.25.	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.063 ($NaNO_3$)	~23	4.4×10^7	LP/LUM/AVE; τ_0 = 0.37 μs; OT	84A148
	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.5 ($NaNO_3$)	~23	1.9×10^8	LP/LUM/AVE; τ_0 = 0.36 μs; OT	84A148
19.14.26.	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.09 mol/L $NaNO_3$		1.5×10^9	LP/LUM/AVE; τ_0 = 0.34 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.99 mol/L $NaNO_3$		1.9×10^9	LP/LUM/AVE; τ_0 = 0.34 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.01 mol/L SLS		1.9×10^7	LP/LUM/AVE; τ_0 = 0.56 μs; OT	84N034

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.14.	**$Ru(4,4'\text{-}Me_2bpy)_3^{2+}$**—Continued						
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		1.2×10^7	LP/LUM/AVE; τ_0 = 0.56 μs; OT	84N034
19.14.27.	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, [$NaNO_3$] + [NaCl] = 0.99 mol/L		5.1×10^9	LP/LUM/AVE; τ_0 = 0.34 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		$\sim 6 \times 10^6$	LP/LUM/AVE; τ_0 = 0.56 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84N034
19.14.28.	$HgCl_4^{2-}$	H_2O	0.01 mol/L HNO_3, [$NaNO_3$] + [NaCl] = 0.99 mol/L		7.2×10^8	LP/LUM/AVE; τ_0 = 0.34 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
19.14.29.	O_2	H_2O		25	4.2×10^9	SS/LUM; τ_0 = 0.33 μs (LP/LUM/AVE); OT?	766404
19.14.30.	$Rh(bpy)_3^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	1.1×10^9	SS/LUM or LP/LUM/SST; OT	81N003
	$Rh(bpy)_3^{3+}$	H_2O	0.5 mol/L NaOH; μ = 0.5	25	7.7×10^8	SS/LUM or LP/LUM/SST; OT	81N003
19.14.31.	*cis*-$Rh(bpy)_2(H_2O)_2^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	7.8×10^8	SS/LUM or LP/LUM/SST; OT	81N003
19.14.32.	*cis*-$Rh(bpy)_2(OH)_2^+$	H_2O	0.5 mol/L NaOH; μ = 0.5	25	1.8×10^7	SS/LUM or LP/LUM/SST; ET	81N003
19.14.33.	$Rh(phen)_3^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	1.4×10^9	SS/LUM or LP/LUM/SST; OT	81N003
	Organic Quenchers						
19.14.34.	Ascorbate ion	H_2O	pH 5; μ = 0.7 (Na_2SO_4)	25	2×10^6	SS/LUM; τ_0 = 0.33 μs (766404); RT	82A278
19.14.35.	$bpyH^+$	H_2O	μ = 0.5 (HCl, NaCl)	25	6.1×10^8	SS/LUM; τ_0 = 0.33 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
	$bpyH^+$	H_2O	μ = 0.5 (HBr, NaBr)	25	8.5×10^8	SS/LUM; τ_0 = 0.33 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
	$bpyH^+$	H_2O	μ = 0.5 (HNO_3, $NaNO_3$)	25	8.0×10^8	SS/LUM; τ_0 = 0.33 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.14.	**$Ru(4,4'\text{-}Me_2bpy)_3^{2+}$**—Continued						
	$bpyH^+$	H_2O	μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	3.6×10^8	SS/LUM; τ_0 = 0.33 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.14.36.	$bpyH_2^{2+}$	H_2O	μ = 0.5 (HCl, NaCl)	25	2.6×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.14.37.	4,4'-Dimethyl-$bpyH_2^{2+}$	H_2O	μ = 0.5 (HCl, NaCl)	25	2.2×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
	4,4'-Dimethyl-$bpyH_2^{2+}$	H_2O	μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	2.9×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.14.38.	DQ^{2+}	H_2O	0.1 mol/L LiCl	25	2.4×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.1 mol/L NaCl	25	2.4×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.1 mol/L KCl	25	2.5×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.1 mol/L RbCl	25	2.5×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.1 mol/L CsCl	25	2.5×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.1 mol/L TMAC	25	2.3×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.1 mol/L TEAC	25	2.3×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.1 mol/L TPrAC	25	2.2×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.1 mol/L TBAC	25	2.1×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.1 mol/L TPeAC	25	2.0×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.1 mol/L TPrAB	25	2.7×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.14.	**$Ru(4,4'\text{-}Me_2bpy)_3^{2+}$**—Continued						
	DQ^{2+}	H_2O	0.1 mol/L TBAB	25	2.6×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.5 mol/L HCl	25	3.5×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.5 mol/L HBr	25	4.4×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.5 mol/L LiCl	25	3.5×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.5 mol/L NaCl	25	3.6×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.5 mol/L KCl	25	3.7×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.5 mol/L RbCl	25	3.8×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.5 mol/L CsCl	25	3.8×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	0.5 mol/L LiBr	25	4.6×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT	85S022
	DQ^{2+}	H_2O	μ = 0.5 (HF, NaF)	25	2.4×10^9	SS/LUM; τ_0 = 0.33 μs (766404); [Q] = (5-50) × 10^{-4} mol/L	83C017
	DQ^{2+}	H_2O	μ = 0.5 (HCl, NaCl)	25	3.6×10^9	SS/LUM; τ_0 = 0.33 μs (766404); [Q] = (5-50) × 10^{-4} mol/L	83C017
	DQ^{2+}	H_2O	μ = 0.5 (HBr, NaBr)	25	4.4×10^9	SS/LUM; τ_0 = 0.33 μs (766404); [Q] = (5-50) × 10^{-4} mol/L	83C017
	DQ^{2+}	H_2O	μ = 0.5 (HI, NaI)	25	5.8×10^9	SS/LUM; τ_0 = 0.33 μs (766404); [Q] = (5-50) × 10^{-4} mol/L	83C017
	DQ^{2+}	H_2O	μ = 0.5 (HNO_3, $NaNO_3$)	25	4.4×10^9	SS/LUM; τ_0 = 0.33 μs (766404); [Q] = (5-50) × 10^{-4} mol/L	83C017
	DQ^{2+}	H_2O	pH <1; μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	2.8×10^9	SS/LUM; τ_0 = 0.33 μs (766404); [Q] = (5-50) × 10^{-4} mol/L	83C017
	DQ^{2+}	H_2O	pH >2; μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	2.4×10^9	SS/LUM; τ_0 = 0.33 μs (766404); [Q] = (5-50) × 10^{-4} mol/L	83C017

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.14. $Ru(4,4'\text{-}Me_2bpy)_3^{2+}$—Continued							
19.14.39.	MV^{2+}	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.1×10^9	LP/LUM/SST; τ_0 = 0.35 μs; OT	85F222
19.14.40.	$phenH^+$	H_2O	μ = 0.5 (HCl, NaCl)	25	2.4×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
	$phenH^+$	H_2O	μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	2.1×10^9	SS/LUM; τ_0 = 0.33 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.15. $Ru(3,4,7,8\text{-}Me_4phen)_3^{2+}$							
Inorganic Quenchers							
19.15.1.	$Co(sep)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	6.9×10^8	SS/LUM; τ_0 = 1.4 μs (766404); ET, OT	84A238
19.15.2.	Cu^{2+}	H_2O	0.25 mol/L H_2SO_4; μ = 0.8-1	25	6.5×10^7	SL/LUM/SPC; τ_0 = 1.5 μs; $\Delta H^{\ddagger}$ = 19 kJ/mol; $\Delta S^{\ddagger}$ = −32 J/mol·K (20-80°C); OT	80A308
	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	1.0×10^8	SS/LUM; τ_0 = 1.4 μs (766404); OT; f = 0.95	78A090
	Cu^{2+}	H_2O	0.5 mol/L Li_2SO_4	25	8.8×10^7	SS/LUM; τ_0 = 1.5 μs (LP/LUM/AVE); OT	78A090
19.15.3.	$CuCl^+$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	2.3×10^8	SL/LUM/SPC; OT; k_q from k_{obs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031
19.15.4.	$CuCl_2$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	2.2×10^9	SL/LUM/SPC; OT; k_q from k_{obs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.15. $Ru(3,4,7,8\text{-}Me_4phen)_3^{2+}$—Continued							
19.15.5.	$Cu(H_2O)_n^{2+}$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	4.8×10^7	SL/LUM/SPC; OT; k_q from k_{obs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031
19.15.6.	$Eu(crypt)^{3+}$	H_2O	1 mol/L KCl	~22	3.4×10^7	SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L	86E195
19.15.7.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4	25	3.4×10^9	SS/LUM; τ_0 = 1.4 μs (LP/LUM/AVE); OT	766404
19.15.8.	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.09 mol/L $NaNO_3$		3.0×10^9	LP/LUM/AVE; τ_0 = 2.3 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.01 mol/L SLS		7.5×10^7	LP/LUM/AVE; τ_0 = 1.9 μs; OT	84N034
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		6.1×10^7	LP/LUM/AVE; τ_0 = 2.2 μs; OT; [Q] ≤ 0.02 mol/L	84N034
19.15.9.	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		2.6×10^7	LP/LUM/AVE; τ_0 = 2.2 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84N034
19.15.10.	O_2	H_2O		25	5.8×10^9	SS/LUM; τ_0 = 1.4 μs (LP/LUM/AVE); OT?	766404
19.15.11.	$Os(NH_3)_6^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	7.9×10^7	SS/LUM or LP/LUM/SST; τ_0 = 1.4 μs (766404); OT, ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.15.12.	$Os(NH_3)_5Cl^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	4.2×10^8	SS/LUM or LP/LUM/SST; τ_0 = 1.4 μs (766404); OT, ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.15.13.	$Os(NH_3)_5(H_2O)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	1.4×10^8	SS/LUM or LP/LUM/SST; τ_0 = 1.4 μs (766404); OT, ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.15.14.	$Os(NH_3)_5I^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	8.5×10^8	SS/LUM or LP/LUM/SST; τ_0 = 1.4 μs (766404); OT, ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.15. $Ru(3,4,7,8\text{-}Me_4phen)_3^{2+}$—Continued							
19.15.15.	Ti^{3+}	H_2O	1.5 mol/L HCl; μ = 3.0 (LiCl)	25	3.7×10^6	LP/LUM/SST; τ_0 = 1.0 μs; τ_0 extrap'd to [Q] = 0; intercept of S-V plot is not 1.0; 20-60% Ti^{3+} coordinated by Cl^-	79A183
Organic Quenchers							
19.15.16.	Ascorbate ion	H_2O	pH 5; μ = 0.7 (Na_2SO_4)	25	1.1×10^7	SS/LUM; τ_0 = 1.4 μs (766404); RT	82A278
19.15.17.	$bpyH^+$	H_2O	μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	3.5×10^9	SS/LUM; τ_0 = 1.4 μs (766404); OT; [Q] = (5-50) $\times 10^{-4}$ mol/L; k_q from pH dependence of K_{SV}	83C017
19.16. $Ru(3,5,6,8\text{-}Me_4phen)_3^{2+}$							
Inorganic Quenchers							
19.16.1.	$Co(sep)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	3.0×10^8	SS/LUM; τ_0 = 2.2 μs (766404); ET, OT	84A238
19.16.2.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4	25	2.5×10^9	SS/LUM; τ_0 = 2.1 μs (LP/LUM/AVE); OT	766404
19.16.3.	O_2	H_2O		25	3.6×10^9	SS/LUM; τ_0 = 2.2 μs (LP/LUM/AVE); OT?	766404
19.16.4.	$Os(NH_3)_5(H_2O)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	4.9×10^7	SS/LUM or LP/LUM/SST; τ_0 = 2.2 μs (766404); OT, ET?; [Q] = (3-200) $\times 10^{-4}$ mol/L	82A145
19.16.5.	$Os(NH_3)_5I^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	6.6×10^8	SS/LUM or LP/LUM/SST; τ_0 = 2.2 μs (766404); OT, ET?; [Q] = (3-200) $\times 10^{-4}$ mol/L	82A145
Organic Quenchers							
19.16.6.	Ascorbate ion	H_2O	pH 5; μ = 0.7 (Na_2SO_4)	25	3.6×10^7	SS/LUM; τ_0 = 2.2 μs (766404); RT	82A278
19.17. $Ru(4,7\text{-}Me_2phen)_3^{2+}$							
Inorganic Quenchers							
19.17.1.	$Co(AMMEsarH)^{4+}$	H_2O	0.1 mol/L HCl, 0.1 mol/L LiCl	25	7.4×10^8	SS/LUM or LP/LUM/AVE; τ_0 = 1.7 μs (766404); ET, OT	84A238
19.17.2.	$Co(AZAMEsar)^{3+}$	H_2O	μ = 0.2 (LiCl)	25	8.4×10^8	SS/LUM or LP/LUM/AVE; τ_0 = 1.7 μs (766404); ET, OT	84A238

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.17. $Ru(4,7\text{-}Me_2phen)_3^{2+}$—Continued							
19.17.3.	$Co(bpy)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	2.9×10^7	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
	$Co(bpy)^{2+}$	H_2O	0.5 mol/L NaF, 0.025 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	9.6×10^7	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
	$Co(bpy)^{2+}$	H_2O	0.5 mol/L NaCl, 0.025 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	1.5×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
	$Co(bpy)^{2+}$	H_2O	0.5 mol/L NaBr, 0.025 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	1.8×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
	$Co(bpy)^{2+}$	H_2O	0.17 mol/L Na_2SO_4, 0.025 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	1.0×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
19.17.4.	$Co(bpy)_3^{+}$	AN	0.1 mol/L TEAP	25	3.8×10^9	LP/LUM/AVE; τ_0 = 1.1 μs; RT	86A077
19.17.5.	$Co(bpy)_3^{2+}$	AN	0.1 mol/L TEAP	25	1.9×10^8	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); OT, ET?	86A077
	$Co(bpy)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	1.0×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT, ET	85S022
	$Co(bpy)_3^{2+}$	H_2O	0.16 mol/L Na_2SO_4, Pbuf; pH 7.8; μ = 0.5; $[Co^{II}]/[L]$ = 0.2	25	1.6×10^9	SS/LUM; τ_0 = 1.7 μs (766404); OT, ET	85S022
19.17.6.	$Co(5\text{-}Brphen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	3.4×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
19.17.7.	$Co(5\text{-}Clphen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	2.8×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
19.17.8.	$Co(5\text{-}Clphen)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	1.4×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.17.	**$Ru(4,7\text{-}Me_2phen)_3^{2+}$**—Continued						
19.17.9.	$Co(diAMsar)^{3+}$	H_2O	0.16 mol/L LiCl, 0.05 mol/L EtMO; pH 7.5	25	5.8×10^8	SS/LUM; τ_0 = 1.7 μs (766404); ET, OT; f = 0.90 at pH 8.3	84A238
19.17.10.	$Co(diAMsarH_2)^{5+}$	H_2O	0.1 mol/L HCl, 0.1 mol/L LiCl	25	1.1×10^9	SS/LUM, LP/LUM/AVE; τ_0 = 1.7 μs (766404); ET, OT	84A238
19.17.11.	$Co(en)_3^{3+}$	H_2O	ACbuf; pH 4.7; μ = 0.01 (NaCl)	25	1.1×10^8	SS/LUM; τ_0 = 1.7 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
19.17.12.	$Co(4,4'\text{-}Me_2bpy)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	7.4×10^7	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
19.17.13.	$Co(2,9\text{-}Me_2phen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	5.4×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
19.17.14.	$Co(4,7\text{-}Me_2phen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	4.3×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
19.17.15.	$Co(4,7\text{-}Me_2phen)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	1.4×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
19.17.16.	$Co(5\text{-}Mephen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	2.0×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
19.17.17.	$Co(5,6\text{-}Me_2phen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	3.0×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
19.17.18.	$Co(NH_3)_6^{3+}$	H_2O	0.1 mol/L H_2SO_4	~22	2.3×10^7	SS/LUM; τ_0^{air} = 0.52 μs (LP/LUM/AVE); OT	84A255
	$Co(NH_3)_6^{3+}$	H_2O	ACbuf; pH 4.7; μ = 0.01 (NaCl)	25	7.7×10^7	SS/LUM; τ_0 = 1.7 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
19.17.19.	$Co(phen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	1.6×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
19.17.20.	$Co(phen)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	1.1×10^8	SS/LUM; τ_0 = 1.7 μs (766404); OT	85S022
19.17.21.	$Co(sep)^{3+}$	H_2O	0.2 mol/L LiCl	25	9.5×10^8	SS/LUM; τ_0 = 1.7 μs (766404); ET, OT; f = 0.64	84A238

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.17.	**$Ru(4,7\text{-}Me_2phen)_3^{2+}$**—Continued						
	$Co(sep)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	7.0×10^8	SS/LUM; τ_0 = 1.7 μs (766404); ET, OT	84A238
19.17.22.	Cr^{3+}	H_2O	0.04 mol/L H_2SO_4; μ = 1.0 ($MgCl_2$)	25	1.3×10^7	SS/LUM; τ_0 = 1.7 μs (LP/LUM/AVE); ET; [Q] ≤ 0.006 mol/L	766404
19.17.23.	Cu^{2+}	D_2O	0.25 mol/L H_2SO_4; μ = 0.8-1	25	7.8×10^7	SL/LUM/SPC; τ_0 = 2.2 μs; $\Delta H^\ddagger$ = 20 kJ/mol; $\Delta S^\ddagger$ = −26 J/mol·K (20-80°C). OT	80A308
	Cu^{2+}	H_2O	μ = 0.12 ($NaNO_3$)	25	8.6×10^7 (calc)	LP/LUM/SST; τ_0 = 1.6 μs; OT	85N199
	Cu^{2+}	H_2O	μ = 0.18 ($NaNO_3$)	25	7.7×10^7 (calc)	LP/LUM/SST; τ_0 = 1.7 μs (83N004); OT	85N199
	Cu^{2+}	H_2O	0.25 mol/L H_2SO_4; μ = 0.8-1	25	7.9×10^7	SL/LUM/SPC; τ_0 = 1.6 μs; $\Delta H^\ddagger$ = 18 kJ/mol; $\Delta S^\ddagger$ = −34 J/mol·K (20-80°C). OT	80A308
	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	8.6×10^7	SS/LUM; τ_0 = 1.7 μs (766404); OT; f = 0.96	78A090
19.17.24.	$CuCl^+$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	3.2×10^8	SL/LUM/SPC; OT; k_q from k_{obs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031
19.17.25.	$CuCl_2$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	2.6×10^9	SL/LUM/SPC; OT; k_q from k_{obs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031
19.17.26.	$Cu(H_2O)_6^{2+}$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	7.8×10^7	SL/LUM/SPC; OT; k_q from k_{obs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.17. $Ru(4,7\text{-}Me_2phen)_3^{2+}$—Continued							
19.17.27.	Eu^{2+}	H_2O	0.05 mol/L HCl; μ = 0.5 (NaCl)	25	7.0×10^6	SS/LUM; τ_0 = 1.7 μs (766404); RT	78A087
19.17.28.	Eu^{3+}	H_2O	0.025 mol/L HCl, $[MgCl_2] + [Eu^{3+}]$ = 0.9 mol/L	25	2.1×10^6	SS/LUM; τ_0 = 1.7 μs (LP/LUM/AVE); OT; [Q] ≤ 0.5 mol/L; Q mainly as $EuCl^{2+}$	766404
	Eu^{3+}	H_2O	0.025 mol/L HCl; μ = 2.8 ($MgCl_2$)	25	1.3×10^6	SL/LUM/SPC; τ_0 = 1.6 μs; $\Delta H^{\ddagger}$ = 25 kJ/mol; $\Delta S^{\ddagger}$ = −44 J/mol·K (20-80°C); OT; Q mainly as $EuCl^{2+}$	80A308
19.17.29.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4	25	3.0×10^9	SS/LUM; τ_0 = 1.7 μs (LP/LUM/AVE); OT	766404
19.17.30.	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.063 ($NaNO_3$)	~23	9.5×10^7	LP/LUM/AVE; τ_0 = 1.9 μs; OT	84A148
	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.5 ($NaNO_3$)	~23	3.8×10^8	LP/LUM/AVE; τ_0 = 1.6 μs; OT	84A148
19.17.31.	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.09 mol/L $NaNO_3$		2.8×10^9	LP/LUM/AVE; τ_0 = 1.9 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.99 mol/L $NaNO_3$		2.8×10^9	LP/LUM/AVE; τ_0 = 1.9 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.01 mol/L SLS		3.0×10^7	LP/LUM/AVE; τ_0 = 3.3 μs; OT	84N034
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		2.4×10^7	LP/LUM/AVE; τ_0 = 3.4 μs; OT	84N034
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, $[NaNO_3] + [NaCl]$ = 0.40 mol/L, 0.01 mol/L SLS		2.3×10^7	LP/LUM/AVE; τ_0 = 3.5 μs; OT	84N034
19.17.32.	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, $[NaNO_3] + [NaCl]$ = 0.99 mol/L		8.5×10^9	LP/LUM/AVE; τ_0 = 1.9 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		1.2×10^7	LP/LUM/AVE; τ_0 = 3.4 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84N034

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.17.	**$Ru(4,7\text{-}Me_2phen)_3^{2+}$**—Continued						
19.17.33.	$HgCl_4^{2-}$	H_2O	0.01 mol/L HNO_3, $[NaNO_3]$ + [NaCl] = 0.99 mol/L		1.0×10^9	LP/LUM/AVE; τ_0 = 1.9 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
19.17.34.	O_2	H_2O		25	4.5×10^9	SS/LUM; τ_0 ≈ 1.7 μs (LP/LUM/AVE); OT?	766404
19.17.35.	$Os(bpy)_3^{2+}$	H_2O	μ = 1.0 (Na_2SO_4)	25	2.5×10^9	LP/LUM/SST; τ_0 = 1.7 μs; ET; [Q] ≤ 0.005 mol/L	80E040
19.17.36.	$Os(NH_3)_6^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	5.0×10^7	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); OT, ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.17.37.	$Os(NH_3)_5Cl^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	3.0×10^8	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); OT, ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.17.38.	$Os(NH_3)_5(H_2O)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	8.7×10^7	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); OT, ET?; [Q] ≈ (3-200) × 10^{-4} mol/L	82A145
19.17.39.	$Os(NH_3)_5(N_2)^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	$\leq 3 \times 10^7$	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); RT; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.17.40.	$Rh(bpy)_3^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	1.3×10^9	SS/LUM or LP/LUM/SST; OT	81N003
	$Rh(bpy)_3^{3+}$	H_2O	0.5 mol/L NaOH; μ = 0.5	25	9.9×10^8	SS/LUM or LP/LUM/SST; OT	81N003
	$Rh(bpy)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	9×10^8	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); OT	82A145
19.17.41.	*cis*-$Rh(bpy)_2(H_2O)_2^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	1.4×10^9	SS/LUM or LP/LUM/SST; OT	81N003
19.17.42.	*cis*-$Rh(bpy)_2(OH)_2^{+}$	H_2O	0.5 mol/L NaOH; μ = 0.5	25	2.5×10^7	SS/LUM or LP/LUM/SST; ET	81N003
19.17.43.	$Rh(4,4'\text{-}Me_2bpy)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.2×10^9	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); OT	82A145
19.17.44.	$Rh(5\text{-}Mephen)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.3×10^9	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); OT	82A145
19.17.45.	$Rh(5,6\text{-}Me_2phen)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.6×10^9	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); OT	82A145

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.17. $Ru(4,7\text{-}Me_2phen)_3^{2+}$—Continued							
19.17.46.	$Rh(phen)_3^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	1.5×10^9	SS/LUM or LP/LUM/SST; OT	81N003
19.17.47.	$Ru(4,7\text{-}Me_2phen)_3^{3+}$	AN	0.1 mol/L TEAP	25	2.5×10^9	LP/LUM/AVE; τ_0 = 1.1 μs; OT	86A077
19.17.48.	Ti^{3+}	H_2O	1.5 mol/L HCl; μ = 3.0 (LiCl)	25	3.8×10^6	LP/LUM/SST; τ_0 = 1.3 μs; ET; 20-60% Ti^{3+} coordinated by Cl^-	79A183
Organic Quenchers							
19.17.49.	$bpyH^+$	H_2O	μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	1.4×10^9	SS/LUM; τ_0 = 1.7 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
	$bpyH^+$	H_2O	μ = 0.5 (HCl, NaCl)	25	2.4×10^9	SS/LUM; τ_0 = 1.7 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.17.50.	*N,N'*-Dibenzyl-vio^{2+}	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	2.4×10^9	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); OT; [Q] = (3.5-500) × 10^{-5} mol/L	82A145
19.17.51.	*N,N*-Diethylaniline	MeOH		25	8.6×10^6	SL/LUM/SPC; τ_0 = 0.85 μs; $\Delta G^{\ddagger}$ = 33 kJ/mol; RT	83E623
19.17.52.	*N,N*-Dimethylaniline	MeOH		25	3.7×10^6	SL/LUM/SPC; τ_0 = 0.85 μs; $\Delta G^{\ddagger}$ = 36 kJ/mol; RT	83E623
19.17.53.	4,4'-Dimethyl-$bpyH_2^{2+}$	H_2O	μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	2.4×10^9	SS/LUM; τ_0 = 1.7 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.17.54.	DQ^{2+}	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	2.4×10^9	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); OT; [Q] = (3.5-500) × 10^{-5} mol/L	82A145
	DQ^{2+}	H_2O	μ = 0.5 (HCl, NaCl)	25	4.1×10^9	SS/LUM; τ_0 = 1.7 μs (766404); [Q] = (5-50) × 10^{-4} mol/L	83C017
19.17.55.	*N,N'*-Ethylene-4,4'-dimethyl-bpy^{2+}	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	2.1×10^9	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); OT; [Q] = (3.5-500) × 10^{-5} mol/L	82A145

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.17. $Ru(4,7\text{-}Me_2phen)_3^{2+}$—Continued							
19.17.56.	MV^{2+}	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.8×10^9	SS/LUM or LP/LUM/SST; τ_0 = 1.7 μs (766404); OT; [Q] = (3.5-500) × 10^{-5} mol/L	82A145
	MV^{2+}	H_2O	0.0067 mol/L Pbuf, ≤0.2 mol/L HSEtOH; pH 7	30	4.4×10^8	SS/QYP; τ_0 = 1.7 μs (766404); OT; [Q] ≤ 0.01 mol/L; τ_0 at 25 °C; see Mech. [7]	81A139
19.17.57.	4,*N*,*N*-Trimethylaniline	MeOH		25	1.8×10^8	SL/LUM/SPC; τ_0 = 0.85 μs; $\Delta G^{\ddagger}$ = 26 kJ/mol; RT	83E623
19.18. $Ru(5\text{-}Mephen)_3^{2+}$							
Inorganic Quenchers							
19.18.1.	$Co(bpy)_3^{2+}$	H_2O	0.16 mol/L Na_2SO_4, Pbuf; pH 7.8; μ = 0.5; $[Co^{II}]/[L]$ = 0.2	25	1.2×10^9	SS/LUM; τ_0 = 1.3 μs (766404); OT, ET	85S022
19.18.2.	$Co(sep)^{3+}$	H_2O	0.2 mol/L LiCl	25	7.3×10^8	SS/LUM; τ_0 = 1.3 μs (766404); ET, OT	84A238
	$Co(sep)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	5.5×10^8	SS/LUM; τ_0 = 1.3 μs (766404); ET, OT	84A238
19.18.3.	Cr^{3+}	H_2O	0.04 mol/L H_2SO_4; μ = 1.0 ($MgCl_2$)	25	1.3×10^7	SS/LUM; τ_0 = 1.3 μs (LP/LUM/AVE); ET	766404
19.18.4.	Cu^{2+}	H_2O	μ = 0.12 ($NaNO_3$)	25	4.9×10^7 (calc)	LP/LUM/SST; τ_0 = 1.4 μs; OT	85N199
	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	6.0×10^7	SS/LUM; τ_0 = 1.3 μs (766404); OT; f = 0.74	78A090
19.18.5.	Eu^{3+}	H_2O	0.025 mol/L HCl, $[MgCl_2]$ + $[Eu^{3+}]$ = 0.9 mol/L	25	4.2×10^5	SS/LUM; τ_0 = 1.3 μs (LP/LUM/AVE); OT; Q mainly as $EuCl^{2+}$	766404
19.18.6.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4	25	2.6×10^9	SS/LUM; τ_0 = 1.3 μs (LP/LUM/AVE); OT	766404
19.18.7.	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.063 ($NaNO_3$)	~23	8.4×10^7	LP/LUM/AVE; τ_0 = 1.5 μs; OT	84A148
	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.5 ($NaNO_3$)	~23	3.3×10^8	LP/LUM/AVE; τ_0 = 1.5 μs; OT	84A148

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.18. $Ru(5\text{-Mephen})_3^{2+}$—*Continued*							
19.18.8.	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.09 mol/L $NaNO_3$		1.9×10^9	LP/LUM/AVE; τ_0 = 1.4 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.99 mol/L $NaNO_3$		2.6×10^9	LP/LUM/AVE; τ_0 = 1.4 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.01 mol/L SLS		1.3×10^7	LP/LUM/AVE; τ_0 = 2.3 μs; OT	84N034
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		1.1×10^7	LP/LUM/AVE; τ_0 = 2.4 μs; OT	84N034
19.18.9.	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, [$NaNO_3$] + [NaCl] = 0.99 mol/L		6.3×10^9	LP/LUM/AVE; τ_0 = 1.4 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		$\sim 3 \times 10^6$	LP/LUM/AVE; τ_0 = 2.4 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84N034
19.18.10.	$HgCl_4^{2-}$	H_2O	0.01 mol/L HNO_3, [$NaNO_3$] + [NaCl] = 0.99 mol/L		8.1×10^8	LP/LUM/AVE; τ_0 = 1.4 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
19.18.11.	O_2	H_2O		25	5.0×10^9	SS/LUM; τ_0 = 1.3 μs (LP/LUM/AVE); OT?	766404
19.18.12.	$Rh(bpy)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	7×10^8	SS/LUM or LP/LUM/SST; τ_0 = 1.3 μs (766404); OT	82A145
19.18.13.	$Rh(4,4'\text{-}Me_2bpy)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	4.9×10^8	SS/LUM or LP/LUM/SST; τ_0 = 1.3 μs (766404); OT	82A145
19.18.14.	$Rh(5\text{-Mephen})_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.0×10^9	SS/LUM or LP/LUM/SST; τ_0 = 1.3 μs (766404); OT	82A145
19.18.15.	$Rh(5,6\text{-}Me_2phen)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.3×10^9	SS/LUM or LP/LUM/SST; τ_0 = 1.3 μs (766404); OT	82A145
Organic Quenchers							
19.18.16.	Ascorbate ion	H_2O	pH 5; μ = 0.7 (Na_2SO_4)	25	1.7×10^8	SS/LUM; τ_0 = 1.3 μs (766404); RT	82A278
19.18.17.	$bpyH^+$	H_2O	μ = 0.5 (HCl, NaCl)	25	3.4×10^7	SS/LUM; τ_0 = 1.3 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.18. $Ru(5\text{-Mephen})_3^{2+}$—Continued							
19.18.18.	$bpyH_2^{2+}$	H_2O	μ = 0.5 (HCl, NaCl)	25	3.2×10^9	SS/LUM; τ_0 = 1.3 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.18.19.	DQ^{2+}	H_2O	μ = 0.5 (HCl, NaCl)	25	3.3×10^9	SS/LUM; τ_0 = 1.3 μs (766404); [Q] = (5-50) × 10^{-4} mol/L	83C017
19.18.20.	$phenH^+$	H_2O	μ = 0.5 (HCl, NaCl)	25	1.8×10^9	SS/LUM; τ_0 = 1.3 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.18.21.	$phenH_2^{2+}$	H_2O	μ = 0.5 (HCl, NaCl)	25	3.8×10^9	SS/LUM; τ_0 = 1.3 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.19. $Ru(5,6\text{-}Me_2phen)_3^{2+}$							
Inorganic Quenchers							
19.19.1.	$Co(en)_3^{3+}$	H_2O	ACbuf; pH 4.7; μ = 0.01 (NaCl)	25	9.1×10^7	SS/LUM; τ_0 = 1.8 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
19.19.2.	$Co(NH_3)_6^{3+}$	H_2O	ACbuf; pH 4.7; μ = 0.01 (NaCl)	25	5.3×10^7	SS/LUM; τ_0 = 1.8 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
19.19.3.	$Co(sep)^{3+}$	H_2O	0.2 mol/L LiCl	25	7.2×10^8	SS/LUM; τ_0 = 1.8 μs (766404); ET, OT	84A238
	$Co(sep)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	5.7×10^8	SS/LUM; τ_0 = 1.8 μs (766404); ET, OT	84A238
19.19.4.	Cr^{3+}	H_2O	0.04 mol/L H_2SO_4; μ = 1.0 ($MgCl_2$)	25	1.4×10^7	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); ET	766404
19.19.5.	Cu^{2+}	H_2O	μ = 0.12 ($NaNO_3$)	25	5.2×10^7 (calc)	LP/LUM/SST; τ_0 = 1.8 μs; OT	85N199
	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	7.6×10^7	SS/LUM; τ_0 = 1.8 μs (766404); OT; f = 0.79	78A090
19.19.6.	Eu^{3+}	H_2O	0.025 mol/L HCl, [$MgCl_2$] + [Eu^{3+}] = 0.9 mol/L	25	7.5×10^5	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); OT; Q mainly as $EuCl^{2+}$	766404
19.19.7.	$Eu(crypt)^{3+}$	H_2O	1 mol/L KCl	~22	6.0×10^7	SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L	86E195

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.19. $Ru(5,6\text{-}Me_2phen)_3^{2+}$—Continued							
19.19.8.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4	25	2.6×10^9	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); OT	766404
19.19.9.	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.063 ($NaNO_3$)	~23	8.3×10^7	LP/LUM/AVE; τ_0 = 1.9 μs; OT	84A148
	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.5 ($NaNO_3$)	~23	3.6×10^8	LP/LUM/AVE; τ_0 = 2.0 μs; OT	84A148
19.19.10.	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.09 mol/L $NaNO_3$		2.9×10^9	LP/LUM/AVE; τ_0 = 1.9 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.99 mol/L $NaNO_3$		2.6×10^9	LP/LUM/AVE; τ_0 = 1.9 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.01 mol/L SLS		1.7×10^7	LP/LUM/AVE; τ_0 = 3.1 μs; OT	84N034
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		1.3×10^7	LP/LUM/AVE; τ_0 = 3.2 μs; OT	84N034
19.19.11.	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, [$NaNO_3$] + [NaCl] = 0.99 mol/L		5.0×10^9	LP/LUM/AVE; τ_0 = 1.9 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		$\sim 4 \times 10^6$	LP/LUM/AVE; τ_0 = 3.2 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84N034
19.19.12.	$HgCl_4^{2-}$	H_2O	0.01 mol/L HNO_3, [$NaNO_3$] + [NaCl] = 0.99 mol/L		7.8×10^8	LP/LUM/AVE; τ_0 = 1.9 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
19.19.13.	O_2	H_2O		25	4.7×10^9	SS/LUM; τ_0 = 1.8 μs (LP/LUM/AVE); OT?	766404
19.19.14.	$Os(NH_3)_6^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	$\leq 3 \times 10^7$	SS/LUM or LP/LUM/SST; τ_0 = 1.8 μs (766404); OT, ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145
19.19.15.	$Os(NH_3)_5(H_2O)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	$\leq 2 \times 10^7$	SS/LUM or LP/LUM/SST; τ_0 = 1.8 μs (766404); OT, ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.19.	**$Ru(5,6\text{-}Me_2phen)_3^{2+}$**—Continued						
19.19.16.	$Os(NH_3)_5I^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	6.6×10^9	SS/LUM or LP/LUM/SST; τ_0 = 1.8 μs (766404); OT, ET?; [Q] = (3-200) × 10^{-4} mol/L	82A145
	Organic Quenchers						
19.19.17.	Ascorbate ion	H_2O	pH 5; μ = 0.7 (Na_2SO_4)	25	1.1×10^8	SS/LUM; τ_0 = 1.8 μs (766404); RT	82A278
19.19.18.	$bpyH^+$	H_2O	μ = 0.5 (HCl, NaCl)	25	9.9×10^7	SS/LUM; τ_0 = 1.8 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
	$bpyH^+$	H_2O	μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	6×10^7	SS/LUM; τ_0 = 1.8 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.19.19.	$bpyH_2^{2+}$	H_2O	μ = 0.5 (HCl, NaCl)	25	3.6×10^9	SS/LUM; τ_0 = 1.8 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.19.20.	*N,N*-Diethylaniline	MeOH		25	2.0×10^8	SL/LUM/SPC; τ_0 = 1.4 μs; $\Delta G^{\ddagger}$ = 26 kJ/mol; RT	83E623
19.19.21.	DQ^{2+}	H_2O	μ = 0.5 (HCl, NaCl)	25	3.2×10^9	SS/LUM; τ_0 = 1.8 μs (766404); [Q] = (5-50) × 10^{-4} mol/L	83C017
19.19.22.	4,*N,N*-Trimethylaniline	MeOH		25	3.3×10^9	SL/LUM/SPC; τ_0 = 1.4 μs; $\Delta G^{\ddagger}$ = 19 kJ/mol; RT	83E623
19.20.	**$Ru\{4,7\text{-}(PhSO_3)_2phen\}_3^{4-}$**						
	Inorganic Quenchers						
19.20.1.	O_2	MeOH			1.9×10^9	SS/LUM; τ_0 = 5.5 μs (LP/LUM/AVE); ET	777221
19.21.	**$Ru(4,7\text{-}Ph_2phen)_3^{2+}$**						
	Inorganic Quenchers						
19.21.1.	$Fe(CN)_6^{4-}$	H_2O			1.5×10^{10}	SL/LUM/SPC; τ_0^{air} = 0.91 μs; [Q] ≤ 2 × 10^{-4} mol/L; some SQ	85R098
	$Fe(CN)_6^{4-}$	H_2O/Me_2SO_4 (9/1)	0.0045 mol/L TRbuf; 0.045 mol/L NaCl; pH 7.2		3.0×10^9	SL/LUM/SPC; τ_0^{air} = 0.93 μs; [Q] ≤ 6 × 10^{-4} mol/L; some SQ	85R098

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.21. $Ru(4,7\text{-}Ph_2phen)_3^{2+}$—Continued							
19.21.2.	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.01 mol/L SLS		9.5×10^5	LP/LUM/AVE; τ_0 = 5.8 μs; OT	84N034
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		8.0×10^5	LP/LUM/AVE; τ_0 = 5.8 μs; OT	84N034
19.21.3.	O_2	MeOH			2.5×10^9	SS/LUM; τ_0 = 5.3 μs (LP/LUM/AVE); ET	777221
Organic Quenchers							
19.21.4.	*N,N'*-Dibutyl-vio^{2+}	AN	μ = 0 (calc'd)		1.6×10^8	LP/LUM/SST; OT	83N153
19.21.5.	*N,N'*-Diethyl-vio^{2+}	AN	μ = 0 (calc'd)		1.5×10^8	LP/LUM/SST; OT	83N153
19.22. $Ru(5\text{-}Phphen)_3^{2+}$							
Inorganic Quenchers							
19.22.1.	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	5.7×10^7	SS/LUM; τ_0 = 1.3 μs (766404); OT; f = 0.51	78A090
19.22.2.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4	25	2.7×10^9	SS/LUM; τ_0 = 1.3 μs (LP/LUM/AVE); OT	766404
19.22.3.	O_2	H_2O		25	4.7×10^9	SS/LUM; τ_0 = 1.3 μs (LP/LUM/AVE); OT?	766404
19.23. $Ru[4,4'\text{-}(SO_3)_2bpy]_3^{4-}$							
Inorganic Quenchers							
19.23.1.	Cu^{2+}	D_2O	μ = 0.2 ($NaClO_4$)	25	1.6×10^8	SL/LUM/SPC; τ_0 = 0.99 μs; OT	85E617
	Cu^{2+}	H_2O	pH 5-6; μ = 0.2 ($NaClO_4$)	25	1.9×10^8	SL/LUM/SPC; τ_0 = 0.48 μs; OT; [Q] ≤ 0.025 mol/L	85E617
	Cu^{2+}	H_2O	0.25 mol/L H_2SO_4; μ = 0.95	25	7.5×10^7	SL/LUM/SPC; OT	85E617
Organic Quenchers							
19.23.2.	MV^{2+}	H_2O	μ = 0 (calc'd, Na_2SO_4)	25	2.3×10^{10}	SL/LUM/SPC; τ_0 = 0.48 μs; OT	85E617
19.24. $Ru(2,2'\text{-bipyrazine})_3^{2+}$							
Inorganic Quenchers							
19.24.1.	Cl^-	AN			1.6×10^9	LP/LUM/SST; τ_0 = 0.84 μs; RT?	86A134
19.24.2.	$Co(NH_3)_6^{3+}$	H_2O	μ = 1.0 (KCl)	20	1.3×10^8	SS/LUM; τ_0 = 0.92 μs (LP/LUM/AVE); OT	85E218
19.24.3.	$Co(NH_3)_5Cl^{2+}$	H_2O	μ = 1.0 (KCl)	20	5.7×10^9	SS/LUM; τ_0 = 0.92 μs (LP/LUM/AVE); OT	85E218

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.24. $Ru(2,2'\text{-bipyrazine})_3^{2+}$—Continued							
19.24.4.	Cu^{2+}	H_2O	μ = 1.0 (KCl)	20	5×10^8	SS/LUM; τ_0 = 0.92 μs (LP/LUM/AVE); OT	85E218
	Cu^{2+}	H_2O	2 mol/L H_2SO_4	20	5×10^8	SS/LUM; τ_0 = 50 ns (LP/LUM/AVE); ET; S* monoprotonated	85E218
	Cu^{2+}	H_2SO_4 (98%)		20	3×10^7	SS/LUM; τ_0 = 0.52 μs (LP/LUM/AVE); S* hexaprotonated	85E218
19.24.5.	Fe^{2+}	H_2O	μ = 1.0 (KCl)	20	6×10^8	SS/LUM; τ_0 = 0.92 μs (LP/LUM/AVE); RT	85E218
	Fe^{2+}	H_2O	2 mol/L H_2SO_4	20	7×10^8	SS/LUM; τ_0 = 50 ns (LP/LUM/AVE); RT; S* monoprotonated	85E218
	Fe^{2+}	H_2SO_4 (98%)		20	1.1×10^8	SS/LUM; τ_0 = 0.52 μs (LP/LUM/AVE); S* hexaprotonated	85E218
19.24.6.	Fe^{3+}	H_2O	μ = 1.0 (KCl)	20	1.1×10^{10}	SS/LUM; τ_0 = 0.92 μs (LP/LUM/AVE); OT	85E218
	Fe^{3+}	H_2O	2 mol/L H_2SO_4	20	1×10^8	SS/LUM; τ_0 = 50 ns (LP/LUM/AVE); OT; S* monoprotonated	85E218
	Fe^{3+}	H_2SO_4 (98%)		20	1×10^7	SS/LUM; τ_0 = 0.52 μs (LP/LUM/AVE); S* hexaprotonated	85E218
19.24.7.	$Fe(CN)_6^{3-}$	H_2O	μ = 1.0 (KCl)	20	5.6×10^9	SS/LUM; τ_0 = 0.92 μs (LP/LUM/AVE); OT	85E218
	$Fe(CN)_6^{3-}$	H_2O	2 mol/L H_2SO_4	20	4.1×10^{10}	SS/LUM; τ_0 = 50 ns (LP/LUM/AVE); S* monoprotonated	85E218
19.24.8.	$Fe(CN)_6^{4-}$	H_2O	μ = 1.0 (KCl)	20	1.0×10^{10}	SS/LUM; τ_0 = 0.92 μs (LP/LUM/AVE); RT	85E218
	$Fe(CN)_6^{4-}$	H_2O	2 mol/L H_2SO_4	20	5.3×10^9	SS/LUM; τ_0 = 50 ns (LP/LUM/AVE); S* monoprotonated	85E218
19.24.9.	I^-	H_2O	μ = 1.0 (KCl)	20	7.0×10^9	SS/LUM; τ_0 = 0.92 μs (LP/LUM/AVE); RT	85E218
Organic Quenchers							
19.24.10.	Aniline	AN	μ = 0.1 (TBAP)	22	5.2×10^9	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.24. $Ru(2,2'\text{-bipyrazine})_3^{2+}$—Continued							
19.24.11.	1,4-Bis(*N*-phenylamino)benzene	AN	μ = 0.1 (TBAP)	22	1.1×10^{10}	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218
19.24.12.	1,2-Dimethoxybenzene	AN	μ = 0.1 (TBAP)	22	1.7×10^{8}	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218
19.24.13.	1,4-Dimethoxybenzene	AN	μ = 0.1 (TBAP)	22	8.6×10^{8}	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218
19.24.14.	*N,N*-Dimethylaniline	AN	μ = 0.1 (TBAP)	22	8.4×10^{9}	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218
19.24.15.	Diphenylamine	AN	μ = 0.1 (TBAP)	22	5.6×10^{9}	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218
19.24.16.	EDTA	H_2O	0.05 mol/L PHTHbuf; pH 5		3.9×10^{7}	LP/LUM/SST; τ_0 = 0.75 μs; RT; [Q] = 0.002-0.02 mol/L	85A431
	EDTA	H_2O	0.1 mol/L PHTHbuf; pH 5		3.9×10^{7}	LP/LUM/AVE; τ_0 = 0.75 μs; RT; [Q] ≤ 0.01 mol/L	83N178
	EDTA	H_2O	pH 8.7; μ = 1.0 (Na_2SO_4)		6.9×10^{8}	SS/LUM, LP/LUM/AVE; τ_0^{air} = 0.60 μs; RT; f = ~0.7 (85F311); [Q] = (1-1000) × 10^{-4} mol/L	86A120
	EDTA	H_2O	pH 11.0; μ = 1.0 (Na_2SO_4)		7.7×10^{8}	SS/LUM, LP/LUM/AVE; τ_0^{air} = 0.60 μs; RT; f = ~0.7 (85F311); [Q] = (1-1000) × 10^{-4} mol/L	86A120
19.24.17.	MV^{2+}	H_2O	0.5 mol/L KCl	25	8.6×10^{6}	SS/LUM; τ_0 = 1.0 μs (83E209); OT	83F371
19.24.18.	Phenothiazine	AN	μ = 0.1 (TBAP)	22	7.9×10^{9}	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218
19.24.19.	Triethanolamine	H_2O	0.5 mol/L KCl	25	2.5×10^{8}	SS/LUM; τ_0 = 1.0 μs (83E209); RT	83F371
19.24.20.	1,2,3-Trimethoxybenzene	AN	μ = 0.1 (TBAP)	22	6.5×10^{7}	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218
19.24.21.	1,2,4-Trimethoxybenzene	AN	μ = 0.1 (TBAP)	22	2.9×10^{9}	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218
19.24.22.	1,3,5-Trimethoxybenzene	AN	μ = 0.1 (TBAP)	22	2.7×10^{7}	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218
19.24.23.	4,*N,N*-Trimethylaniline	AN	μ = 0.1 (TBAP)	22	8.6×10^{9}	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218
19.24.24.	Triphenylamine	AN	μ = 0.1 (TBAP)	22	6.2×10^{9}	SS/LUM; τ_0 = 0.74 μs (LP/LUM/AVE); RT	85E218

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.25. $Ru(3,3'\text{-bipyridazine})_3^{2+}$							
Organic Quenchers							
19.25.1.	MV^{2+}	H_2O		25	7.6×10^7	EMI; τ_0 = 0.70 μs	83E209
	MV^{2+}	H_2O	0.5 mol/L KCl	25	7.6×10^7	SS/LUM; τ_0 = 0.70 μs (83E209); OT	83F371
	MV^{2+}	H_2O	0.05 mol/L PHTHbuf; pH 5		4.8×10^7	LP/LUM/SST; τ_0 = 0.58 μs; OT; [Q] = 0.002-0.02 mol/L	85A431
19.25.2.	Triethanolamine	H_2O		25	1.3×10^6	EMI; τ_0 = 0.70 μs	83E209
	Triethanolamine	H_2O	0.5 mol/L KCl	25	1.3×10^6	SS/LUM; τ_0 = 0.70 μs (83E209); RT	83F371
19.26. $Ru(2,2'\text{-bipyrimidine})_3^{2+}$							
Inorganic Quenchers							
19.26.1.	O_2	AN			5.3×10^8	LP/LUM/SST; τ_0 = 67 ns; p_Q = (2, 10) × 10^4 Pa	86B098
	O_2	H_2O			$\sim 1 \times 10^9$	LP/LUM/SST; τ_0 = 83 ns; p_Q = (2, 10) × 10^4 Pa	86B098
	O_2	MeOH			4.5×10^8	LP/LUM/SST; τ_0 = 0.10 μs; p_Q = (2, 10) × 10^4 Pa	86B098
Organic Quenchers							
19.26.2.	Triethanolamine	H_2O	0.5 mol/L KCl	25	3.6×10^7	SS/LUM; τ_0 = 60 ns (83E209); RT	83F371
19.27. $Ru^{II}[1,2\text{-bis(phenylthio)ethane}]_2Cl(\mu\text{-vio})Ru^{II}(bpy)_2Cl^{2+}$							
Organic Quenchers							
19.27.1.	*N*-Methyl-4-carbamyl-py^+	AN/CH_2Cl_2 (1.5/1)		−23	2.7×10^8	LP/LUM/AVE; τ_0 = 0.10 μs; OT	85F051
19.28. $Ru^{II}[1,2\text{-bis(phenylthio)ethane}]_2Cl(\mu\text{-vio})Ru^{III}(bpy)_2Cl^{3+}$							
Organic Quenchers							
19.28.1.	*N*-Methyl-4-carbamyl-py^+	AN/CH_2Cl_2 (1.5/1)		−23	2.4×10^8	LP/LUM/AVE; τ_0 = 0.10 μs; OT; [Q] ≤ 0.018 mol/L	85F051
19.29. $Ru(bpy)_2[(BUG)_2bpy]^{n+}$							
Organic Quenchers							
19.29.1.	MV^{2+}	H_2O	μ = 0.06 (NaCl)	~24	2.6×10^8	LP/LUM/AVE, SS/LUM; τ_0 = 0.53 μs; OT; [Q] = 0.005-0.020 mol/L	85A387
	MV^{2+}	H_2O	μ = 0.15 (NaCl)	~24	6.1×10^8	LP/LUM/AVE, SS/LUM; τ_0 = 0.53 μs; OT; [Q] = 0.005-0.020 mol/L	85A387

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.29.	**$Ru(bpy)_2[(BUG)_2bpy]^{n+}$**—Continued						
	MV^{2+}	H_2O	μ = 0.30 (NaCl)	~24	8.8×10^8	LP/LUM/AVE, SS/LUM; τ_0 = 0.53 μs; OT; [Q] = 0.005-0.020 mol/L	85A387
	MV^{2+}	H_2O	μ = 0.60 (NaCl)	~24	1.2×10^9	LP/LUM/AVE, SS/LUM; τ_0 = 0.53 μs; OT; [Q] = 0.005-0.020 mol/L	85A387
19.30.	***cis*-$Ru(bpy)_2(CN)_2$**						
	Inorganic Quenchers						
19.30.1.	Co^{2+}	H_2O		~21	6.4×10^6	FP/LUM/SST; τ_0 = 0.27 μs; ET; some SQ	776220
19.30.2.	$Co(acac)_2$	MeOH		~21	4.3×10^7	SS/LUM; τ_0 = 0.40 μs (FP/LUM/SST); ET	776220
19.30.3.	$Co(acac)_3$	MeOH		~21	8.2×10^8	SS/LUM; τ_0 = 0.40 μs (FP/LUM/SST)	776220
19.30.4.	$Co(CN)_6^{3-}$	H_2O		~21	1.6×10^6	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST)	776220
19.30.5.	$Co(C_2O_4)_3^{3-}$	H_2O		~21	3.0×10^6	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST); OT	776220
19.30.6.	$Co(NH_3)_6^{3+}$	H_2O		~21	1.4×10^6	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST); OT	776220
19.30.7.	$Co(NH_3)_5Cl^{2+}$	H_2O		~21	3.4×10^6	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST); OT	776220
19.30.8.	Cr^{3+}	H_2O	0.001 mol/L CF_3SO_3H	15	1.4×10^7 (corr)	LP/LUM/SST; ET	86E096
19.30.9.	$Cr(acac)_3$	MeOH		~21	4.4×10^8	SS/LUM; τ_0 = 0.40 μs (FP/LUM/SST); ET	776220
19.30.10.	$Cr(CN)_6^{3-}$	H_2O		~21	3.0×10^8	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST); ET	776220
19.30.11.	$Cr(C_2O_4)_3^{3-}$	H_2O		~21	1.9×10^8	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST); ET	776220
19.30.12.	*trans*-$Cr(cyclam)(CN)_2^+$	H_2O	0.001 mol/L CF_3SO_3H	15	1.8×10^8 (corr)	LP/LUM/SST; ET	86E096
19.30.13.	*trans*-$Cr(diethylenetriamine)_2^{3+}$	H_2O	0.001 mol/L CF_3SO_3H	15	1.9×10^8 (corr)	LP/LUM/SST; ET	86E096
19.30.14.	$Cr(en)_3^{3+}$	H_2O	0.001 mol/L CF_3SO_3H	15	7.5×10^7 (corr)	LP/LUM/SST; ET	86E096

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.30.	***cis*-Ru(bpy)$_2$(CN)$_2$**—Continued						
19.30.15.	*trans*-$Cr(en)_2Br_2^+$	H_2O	0.1 mol/L KCl	11	1.1×10^9	LP/LUM/AVE; τ_0 = 0.30 μs; ET; [Q] = 0.001-0.004 mol/L	84E372
19.30.16.	*cis*-$Cr(en)_2Cl_2^+$	H_2O	0.1 mol/L KCl	11	5.1×10^8	LP/LUM/AVE; τ_0 = 0.30 μs; ET	84E372
	cis-$Cr(en)_2Cl_2^+$	H_2O	0.001 mol/L CF_3SO_3H	15	2.1×10^8 (corr)	LP/LUM/SST; ET	86E096
19.30.17.	*trans*-$Cr(en)_2Cl_2^+$	H_2O	0.1 mol/L KCl	11	8.2×10^8	LP/LUM/AVE; τ_0 = 0.30 μs; ET; [Q] = 0.001-0.009 mol/L	84E372
	trans-$Cr(en)_2Cl_2^+$	H_2O	0.001 mol/L CF_3SO_3H	15	3.6×10^8 (corr)	LP/LUM/SST; ET	86E096
19.30.18.	*trans*-$Cr(en)_2F_2^+$	H_2O	0.1 mol/L KCl	11	9.0×10^7	LP/LUM/AVE; τ_0 = 0.30 μs; ET; [Q] = 0.005-0.01 mol/L	84E372
19.30.19.	*cis*-$Cr(en)_2(NCS)_2^+$	H_2O	0.1 mol/L KCl	11	1.2×10^9	LP/LUM/AVE; τ_0 = 0.30 μs; ET	84E372
19.30.20.	*trans*-$Cr(en)_2(NCS)_2^+$	H_2O	0.1 mol/L KCl	11	9.1×10^8	LP/LUM/AVE; τ_0 = 0.30 μs; ET; [Q] = 0.001-0.006 mol/L	84E372
19.30.21.	*cis*-$Cr(en)_2(NCS)Cl^+$	H_2O	0.1 mol/L KCl	11	7.0×10^8	LP/LUM/AVE; τ_0 = 0.30 μs; ET	84E372
19.30.22.	*trans*-$Cr(en)_2(NCS)Cl^+$	H_2O	0.1 mol/L KCl	11	8.0×10^8	LP/LUM/AVE; τ_0 = 0.30 μs; ET; [Q] = 0.001-0.008 mol/L	84E372
19.30.23.	*trans*-$Cr(en)_2(ONO)Cl^+$	H_2O	0.1 mol/L KCl	11	5.3×10^8	LP/LUM/AVE; τ_0 = 0.30 μs; ET; [Q] = 0.002-0.009 mol/L	84E372
19.30.24.	$Cr(NH_3)_6^{3+}$	H_2O	0.001 mol/L CF_3SO_3H	15	6.1×10^7 (corr)	LP/LUM/SST; ET; [Q] ≤ 0.020 mol/L	86E096
19.30.25.	$Cr(NH_3)_5Br^{2+}$	H_2O	0.001 mol/L CF_3SO_3H	15	2.1×10^8 (corr)	LP/LUM/SST; ET	86E096
19.30.26.	$Cr(NH_3)_5(CN)^{2+}$	H_2O	0.001 mol/L CF_3SO_3H	15	1.1×10^8 (corr)	LP/LUM/SST; ET	86E096
19.30.27.	$Cr(NH_3)_5Cl^{2+}$	H_2O	0.001 mol/L CF_3SO_3H	15	1.9×10^8 (corr)	LP/LUM/SST; ET	86E096
19.30.28.	$Cr(NH_3)_5(H_2O)^{3+}$	H_2O	0.001 mol/L CF_3SO_3H	15	6.8×10^7 (corr)	LP/LUM/SST; ET	86E096

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.30.	***cis*-Ru(bpy)$_2$(CN)$_2$**—Continued						
19.30.29.	$Cr(NH_3)_5(N_3)^{2+}$	H_2O	0.001 mol/L CF_3SO_3H	15	2.3×10^8 (corr)	LP/LUM/SST; ET	86E096
19.30.30.	*trans*-$Cr(NH_3)_2(NCS)_4^-$	H_2O		~21	1.9×10^9	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST); ET	776220
19.30.31.	$Cr(NH_3)_5(NCS)^{2+}$	H_2O	0.001 mol/L CF_3SO_3H	15	3.8×10^8 (corr)	LP/LUM/SST; ET	86E096
19.30.32.	Cr[*trans*-(R)-cyclohexanediamine]$_3^{3+}$	H_2O	0.001 mol/L CF_3SO_3H	15	9.9×10^7 (corr)	LP/LUM/SST; ET	86E096
19.30.33.	Cu^{2+}	H_2O		~21	3.9×10^8	FP/LUM/SST; τ_0 = 0.27 μs; OT, ET; some SQ	776220
19.30.34.	$Cu(acac)_2$	MeOH		~21	1.1×10^9	SS/LUM; τ_0 = 0.40 μs (FP/LUM/SST); OT, ET	776220
19.30.35.	$Fe(CN)_6^{3-}$	H_2O		~21	6.9×10^9	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST); OT	776220
	$Fe(CN)_6^{3-}$	H_2O	pH 7	~24	7.2×10^9	LP/LUM/SST; τ_0 = 0.25 μs; OT; f = <0.1; [Q] = 3 × 10^{-4} mol/L	80A133
	$Fe(CN)_6^{3-}$	H_2O	0.0018 mol/L polybrene; pH 7	~24	1.9×10^9	LP/LUM/SST; τ_0 = 0.25 μs; OT; f = 0.9; [Q] = 3 × 10^{-4} mol/L	80A133
	$Fe(CN)_6^{3-}$	H_2O	0.0023 mol/L polybrene; pH 7	~24	2.4×10^9	LP/LUM/SST; τ_0 = 0.25 μs; OT; f = 0.9; [Q] = 3 × 10^{-4} mol/L	80A133
	$Fe(CN)_6^{3-}$	H_2O	0.0030 mol/L polybrene; pH 7	~24	2.8×10^9	LP/LUM/SST; τ_0 = 0.25 μs; OT; f = 0.9; [Q] = 3 × 10^{-4} mol/L	80A133
	$Fe(CN)_6^{3-}$	H_2O	0.0045 - 0.063 mol/L polybrene; pH 7	~24	3.9×10^9	LP/LUM/SST; τ_0 = 0.25 μs; OT; f = 0.9; [Q] = 3 × 10^{-4} mol/L	80A133
	$Fe(CN)_6^{3-}$	H_2O	0.013 mol/L polybrene; pH 2.1-12.2 ($HClO_4$ or NaOH)	~24	4.2×10^9	LP/LUM/SST; τ_0 = 0.25 μs; OT; f = 0.9; [Q] = 3 × 10^{-4} mol/L	80A133
19.30.36.	$Fe(CN)_6^{4-}$	H_2O		~21	6.1×10^8	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST); ET, RT	776220
19.30.37.	I^-	H_2O		~21	1.5×10^5	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST)	776220
19.30.38.	Ni^{2+}	H_2O		~21	9×10^6	FP/LUM/SST; τ_0 = 0.27 μs; ET; some SQ	776220

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.30.	***cis*-Ru(bpy)$_2$(CN)$_2$**—Continued						
19.30.39.	$Ni(acac)_2$	MeOH		~21	1.4×10^8	SS/LUM; τ_0 = 0.40 μs (FP/LUM/SST)	776220
19.30.40.	$NiCl_4^{2-}$	H_2O		~21	4.4×10^9	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST)	776220
19.30.41.	O_2	H_2O		~21	4.5×10^9	SS/LUM; τ_0 = 0.26 μs (LP/LUM/SST); ET	737658
	O_2	MeOH			5.0×10^9	SS/LUM; τ_0 = 0.40 μs (LP/LUM/AVE); ET; k_q = 4.5×10^9 L mol^{-1} s^{-1} at ~21 °C with SS/LUM and τ_0 = 0.42 μs from same lab in 737658	777221
19.30.42.	$PtCl_4^{2-}$	H_2O		~21	6.0×10^8	SS/LUM; τ_0 = 0.27 μs (FP/LUM/SST); ET	776220
Organic Quenchers							
19.30.43.	9,10-Anthraquinone-2,6-disulfonate ion	H_2O	pH 4.2 (HAc)		7.1×10^8	SS/LUM; τ_0^{air} = 0.2 μs (assumed); OT; [Q] = (3-25) $\times 10^{-4}$ mol/L	82N119
	9,10-Anthraquinone-2,6-disulfonate ion	H_2O	2% w/w colloidal ZrO_2; pH 4.2 (HAc)		3.9×10^8	SS/LUM; τ_0^{air} = 0.2 μs (assumed); OT; [Q] = (3-25) $\times 10^{-4}$ mol/L; Q adsorbed	82N119
19.30.44.	*N,N'*-Bis(poly-2,4-ionene)-(vio^{2+}) polycation	H_2O	pH 5-7		2.5×10^9	LP/LUM/AVE; OT; f = 0.09; [Q] = 0.001 mol/L	85B030
19.30.45.	*N*-Methyl-*N'*-(poly-2,4-ionene)-(vio^{2+}) polycation	H_2O	pH 5-7		2.8×10^9	LP/LUM/AVE; OT; f = 0.08; [Q] = 0.001 mol/L	85B030
19.30.46.	MV^{2+}	AN	0.1 mol/L TBAP		9.2×10^9	SS/LUM; τ_0 = 0.34 μs (FP/LUM/SST); OT	767009
	MV^{2+}	H_2O	μ = 0.024 (NaCl)	~23	5.3×10^9	LP/LUM/SST; τ_0^{air} = 0.19 μs; OT; [Q] ≤ 0.008 mol/L	79F442
	MV^{2+}	H_2O	μ = 0.52 (NaCl)	~23	5.3×10^9	LP/LUM/SST; τ_0^{air} = 0.20 μs; OT; [Q] ≤ 0.024 mol/L	79F442
	MV^{2+}	H_2O	pH 5-7		4.1×10^9	LP/LUM/AVE; OT; f = 0.09	85B030
19.30.47.	PolyVio10	H_2O	pH 5-7		1.1×10^9	LP/LUM/AVE; OT; f = 0.10; [Q] = 0.001 mol/L; [Q] based on viologen units	85B030
19.30.48.	PolyVio11	H_2O	pH 5-7		1.1×10^9	LP/LUM/AVE; OT; f = 0.13; [Q] = 0.001 mol/L; [Q] based on viologen units	85B030

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.30. *cis*-$Ru(bpy)_2(CN)_2$—Continued							
19.30.49.	PolyVio12	H_2O	pH 5-7		2.2×10^9	LP/LUM/AVE; OT; f = 0.07; [Q] = 0.001 mol/L; [Q] based on viologen units	85B030
19.30.50.	PolyVio13	H_2O	pH 5-7		1.6×10^9	LP/LUM/AVE; OT; f = 0.11; [Q] = 0.001 mol/L; [Q] based on viologen units	85B030
19.31. $Ru(bpy)_2[4,4'\text{-}(COOH)_2bpy]^{2+}$							
Inorganic Quenchers							
19.31.1.	Cu^{2+}	H_2O	pH 1.5		8.2×10^7	SS/LUM; τ_0 = 0.21 μs (SL/LUM/SPC); OT	85E075
Organic Quenchers							
19.31.2.	MV^{2+}	H_2O	0.1 mol/L HCl; μ = 0.137 (NaCl)	~23	6.1×10^8	LP/LUM/SST; τ_0^{air} = 0.23 μs; OT; [Q] ≤ 0.024 mol/L	79F442
	MV^{2+}	H_2O	0.1 mol/L HCl; μ = 0.62 (NaCl)	~23	1.0×10^9	LP/LUM/SST; τ_0^{air} = 0.22 μs; OT; [Q] ≤ 0.024 mol/L	79F442
19.32. $Ru(bpy)_2[4,4'\text{-}(COO)_2bpy]$							
Inorganic Quenchers							
19.32.1.	Cu^{2+}	H_2O	pH 4.3		1.3×10^9	SS/LUM; τ_0 = 0.46 μs (SL/LUM/SPC); OT; partial protonation of one COO^- group in S*	85E075
Organic Quenchers							
19.32.2.	MV^{2+}	H_2O	μ = 0.029 (NaCl)	~23	2.5×10^9	LP/LUM/SST; τ_0^{air} = 0.40 μs; OT; [Q] ≤ 0.01 mol/L	79F442
	MV^{2+}	H_2O	μ = 0.53 (NaCl)	~23	1.9×10^9	LP/LUM/SST; τ_0^{air} = 0.39 μs; OT; [Q] ≤ 0.024 mol/L	79F442
	MV^{2+}	H_2O	μ = 0 (calc'd, Na_2SO_4)	25	1.9×10^9	SL/LUM/SPC; τ_0 = 0.51 μs; OT	85E617
19.33. $Ru(bpy)[4,4'\text{-}(COOchl)_2bpy]_2^{2+}$							
Organic Quenchers							
19.33.1.	*N,N*-Dimethylaniline	AN	0.1 mol/L TEAP	25	2.1×10^9	SS/LUM; τ_0 = 2.1 μs; RT; τ in BuN	77F920
	N,N-Dimethylaniline	AN/BuN (3/1)			2.1×10^9	EMI; τ_0 = 2.1 μs (SL/LUM/SPC); RT	776441
19.33.2.	1,2-Dinitrobenzene	AN	0.1 mol/L TEAP	25	2.8×10^6	SS/LUM; τ_0 = 2.1 μs; OT; τ in BuN	77F920
19.33.3.	1,4-Dinitrobenzene	AN	0.1 mol/L TEAP	25	8.3×10^7	SS/LUM; τ_0 = 2.1 μs; OT; τ in BuN	77F920

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.33. $Ru(bpy)[4,4'-(COOchl)_2bpy]_2^{2+}$—Continued							
19.33.4.	MV^{2+}	AN/BuN (3/1)			3.6×10^7	EMI; τ_0 = 2.1 μs (SL/LUM/SPC); OT	776441
	MV^{2+}	AN/BuN (1/1)	0.1 mol/L TEAP	25	3.6×10^7	SS/LUM; τ_0 = 2.1 μs; OT; τ in BuN	77F920
19.33.5.	Tetracyanoethene	AN	0.1 mol/L TEAP	25	4.6×10^9	SS/LUM; τ_0 = 2.1 μs; OT; τ in BuN	77F920
19.34. $Ru(bpy)_2[4,4'-(COOchl)_2bpy]^{2+}$							
Organic Quenchers							
19.34.1.	*N,N*-Dimethylaniline	AN	0.1 mol/L TEAP	25	3.7×10^8	SS/LUM; τ_0 = 2.0 μs; RT; τ in BuN	77F920
	N,N-Dimethylaniline	AN/BuN (3/1)			3.7×10^8	EMI; τ_0 = 2.0 μs (SL/LUM/SPC); RT	776441
19.34.2.	1,2-Dinitrobenzene	AN	0.1 mol/L TEAP	25	4.8×10^6	SS/LUM; τ_0 = 2.0 μs; OT; τ in BuN	77F920
19.34.3.	1,4-Dinitrobenzene	AN	0.1 mol/L TEAP	25	1.3×10^8	SS/LUM; τ_0 = 2.0 μs; OT; τ in BuN	77F920
19.34.4.	MV^{2+}	AN/BuN (3/1)			3.5×10^7	EMI; τ_0 = 2.0 μs (SL/LUM/SPC); OT	776441
	MV^{2+}	AN/BuN (1/1)	0.1 mol/L TEAP	25	3.5×10^7	SS/LUM; τ_0 = 2.0 μs; OT; τ in BuN	77F920
19.34.5.	Tetracyanoethene	AN	0.1 mol/L TEAP	25	3.0×10^9	SS/LUM; τ_0 = 2.0 μs; OT; τ in BuN	77F920
19.35. $Ru(bpy)_2[4,4'-(COOet)_2bpy]^{2+}$							
Inorganic Quenchers							
19.35.1.	H_2O	EtOH		22	9.3×10^4	LP/LUM/SST; τ_0 = 1.0 μs; [Q] ≤ 1.8 mol/L; nonlinear S-V plot at higher [Q]	80S001
Organic Quenchers							
19.35.2.	*N,N'*-Dibenzyl-vio^{2+}	EtOH		22	3.6×10^8	LP/LUM/SST, SS/LUM; τ_0 = 1.0 μs; OT	80S001
	N,N'-Dibenzyl-vio^{2+}	H_2O		22	2.3×10^8	LP/LUM/SST, SS/LUM; τ_0 = 0.37 μs; OT	80S001
19.35.3.	*N,N*-Dimethylaniline	EtOH		22	3.7×10^8	LP/LUM/SST, SS/LUM; τ_0 = 1.0 μs; RT	80S001
19.35.4.	MV^{2+}	EtOH		22	2.9×10^8	LP/LUM/SST, SS/LUM; τ_0 = 1.0 μs; OT	80S001

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.35. $Ru(bpy)_2[4,4'-(COOEt)_2bpy]^{2+}$—Continued							
	MV^{2+}	H_2O		22	1.3×10^8	LP/LUM/SST, SS/LUM; τ_0 = 0.37 μs; OT; [Q] ≤ 0.02 mol/L	80S001
19.36. $Ru(bpy)_2(4,4'-Cl_2bpy)^{2+}$							
Inorganic Quenchers							
19.36.1.	$Eu(crypt)^{3+}$	H_2O	1 mol/L KCl	~22	5.6×10^6	SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L	86E195
19.37. $Ru(bpy)_2(Do_2Ca_2bpy)^{2+}$							
Organic Quenchers							
19.37.1.	*N*-Butylphenothiazine	AN		25	5.9×10^9	SS/LUM; τ_0 = 0.57 μs; RT; [Q] = (1-10) × 10^{-5} mol/L	80N169
19.37.2.	Nitrilotriacetate ion	H_2O/MeOH (1/1)			3×10^8	SS/LUM; RT	80N125
19.38. $Ru(bpy)(3,3'-Me_2bpy)_2^{2+}$							
Inorganic Quenchers							
19.38.1.	$Eu(crypt)^{3+}$	H_2O	1 mol/L KCl	~22	7.1×10^7	SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L	86E195
19.39. $Ru(bpy)_2(3,3'-Me_2bpy)^{2+}$							
Inorganic Quenchers							
19.39.1.	$Eu(crypt)^{3+}$	H_2O	1 mol/L KCl	~22	3.3×10^7	SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L	86E195
19.40. $Ru(bpy)_2(4,4'-Me_2bpy)^{2+}$							
Organic Quenchers							
19.40.1.	MV^{2+}	H_2O	μ = 0.023 (NaCl)	~23	6.7×10^8	LP/LUM/SST; τ_0^{air} = 0.33 μs; OT; [Q] ≤ 0.008 mol/L	79F442
	MV^{2+}	H_2O	μ = 0.52 (NaCl)	~23	2.0×10^9	LP/LUM/SST; τ_0^{air} = 0.34 μs; OT; [Q] ≤ 0.024 mol/L	79F442
19.41. $Ru(bpy)(Me_2dibenzoH_2phen)_2^{2+}$							
Inorganic Quenchers							
19.41.1.	$Ru(Me_2dibenzoH_2phen)_3^{2+}$	AN	μ = 0.02 (KPF_6)	~20	5.5×10^7	LP/LUM/SST; τ_0^{air} = 0.24 μs; ET	84E462
19.42. $Ru(bpy)_2(Me_2dibenzoH_2phen)^{2+}$							
Inorganic Quenchers							
19.42.1.	$Eu(crypt)^{2+}$	H_2O	1 mol/L KCl	~22	1.0×10^9	SL/LUM/SST; RT; [Q] = 0.001-0.01 mol/L	86E195
19.42.2.	$Ru(Me_2dibenzoH_2phen)_3^{2+}$	AN	μ = 0.02 (KPF_6)	~20	6.6×10^7	LP/LUM/SST; τ_0^{air} = 0.20 μs; ET	84E462

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.42. $Ru(bpy)_2(Me_2dibenzoH_2phen)^{2+}$—Continued							
Organic Quenchers							
19.42.3.	*N*-(4-Aminophenyl)aniline	AN	$\mu = 2 \times 10^{-4}$		7.1×10^9	LF/LUM/SST; $\tau_0^{air} = 0.20$ μs; RT	85A248
19.42.4.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	$\mu = 2 \times 10^{-4}$		1.3×10^{10}	LF/LUM/SST; $\tau_0^{air} = 0.20$ μs; RT	85A248
19.42.5.	1,4-Bis(*N*-phenylamino)benzene	AN	$\mu = 2 \times 10^{-4}$		6.6×10^9	LF/LUM/SST; $\tau_0^{air} = 0.20$ μs; RT	85A248
19.42.6.	*N,N*-Dimethylaniline	AN	$\mu = 2 \times 10^{-4}$		4.1×10^7	LF/LUM/SST; $\tau_0^{air} = 0.20$ μs; RT	85A248
19.42.7.	MV^{2+}	H_2O	$\mu = 0.5$		9.6×10^8	SL/LUM/SPC?; $\tau_0^{air} = 0.14$ μs; OT	81E512
19.42.8.	Phenothiazine	AN	$\mu = 2 \times 10^{-4}$		4.2×10^9	LP/LUM/SST; $\tau_0^{air} = 0.20$ μs; RT	85A248
19.42.9.	4,*N,N*-Trimethylaniline	AN	$\mu = 2 \times 10^{-4}$		8.8×10^8	LP/LUM/SST; $\tau_0^{air} = 0.20$ μs; RT	85A248
19.42.10.	Triphenylamine	AN	$\mu = 2 \times 10^{-4}$		4.8×10^6	LP/LUM/SST; $\tau_0^{air} = 0.20$ μs; RT	85A248
19.43. $Ru(bpy)_2[5\text{-}(NH_2)phen]^{2+}$							
Organic Quenchers							
19.43.1.	PolyPTZ	CH_2Cl_2	0.1 mol/L TBAF		1.2×10^8	LP/LUM/AVE; $\tau_0 = 1.2$ μs; RT; [Q] based on phenothiazine units	86A052
19.44. $Ru(bpy)_2[4\text{-}(NO_2)bpy]^{2+}$							
Inorganic Quenchers							
19.44.1.	$Eu(crypt)^{2+}$	H_2O	1 mol/L KCl	~22	2.3×10^9	SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L	86E195
19.44.2.	$Eu(crypt)^{3+}$	H_2O	1 mol/L KCl	~22	2.1×10^7	SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L	86E195
Organic Quenchers							
19.44.3.	MV^{2+}	H_2O/AN (20/1)	$\mu = 0.5$	20	1.1×10^9	SS/LUM; $\tau_0^{air} = 0.32$ μs (SL/LUM/SPC); OT	82S159
19.45. $Ru(bpy)[4,4'\text{-}(SO_3)_2bpy]_2^{2-}$							
Organic Quenchers							
19.45.1.	MV^{2+}	H_2O	$\mu = 0$ (calc'd, Na_2SO_4)	25	1.6×10^{10}	SL/LUM/SPC; $\tau_0 = 0.46$ μs; OT	85E617

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.46. $Ru(bpy)_2$(acetylacetonato)$^+$							
Organic Quenchers							
19.46.1.	1,4-Benzoquinone	AN		25	2.3×10^{10}	SS/LUM; τ_0 = 21 ns (SL/LUM/AVE); OT	84A504
19.46.2.	α-Bromo-4-nitrotoluene	AN		25	3.0×10^{9}	SS/LUM; τ_0 = 21 ns (SL/LUM/AVE); OT	84A504
19.46.3.	1,2-Dimethyl-3-nitrobenzene	AN		25	9.7×10^{6}	SS/LUM; τ_0 = 21 ns (SL/LUM/AVE); OT	84A504
19.46.4.	1,2-Dinitrobenzene	AN		25	8.4×10^{9}	SS/LUM; τ_0 = 21 ns (SL/LUM/AVE); OT	84A504
19.46.5.	1,3-Dinitrobenzene	AN		25	9.3×10^{9}	SS/LUM; τ_0 = 21 ns (SL/LUM/AVE); OT	84A504
19.46.6.	1,4-Dinitrobenzene	AN		25	1.4×10^{10}	SS/LUM; τ_0 = 21 ns (SL/LUM/AVE); OT	84A504
19.46.7.	1-Methoxy-4-nitrobenzene	AN		25	2.2×10^{7}	SS/LUM; τ_0 = 21 ns (SL/LUM/AVE); OT	84A504
19.46.8.	4-Nitrobenzamide	AN		25	4.0×10^{9}	SS/LUM; τ_0 = 21 ns (SL/LUM/AVE); OT	84A504
19.46.9.	3-Nitrotoluene	AN		25	4.4×10^{8}	SS/LUM; τ_0 = 21 ns (SL/LUM/AVE); OT	84A504
19.46.10.	4-Nitrotoluene	AN		25	1.6×10^{8}	SS/LUM; τ_0 = 21 ns (SL/LUM/AVE); OT	84A504
19.47. $Ru(bpy)_2$(3,3′-biisoquinoline)$^{2+}$							
Inorganic Quenchers							
19.47.1.	$Eu(crypt)^{2+}$	H_2O	1 mol/L KCl	~22	1.2×10^{9}	SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L	86E195
19.48. $Ru(bpy)$(3,3′-biisoquinoline)$_2^{2+}$							
Inorganic Quenchers							
19.48.1.	$Eu(crypt)^{2+}$	H_2O	1 mol/L KCl	~22	1.3×10^{9}	SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L	86E195
19.49. $Ru(bpy)_2$(2,2′-bipyrimidine)$^{2+}$							
Inorganic Quenchers							
19.49.1.	O_2	AN			1.1×10^{9}	LP/LUM/SST; τ_0 = 91 ns; p_Q = (2, 10) × 10^4 Pa	86B098
	O_2	H_2O			$\leq 1 \times 10^{9}$	LP/LUM/SST; τ_0 = 13 ns; p_Q = (2, 10) × 10^4 Pa	86B098
	O_2	MeOH			1.0×10^{9}	LP/LUM/SST; τ_0 = 36 ns; p_Q = (2, 10) × 10^4 Pa	86B098

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.50. $Ru(bpy)(2,2'\text{-biquinoline})_2^{2+}$							
Inorganic Quenchers							
19.50.1.	$Eu(crypt)^{2+}$	H_2O	1 mol/L KCl	~22	1.7×10^9	SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L	86E195
19.50.2.	$Ru(2,2'\text{-biquinoline})_3^{2+}$	AN	$\mu = 0.02$ (KPF_6)	~20	3.4×10^7	LP/LUM/SST; $\tau_0^{air} = 0.19$ μs; ET	84E462
19.51. $Ru(bpy)_2(2,2'\text{-biquinoline})^{2+}$							
Inorganic Quenchers							
19.51.1.	$Ru(2,2'\text{-biquinoline})_3^{2+}$	AN	$\mu = 0.02$ (KPF_6)	~20	5.6×10^7	LP/LUM/SST; $\tau_0^{air} = 0.18$ μs; ET	84E462
Organic Quenchers							
19.51.2.	*N*-(4-Aminophenyl)aniline	AN	$\mu = 2 \times 10^{-4}$		8.2×10^9	LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ μs; RT	85A248
19.51.3.	1,4-Bis(*N,N*-dimethylamino)benzene	AN	$\mu = 2 \times 10^{-4}$		1.4×10^{10}	LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ μs; RT	85A248
19.51.4.	1,4-Bis(*N*-phenylamino)benzene	AN	$\mu = 2 \times 10^{-4}$		8.0×10^9	LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ μs; RT	85A248
19.51.5.	*N,N*-Dimethylaniline	AN	$\mu = 2 \times 10^{-4}$		2.4×10^8	LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ μs; RT	85A248
19.51.6.	MV^{2+}	H_2O/AN (20/1)	$\mu = 0.5$	20	4.0×10^8	SS/LUM; $\tau_0^{air} = 0.15$ μs (SL/LUM/SPC); OT	82S159
19.51.7.	Phenothiazine	AN	$\mu = 2 \times 10^{-4}$		7.1×10^9	LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ μs; RT	85A248
19.51.8.	4,*N,N*-Trimethylaniline	AN	$\mu = 2 \times 10^{-4}$		2.1×10^9	LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ μs; RT	85A248
19.51.9.	Triphenylamine	AN	$\mu = 2 \times 10^{-4}$		1×10^7	LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.24$ μs; RT	85A248
19.52. $Ru(bpy)_2(en)^{2+}$							
Organic Quenchers							
19.52.1.	1,4-Benzoquinone	AN		25	2.4×10^{10}	SS/LUM; $\tau_0 = 0.11$ μs (SL/LUM/AVE); OT	84A504
19.52.2.	α-Bromo-4-nitrotoluene	AN		25	3.3×10^9	SS/LUM; $\tau_0 = 0.11$ μs (SL/LUM/AVE); OT	84A504
19.52.3.	1,2-Dimethyl-3-nitrobenzene	AN		25	1.9×10^8	SS/LUM; $\tau_0 = 0.11$ μs (SL/LUM/AVE); OT	84A504
19.52.4.	1,3-Dimethyl-2-nitrobenzene	AN		25	6.8×10^6	SS/LUM; $\tau_0 = 0.11$ μs (SL/LUM/AVE); OT	84A504
19.52.5.	1,2-Dinitrobenzene	AN		25	1.1×10^{10}	SS/LUM; $\tau_0 = 0.11$ μs (SL/LUM/AVE); OT	84A504

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.52. $Ru(bpy)_2(en)^{2+}$—Continued							
19.52.6.	1,3-Dinitrobenzene	AN		25	1.0×10^{10}	SS/LUM; τ_0 = 0.11 μs (SL/LUM/AVE); OT	84A504
19.52.7.	1,4-Dinitrobenzene	AN		25	1.6×10^{10}	SS/LUM; τ_0 = 0.11 μs (SL/LUM/AVE); OT	84A504
19.52.8.	1-Methoxy-4-nitrobenzene	AN		25	7.3×10^{8}	SS/LUM; τ_0 = 0.11 μs (SL/LUM/AVE); OT	84A504
19.52.9.	4-Nitrobenzamide	AN		25	5.4×10^{9}	SS/LUM; τ_0 = 0.11 μs (SL/LUM/AVE); OT	84A504
19.52.10.	3-Nitrotoluene	AN		25	1.6×10^{9}	SS/LUM; τ_0 = 0.11 μs (SL/LUM/AVE); OT	84A504
19.52.11.	4-Nitrotoluene	AN		25	1.2×10^{9}	SS/LUM; τ_0 = 0.11 μs (SL/LUM/AVE); OT	84A504
19.53. $Ru(bpy)[2\text{-(thiazol-2-yl)pyridine}]_2^{2+}$							
Organic Quenchers							
19.53.1.	MV^{2+}	H_2O			5.8×10^{8}	LP/LUM/SST; τ_0 = 0.30 μs; OT; f = ~0.25	83N214
19.54. $Ru(bpy)_2[2\text{-(thiazol-2-yl)pyridine}]^{2+}$							
Organic Quenchers							
19.54.1.	MV^{2+}	H_2O			6.3×10^{8}	LP/LUM/SST; τ_0 = 0.32 μs; OT; f = ~0.25	83N214
19.55. *cis*-$Ru(bpy)_2(vio)Cl^{+}$							
Organic Quenchers							
19.55.1.	*N*-Methyl-4-carbamyl-py^{+}	AN/CH_2Cl_2 (1.5/1)		−23	3.6×10^{8}	LP/LUM/AVE; τ_0 = 0.10 μs; OT	85F051
19.56. Ru(2,7-dimethyl-1,4,5,8-tetraazaphenanthrene)$_3^{2+}$							
Organic Quenchers							
19.56.1.	1,4-Dihydroxybenzene	H_2O		20	5.2×10^{9}	LP/LUM/SST; τ_0 = 90 ns; RT	85S015
19.57. Ru[4-methyl-2-(2-pyridyl)pyrimidine]$_3^{2+}$							
Organic Quenchers							
19.57.1.	MV^{2+}	H_2O		25	3.9×10^{8}	EMI; τ_0 = 0.19 μs	83E209
	MV^{2+}	H_2O	0.5 mol/L KCl	25	3.9×10^{8}	SS/LUM; τ_0 = 0.17 μs (83E209); OT	83F371
	MV^{2+}	H_2O	0.05 mol/L PHTHbuf; pH 5		2.9×10^{9}	SS/LUM; τ_0 = 0.19 μs (83E209); OT; [Q] = 0.002-0.02 mol/L	85A431

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.58. $Ru(phen)_3^{2+}$							
Inorganic Quenchers							
19.58.1.	Ag^+	H_2O	μ = 0 (calc'd)	~21	7.5×10^4	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); [Q] = 0.6-1.3 mol/L	766319
19.58.2.	ClO_4^-	H_2O	μ = 0 (calc'd)	~21	$<3 \times 10^5$	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); [Q] = 0.04 mol/L	766319
19.58.3.	Co^{2+}	H_2O	μ = 0 (calc'd)	~21	2×10^5	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); [Q] = 0.05-0.06 mol/L	766319
19.58.4.	$Co(acac)_2$	MeOH		~21	1.2×10^8	SS/LUM; τ_0 = 0.31 μs (LP/LUM/AVE); ET; [Q] = 0.001-0.008 mol/L	766319
19.58.5.	$Co(acac)_3$	MeOH		~21	8.6×10^8	SS/LUM; τ_0 = 0.31 μs (LP/LUM/AVE); OT; [Q] = 0.001-0.005 mol/L	766319
19.58.6.	$Co(AMMEsarH)^{4+}$	H_2O	0.1 mol/L HCl, 0.1 mol/L LiCl	25	5.2×10^8	SS/LUM or LP/LUM/AVE; τ_0 = 0.92 μs (766404); ET, OT	84A238
19.58.7.	$Co(AZAMEsar)^{3+}$	H_2O	μ = 0.2 (LiCl)	25	4.0×10^8	SS/LUM or LP/LUM/AVE; τ_0 = 0.92 μs (766404); ET, OT	84A238
19.58.8.	$Co(bpy)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	3.4×10^7	SS/LUM; τ_0 = 0.92 μs (766404); OT	85S022
19.58.9.	$Co(bpy)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	6.3×10^7	SS/LUM; τ_0 = 0.92 μs (766404); OT, ET	85S022
	$Co(bpy)_3^{2+}$	H_2O	0.16 mol/L Na_2SO_4, Pbuf; pH 7.8; μ = 0.5; $[Co^{II}]/[L]$ = 0.2	25	9.7×10^8	SS/LUM; τ_0 = 0.92 μs (766404); OT, ET	85S022
19.58.10.	$Co(5\text{-}Clphen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	1.9×10^8	SS/LUM; τ_0 = 0.92 μs (766404); OT	85S022
19.58.11.	$Co(5\text{-}Clphen)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	1.2×10^8	SS/LUM; τ_0 = 0.92 μs (766404); OT	85S022

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.58. $Ru(phen)_3^{2+}$—Continued							
19.58.12.	$Co(CN)_6^{3-}$	H_2O	μ = 0 (calc'd)	~21	2.7×10^7	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); ET; [Q] = 0.21 mol/L	766319
19.58.13.	$Co(C_2O_4)_3^{3-}$	H_2O	μ = 0 (calc'd)	~21	3.5×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 1.1 μs (LP/LUM/AVE); [Q] ≤ 1.2 × 10^{-4} mol/L; some SQ	766319
19.58.14.	$Co(diAMsar)^{3+}$	H_2O	0.16 mol/L LiCl, 0.05 mol/L EtMO, pH 7.5	25	3.4×10^8	SS/LUM or LP/LUM/AVE; τ_0 = 0.92 μs (766404); ET, OT; f = 0.65 at pH 8.3	84A238
19.58.15.	$Co(diAMsarH_2)^{5+}$	H_2O	0.1 mol/L HCl, 0.1 mol/L LiCl	25	8.6×10^8	SS/LUM or LP/LUM/AVE; τ_0 = 0.92 μs (766404); ET, OT; f = 1.0	84A238
19.58.16.	$Co(DMG)_2(C_2H_5)(H_2O)$	H_2O		~22	2.1×10^9	LP/LUM/SST; ET?	83E223
19.58.17.	$Co(en)_3^{3+}$	H_2O	μ = 0 (calc'd)	~21	$<1 \times 10^6$	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); [Q] = 0.003-0.007 mol/L	766319
	$Co(en)_3^{3+}$	H_2O	ACbuf; pH 4.7; μ = 0.01 (NaCl)	25	6.5×10^7	SS/LUM; τ_0 = 0.92 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
19.58.18.	$Co(4,7\text{-}Me_2phen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	2.7×10^8	SS/LUM; τ_0 = 0.92 μs (766404); OT	85S022
19.58.19.	$Co(4,7\text{-}Me_2phen)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	1.1×10^8	SS/LUM; τ_0 = 0.92 μs (766404); OT	85S022
19.58.20.	$Co(NH_3)_6^{3+}$	H_2O	μ = 0 (calc'd)	~21	~3×10^6	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); OT; [Q] = 0.002-0.005 mol/L	766319
	$Co(NH_3)_6^{3+}$	H_2O	0.1 mol/L H_2SO_4	~22	1.2×10^7	SS/LUM; τ_0^{air} = 0.51 μs (LP/LUM/AVE); OT	84A255
	$Co(NH_3)_6^{3+}$	H_2O	ACbuf; pH 4.7; μ = 0.01 (NaCl)	25	4.6×10^7	SS/LUM; τ_0 = 0.92 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
19.58.21.	$Co(NH_3)_5Cl^{2+}$	H_2O	μ = 0 (calc'd)	~21	1.3×10^8	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); OT; [Q] = 0.001-0.004 mol/L	766319
19.58.22.	$Co(phen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	9×10^7	SS/LUM; τ_0 = 0.92 μs (766404); OT	85S022

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.58.	**$Ru(phen)_3^{2+}$**—Continued						
19.58.23.	$Co(phen)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	7.7×10^7	SS/LUM; τ_0 = 0.92 μs (766404); OT	85S022
19.58.24.	$Co(sep)^{3+}$	H_2O	0.2 mol/L LiCl	25	7.0×10^8	SS/LUM; τ_0 = 0.92 μs (766404); ET, OT; f = 0.53	84A238
	$Co(sep)^{3+}$	H_2O	0.1 mol/L TEOA; pH 8.1; μ = 0.2 (LiCl)	25	6.3×10^8	SS/LUM; τ_0 = 0.92 μs (766404); ET, OT	84A238
	$Co(sep)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	5.5×10^8	SS/LUM; τ_0 = 0.92 μs (766404); ET, OT	84A238
19.58.25.	Cr^{3+}	H_2O	0.04 mol/L H_2SO_4; μ = 1.0 ($MgCl_2$)	25	1.4×10^7	SS/LUM; τ_0 = 0.92 μs (LP/LUM/AVE); ET	766404
19.58.26.	$Cr(acac)_3$	MeOH		~21	5.4×10^8	SS/LUM; τ_0 = 0.31 μs (LP/LUM/AVE); ET; [Q] = 0.001-0.004 mol/L	766319
19.58.27.	$Cr(CN)_6^{3-}$	H_2O	μ = 0 (calc'd)	~21	2.3×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 1.1 μs (LP/LUM/AVE); ET; [Q] ≤ 1.7×10^{-4} mol/L; some SQ	766319
19.58.28.	$Cr(C_2O_4)_3^{3-}$	H_2O	μ = 0 (calc'd)	~21	2.3×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 1.1 μs (LP/LUM/AVE); ET; [Q] ≤ 2.5×10^{-4} mol/L; some SQ	766319
19.58.29.	Cu^{2+}	H_2O	μ = 0 (calc'd)	~21	9×10^6	SS/LUM and LP/LUM/AVE; τ_0 = 1.1 μs (LP/LUM/AVE); OT; [Q] = 0.03-0.06 mol/L; some SQ	766319
	Cu^{2+}	H_2O	μ = 0.12 ($NaNO_3$)	25	4.6×10^7 (calc)	LP/LUM/SST; τ_0 = 0.92 μs (83N004); OT	85N199
	Cu^{2+}	H_2O	0.25 mol/L H_2SO_4; μ = 0.8-1	25	6.4×10^7	SL/LUM/SPC; τ_0 = 1.1 μs; $\Delta H^{\ddagger}$ = 13 kJ/mol; $\Delta S^{\ddagger}$ = −51 J/mol·K (20-80°C); OT	80A308
	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	7.5×10^7	SS/LUM; τ_0 = 0.92 μs (766404); OT; f = 0.54	78A090
19.58.30.	$Cu(acac)_2$	MeOH		~21	1.6×10^9	SS/LUM; τ_0 = 0.31 μs (LP/LUM/AVE); OT; [Q] = (3-12) × 10^{-4} mol/L	766319

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.58.	**$Ru(phen)_3^{2+}$**—Continued						
19.58.31.	$CuCl^+$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	2.2×10^8	SL/LUM/SPC; OT; k_q from k_{abs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031
19.58.32.	$CuCl_2$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	2.1×10^9	SL/LUM/SPC; OT; k_q from k_{abs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031
19.58.33.	$Cu(H_2O)_n^{2+}$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	6.1×10^7	SL/LUM/SPC; OT; k_q from k_{abs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031
19.58.34.	Eu^{2+}	H_2O	0.05 mol/L HCl; μ = 0.5 (NaCl)	25	4.9×10^7	SS/LUM; τ_0 = 0.92 µs (766404); RT; [Q] = 0.01-0.09 mol/L	78A087
19.58.35.	Eu^{3+}	H_2O	0.025 mol/L HCl; μ = 2.8 ($MgCl_2$)	25	3.6×10^5	SL/LUM/SPC; τ_0 = 1.1 µs; $\Delta H^{\ddagger}$ = 32 kJ/mol; $\Delta S^{\ddagger}$ = −30 J/mol·K (20-80°C); OT; Q mainly as $EuCl^{2+}$	80A308
19.58.36.	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4	25	2.8×10^9	SS/LUM; τ_0 = 0.92 µs (LP/LUM/AVE); OT	766404
	Fe^{3+}	H_2O	1 mol/L $HClO_4$		2.5×10^9	SS/LUM; τ_0 = 0.81 µs (FP/LUM/SST); OT	767009
19.58.37.	$Fe(CN)_6^{3-}$	H_2O	μ = 0 (calc'd)	~21	4.4×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 1.1 µs (LP/LUM/AVE); [Q] ≤ 5 × 10^{-5} mol/L; some SQ	766319

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.58. $Ru(phen)_3^{2+}$—Continued							
19.58.38.	$Fe(CN)_3^{4-}$	H_2O	μ = 0 (calc'd)	~21	7.3×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 1.1 μs (LP/LUM/AVE); ET?; [Q] ≤ 5×10^{-5} mol/L; some SQ	766319
	$Fe(CN)_3^{4-}$	H_2O			3.4×10^{10}	SL/LUM/SPC; τ_0^{air} = 0.42 μs; [Q] ≤ 2×10^{-4} mol/L; some SQ	85R098
	$Fe(CN)_3^{4-}$	H_2O	0.005 mol/L TRbuf; 0.05 mol/L NaCl; pH 7.2		8.4×10^9	SL/LUM/SPC; τ_0^{air} = 0.52 μs; [Q] ≤ 4×10^{-4} mol/L; some SQ	85R098
19.58.39.	Fe^{III}(cytochrome c)	H_2O	Pbuf; pH 7		$>8 \times 10^7$	LP/ABS/AVE; τ_0 = 0.92 μs (80E040); OT; [Q] = (1-10) × 10^{-5} mol/L; 10.6% of Q as Fe^{II}	84A306
19.58.40.	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.063 ($NaNO_3$)	~23	9.0×10^7	LP/LUM/AVE; τ_0 = 1.1 μs; OT	84A148
	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.5 ($NaNO_3$)	~23	3.1×10^8	LP/LUM/AVE; τ_0 = 1.1 μs; OT	84A148
19.58.41.	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.09 mol/L $NaNO_3$		1.3×10^9	SS/LUM, LP/LUM/AVE; τ_0 = 1.1 μs; OT; [Q] = (2-40) × 10^{-4} mol/L	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.99 mol/L $NaNO_3$		1.9×10^9	SS/LUM, LP/LUM/AVE; τ_0 = 1.1 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.01 mol/L SLS		1.2×10^7	LP/LUM/AVE; τ_0 = 1.8 μs; OT	84N034
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		7.2×10^6	LP/LUM/AVE; τ_0 = 1.8 μs; OT	84N034
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, [$NaNO_3$] + [NaCl] = 0.40 mol/L, 0.01 mol/L SLS		7.1×10^6	LP/LUM/AVE; τ_0 = 2.0 μs; OT	84N034
19.58.42.	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, [$NaNO_3$] + [NaCl] = 0.99 mol/L		5.5×10^9	LP/LUM/AVE; τ_0 = 1.1 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.58.	**$Ru(phen)_3^{2+}$**—Continued						
	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		~4 × 10^6	LP/LUM/AVE; τ_0 = 1.8 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84N034
19.58.43.	$HgCl_4^{2-}$	H_2O	0.01 mol/L HNO_3, $[NaNO_3]$ + [NaCl] = 0.99 mol/L		3.2 × 10^8	LP/LUM/AVE; τ_0 = 1.1 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
19.58.44.	I^-	H_2O	μ = 0 (calc'd)	~21	1 × 10^6	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); [Q] = 0.14-0.16 mol/L	766319
19.58.45.	NO_3^-	H_2O	μ = 0 (calc'd)	~21	<1 × 10^5	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); [Q] = 0.1 mol/L	766319
19.58.46.	Ni^{2+}	H_2O	μ = 0 (calc'd)	~21	6.6 × 10^5	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); [Q] = 0.05-0.06 mol/L	766319
19.58.47.	$Ni(acac)_2$	MeOH		~21	4.2 × 10^7	SS/LUM; τ_0 = 0.31 μs (LP/LUM/AVE); ET; [Q] = 0.002-0.007 mol/L	766319
19.58.48.	O_2	H_2O		~21	4.7 × 10^9	SS/LUM; τ_0 = 1.0 μs (LP/LUM/SST); ET	737658
	O_2	H_2O		25	4.2 × 10^9	SS/LUM; τ_0 = 0.92 μs (LP/LUM/AVE); OT?	766404
	O_2	MeOH		~21	3.2 × 10^9	SS/LUM; τ_0 = 0.31 μs (LP/LUM/SST); ET; same k_q from same lab in 777221	737658
19.58.49.	$PtCl_4^{2-}$	H_2O	μ = 0 (calc'd)	~21	1.7 × 10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 1.1 μs (LP/LUM/AVE); ET; [Q] ≤ 2.2 × 10^{-4} mol/L; some SQ	766319
19.58.50.	$PtCl_5^{2-}$	H_2O	μ = 0 (calc'd)	~21	~2 × 10^{10}	SS/LUM; τ_0 = 1.1 μs (LP/LUM/AVE); OT, ET?; [Q] = (1-3) × 10^{-4} mol/L	766319
19.58.51.	$Rh(bpy)_3^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	9.9 × 10^8	SS/LUM or LP/LUM/SST; OT	81N003
	$Rh(bpy)_3^{3+}$	H_2O	0.5 mol/L NaOH; μ = 0.5	25	7.1 × 10^8	SS/LUM or LP/LUM/SST; OT	81N003
	$Rh(bpy)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	6 × 10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.92 μs (766404); OT	82A145

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.58.	**$Ru(phen)_3^{2+}$**—Continued						
19.58.52.	*cis*-$Rh(bpy)_2(H_2O)_2^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	6.5×10^8	SS/LUM or LP/LUM/SST; OT	81N003
19.58.53.	*cis*-$Rh(bpy)_2(OH)_2^{+}$	H_2O	0.5 mol/L NaOH; μ = 0.5	25	1.2×10^7	SS/LUM or LP/LUM/SST; ET	81N003
19.58.54.	$Rh(4,4'\text{-}Me_2bpy)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	2×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.92 μs (766404); OT	82A145
19.58.55.	$Rh(5\text{-}Mephen)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	9.8×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.92 μs (766404); OT	82A145
19.58.56.	$Rh(5,6\text{-}Me_2phen)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	9.5×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.92 μs (766404); OT	82A145
19.58.57.	$Rh(phen)_3^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	1.2×10^9	SS/LUM or LP/LUM/SST· OT	81N003
19.58.58.	$S_2O_3^{2-}$	H_2O	0.5 mol/L H_2SO_4(?)	20(?)	5.6×10^8	SS/LUM; OT	80F128
19.58.59.	Ti^{3+}	H_2O	1.5 mol/L HCl; μ = 3.0 (LiCl)	25	6.2×10^6	LP/LUM/SST; τ_0 = 0.72 μs; ET; 20-60% Ti^{3+} coordinated by Cl^-	79A183
	Organic Quenchers						
19.58.60.	Ascorbate ion	H_2O	pH 5; μ = 0.7 (Na_2SO_4)	25	2.3×10^8	SS/LUM; τ_0 = 0.92 μs (766404); RT	82A278
19.58.61.	*N,N*-Bis(2-hydroxyethyl)-vio^{2+}	H_2O			2.7×10^9	SS/LUM; τ_0 = 0.9 μs; OT; [Q] = (2-10) × 10^{-4} mol/L	78A269
19.58.62.	$bpyH^+$	H_2O	μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	1×10^7	SS/LUM; τ_0 = 0.92 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
	$bpyH^+$	H_2O	μ = 0.5 (HCl, NaCl)	25	2.2×10^7	SS/LUM; τ_0 = 0.92 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.58.63.	$bpyH_2^{2+}$	H_2O	μ = 0.5 (HCl, NaCl)	25	2.6×10^9	SS/LUM; τ_0 = 0.92 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.58.64.	*N,N*-Dibenzyl-vio^{2+}	H_2O			3.1×10^9	SS/LUM; τ_0 = 0.9 μs; OT; [Q] = (2-10) × 10^{-4} mol/L	78A269
19.58.65.	*N,N*-Dibutyl-vio^{2+}	AN	μ = 0 (calc'd)		2.7×10^8	LP/LUM/SST; OT	83N153
19.58.66.	*N,N*-Diethyl-vio^{2+}	AN	μ = 0 (calc'd)		2.4×10^8	LP/LUM/SST; OT	83N153
19.58.67.	*N,N*-Dihexyl-vio^{2+}	AN	μ = 0 (calc'd)		2.8×10^8	LP/LUM/SST; OT	83N153

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.58.	**$Ru(phen)_3^{2+}$**—Continued						
19.58.68.	4,4′-Dimethyl-bpyH_2^{2+}	H_2O	μ = 0.5 (HCl, NaCl)	25	2.7×10^9	SS/LUM; τ_0 = 0.92 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.58.69.	DQ^{2+}	H_2O	μ = 0.5 (HCl, NaCl)	25	3.3×10^9	SS/LUM; τ_0 = 0.92 μs (766404); [Q] = (5-50) × 10^{-4} mol/L	83C017
19.58.70.	MV^{2+}	AN	0.1 mol/L TBAP		2.9×10^9	SS/LUM; τ_0 = 0.50 μs (FP/LUM/SST); OT	767009
	MV^{2+}	H_2O			2.4×10^9	SS/LUM; τ_0 = 0.9 μs; OT; [Q] = (2-10) × 10^{-4} mol/L	78A269
19.58.71.	phenH^+	H_2O	μ = 0.5 ($NaHSO_4$, Na_2SO_4)	25	4.6×10^8	SS/LUM; τ_0 = 0.92 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
	phenH^+	H_2O	μ = 0.5 (HCl, NaCl)	25	7.8×10^8	SS/LUM; τ_0 = 0.92 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.58.72.	phenH_2^{2+}	H_2O	μ = 0.5 (HCl, NaCl)	25	2.8×10^9	SS/LUM; τ_0 = 0.92 μs (766404); OT; [Q] = (5-50) × 10^{-4} mol/L; k_q from pH dependence of K_{SV}	83C017
19.58.73.	*N,N′*-(Trimethylene)-bpy^{2+}	H_2O			2.1×10^9	SS/LUM; τ_0 = 0.9 μs; OT; [Q] = (2-10) × 10^{-4} mol/L	78A269
19.59.	**$Ru(phen)_2(5\text{-Brphen})^{2+}$**						
	Inorganic Quenchers						
19.59.1.	O_2	MeOH			2.3×10^9	SS/LUM; τ_0 = 0.99 μs (LP/LUM/AVE); ET	777221
19.60.	***cis*-$Ru(phen)_2(CN)_2$**						
	Inorganic Quenchers						
19.60.1.	Co^{2+}	H_2O		~21	1.0×10^7	FP/LUM/SST; τ_0 = 0.71 μs; ET; some SQ	776220
19.60.2.	$Co(acac)_2$	MeOH		~21	3.1×10^7	SS/LUM; τ_0 = 1.6 μs (FP/LUM/SST); ET	776220
19.60.3.	$Co(acac)_3$	MeOH		~21	5.8×10^8	SS/LUM; τ_0 = 1.6 μs (FP/LUM/SST)	776220
19.60.4.	$Co(CN)_6^{3-}$	H_2O		~21	2.8×10^6	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST)	776220

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.60.	***cis*-Ru(phen)$_2$(CN)$_2$**—Continued						
19.60.5.	$Co(C_2O_4)_3^{3-}$	H_2O		~21	3.2×10^9	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST); OT	776220
19.60.6.	$Co(NH_3)_6^{3+}$	H_2O		~21	2.3×10^9	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST); OT	776220
19.60.7.	$Co(NH_3)_5Cl^{2+}$	H_2O		~21	3.9×10^9	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST); OT	776220
19.60.8.	$Cr(acac)_3$	MeOH		~21	3.6×10^8	SS/LUM; τ_0 = 1.6 μs (FP/LUM/SST); ET	776220
19.60.9.	$Cr(CN)_6^{3-}$	H_2O		~21	4.0×10^8	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST); ET	776220
19.60.10.	$Cr(C_2O_4)_3^{3-}$	H_2O		~21	2.7×10^8	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST); ET	776220
19.60.11.	*trans*-$Cr(en)_2Cl_2^+$	H_2O/DMF (3/1)	7.5×10^{-4} mol/L HCl	20	3.6×10^8	SS/LUM; τ_0 = 1.0 μs (LP/LUM/AVE); $\Delta H^\ddagger$ = 7.7 kJ/mol; ET	81E237
19.60.12.	*trans*-$Cr(en)_2F_2^+$	H_2O/DMF (3/1)	7.5×10^{-4} mol/L HCl	20	3.0×10^7	SS/LUM; τ_0 = 1.0 μs (LP/LUM/AVE); $\Delta H^\ddagger$ = 0.96 kJ/mol; ET	81E237
19.60.13.	*trans*-$Cr(en)_2(NCS)_2^+$	H_2O/DMF (3/1)	7.5×10^{-4} mol/L HCl	20	5.3×10^8	SS/LUM; τ_0 = 1.0 μs (LP/LUM/AVE); $\Delta H^\ddagger$ = 9.4 kJ/mol; ET	81E237
19.60.14.	*trans*-$Cr(en)_2(NCS)Cl^+$	H_2O/DMF (3/1)	7.5×10^{-4} mol/L HCl	20	4.1×10^8	SS/LUM; τ_0 = 1.0 μs (LP/LUM/AVE); ET	81E237
19.60.15.	*trans*-$Cr(en)_2(ONO)Cl^+$	H_2O/DMF (3/1)	7.5×10^{-4} mol/L HCl	20	1.9×10^8	SS/LUM; τ_0 = 1.0 μs (LP/LUM/AVE); ET	81E237
19.60.16.	*trans*-$Cr(NH_3)_2(NCS)_4^-$	H_2O		~21	3.3×10^9	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST); ET	776220
19.60.17.	Cu^{2+}	H_2O		~21	4.8×10^8	FP/LUM/SST; τ_0 = 0.71 μs; OT, ET; same k_q from same lab in 74E502; some SQ	776220
19.60.18.	$Cu(acac)_2$	MeOH		~21	1.5×10^9	SS/LUM; τ_0 = 1.6 μs (FP/LUM/SST); OT, ET	776220
19.60.19.	$Fe(CN)_6^{3-}$	H_2O		~21	5.5×10^9	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST); OT	776220
19.60.20.	$Fe(CN)_6^{4-}$	H_2O		~21	5.1×10^8	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST); ET, RT	776220
19.60.21.	I^-	H_2O		~21	4×10^5	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST)	776220

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.60. *cis*-**$Ru(phen)_2(CN)_2$**—Continued							
19.60.22.	Ni^{2-}	H_2O		~21	2.0×10^7	FP/LUM/SST; τ_0 = 0.71 μs; ET; [Q] ≤ 0.14 mol/L; some SQ	776220
19.60.23.	$Ni(acac)_2$	MeOH		~21	6.0×10^7	SS/LUM; τ_0 = 1.6 μs (FP/LUM/SST)	776220
19.60.24.	$NiCl_4^{2-}$	H_2O		~21	5.6×10^9	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST)	776220
19.60.25.	O_2	H_2O		~21	5.5×10^9	SS/LUM; τ_0 = 0.71 μs (LP/LUM/SST); ET	737658
	O_2	MeOH			5.4×10^9	SS/LUM; τ_0 = 1.6 μs (LP/LUM/AVE); ET; k_q = 5.0×10^9 L mol^{-1} s^{-1} at ~21 °C with SS/LUM and τ_0 = 1.7 μs from same lab in 737658	777221
19.60.26.	$PtCl_4^{2-}$	H_2O		~21	1.0×10^9	SS/LUM; τ_0 = 0.71 μs (FP/LUM/SST); ET	776220
19.61.	**$Ru(phen)_2(5\text{-}Clphen)^{2+}$**						
Inorganic Quenchers							
19.61.1.	O_2	MeOH			2.3×10^9	SS/LUM; τ_0 = 0.95 μs (LP/LUM/AVE); ET	777221
19.62.	**$Ru(phen)_2[4,7\text{-}(PhSO_3)_2phen]$**						
Inorganic Quenchers							
19.62.1.	O_2	H_2O		25	3.0×10^9	LP/LUM/AVE; τ_0 = 3.5 μs; $p_Q = 2 \times 10^4$ Pa	85E012
	O_2	H_2O	variable [β-CD]	25	1.5×10^9	LP/LUM/AVE; τ_0 = 2.7 μs; $p_Q = 2 \times 10^4$ Pa; τ_0 and k_q from β-CD titration at constant p_Q; S as 1:1 complex with β-CD	85E012
	O_2	H_2O	variable [β-CD]	25	1.2×10^9	LP/LUM/AVE; τ_0 = 3.6 μs; $p_Q = 2 \times 10^4$ Pa; τ_0 and k_q from β-CD titration at constant p_Q; S as 1:2 complex with β-CD	85E012
	O_2	MeOH			1.8×10^9	SS/LUM; τ_0 = 4.0 μs (LP/LUM/AVE); ET	777221
Organic Quenchers							
19.62.2.	Ascorbate ion	H_2O	pH 5; μ = 0.7 (Na_2SO_4)	25	2.9×10^7	SS/LUM; τ_0 = 2.5 μs; RT; τ estimated	82A278

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.63. $Ru(phen)_2(4,7\text{-}Ph_2phen)^{2+}$							
Inorganic Quenchers							
19.63.1.	Cu^{2+}	H_2O	μ = 0.12 ($NaNO_3$)	25	2.0×10^7 (calc)	LP/LUM/SST; τ_0 = 3.2 μs (83N004); OT	85N199
19.63.2.	O_2	H_2O		25	3.7×10^9	LP/LUM/AVE; τ_0 = 3.1 μs; $p_Q = 2 \times 10^4$ Pa	85E012
	O_2	H_2O	variable [β-CD]	25	1.3×10^9	LP/LUM/AVE; τ_0 = 2.8 μs; $p_Q = 2 \times 10^4$ Pa; τ_0 and k_q from β-CD titration at constant p_Q; S as 1:1 complex with β-CD	85E012
	O_2	H_2O	variable [β-CD]	25	1.3×10^9	LP/LUM/AVE; τ_0 = 3.8 μs; $p_Q = 2 \times 10^4$ Pa; τ_0 and k_q from β-CD titration at constant p_Q; S as 1:2 complex with β-CD	85E012
	O_2	MeOH			2.6×10^9	SS/LUM; τ_0 = 2.6 μs (LP/LUM/AVE); ET	777221
19.64. $Ru(phen)_2(5\text{-}Phphen)^{2+}$							
Inorganic Quenchers							
19.64.1.	O_2	H_2O		25	4.2×10^9	LP/LUM/AVE; τ_0 = 1.0 μs; $p_Q = 2 \times 10^4$ Pa	85E012
	O_2	H_2O	variable [β-CD]	25	1.6×10^9	LP/LUM/AVE; τ_0 = 1.7 μs; $p_Q = 2 \times 10^4$ Pa; τ_0 and k_q from β-CD titration at constant p_Q; S as 1:1 complex with β-CD	85E012
19.65. $Ru[2\text{-(phenylazo)pyridine}]_3^{2+}$							
Inorganic Quenchers							
19.65.1.	Ce^{4+}	H_2O	0.5 mol/L H_2SO_4	22	3.6×10^9	SS/LUM; τ_0^{air} = 0.42 μs (LP/LUM/AVE); OT	84E347
19.65.2.	Fe^{2+}	H_2O	0.5 mol/L H_2SO_4	22	3.6×10^{10}	SS/LUM; τ_0^{air} = 0.42 μs (LP/LUM/AVE); RT	84E347
19.65.3.	$Fe(CN)_6^{4-}$	H_2O	0.5 mol/L H_2SO_4	22	1.8×10^{10}	SS/LUM; τ_0^{air} = 0.42 μs (LP/LUM/AVE); RT	84E347
19.66. Ru(phthalocyanine)$(DMF)_2$							
Inorganic Quenchers							
19.66.1.	$Co(NH_3)_6^{3+}$	AN/H_2O (2.3/1)	0.1 mol/L TEAP		4.7×10^9 (corr)	LP/ABS/SST	83E262

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.66. Ru(phthalocyanine)(DMF)$_2$—Continued							
19.66.2.	$Co(NH_3)_5Cl^{2+}$	AN/H_2O (2.3/1)	0.1 mol/L TEAP		4.7×10^9 (corr)	LP/ABS/SST	83E262
19.66.3.	$Co(NH_3)_5(H_2O)^{3+}$	AN/H_2O (2.3/1)	0.1 mol/L TEAP		2.6×10^9 (corr)	LP/ABS/SST	83E262
19.66.4.	Fe^{3+}	AN/H_2O (2.3/1)	0.1 mol/L TEAP		7.0×10^9 (corr)	LP/ABS/SST	83E262
19.66.5.	$Fe(CN)_6^{3-}$	AN/H_2O (2.3/1)	0.1 mol/L TEAP		2.0×10^9 (corr)	LP/ABS/SST	83E262
19.66.6.	$Ru(NH_3)_6^{3+}$	AN/H_2O (2.3/1)	0.1 mol/L TEAP		5.5×10^9 (corr)	LP/ABS/SST; [Q] ≤ 0.02 mol/L	83E262
Organic Quenchers							
19.66.7.	*N,N*-Bis(2-hydroxyethyl)-vio^{2+}	AN	0.1 mol/L TEAP		2.7×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.8.	*N,N*-Dibenzoyl-vio^{2+}	AN	0.1 mol/L TEAP		1.7×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.9.	*N,N*-Diethyl-bpy^{2+}	AN	0.1 mol/L TEAP		7.6×10^8 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.10.	*N,N*-Diethyl-4,4′-dimethyl-bpy^{2+}	AN	0.1 mol/L TEAP		3.8×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT; [Q] ≤ 0.025 mol/L	83E262
19.66.11.	*N,N*-Dimethyl-bpy^{2+}	AN	0.1 mol/L TEAP		2.5×10^8 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.12.	1,2-Dinitrobenzene	AN	0.1 mol/L TEAP		2.6×10^8 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.13.	1,3-Dinitrobenzene	AN	0.1 mol/L TEAP		3.6×10^7 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.14.	1,4-Dinitrobenzene	AN	0.1 mol/L TEAP		5.9×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT; [Q] ≤ 0.015 mol/L	83E262
19.66.15.	*N,N*-Dipropyl-bpy^{2+}	AN	0.1 mol/L TEAP		6×10^7 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.16.	*N,N*-Ethylene-4,4′-dimethyl-bpy^{2+}	AN	0.1 mol/L TEAP		1.6×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.17.	1-Iodo-4-nitrobenzene	AN	0.1 mol/L TEAP		6.8×10^8 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.18.	Methyl 3-nitrobenzoate	AN	0.1 mol/L TEAP		6×10^6 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.19.	Methyl 4-nitrobenzoate	AN	0.1 mol/L TEAP		8×10^6 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.66. Ru(phthalocyanine)(DMF)$_2$—Continued							
19.66.20.	MV^{2+}	AN	0.1 mol/L TEAP		2.8×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT; [Q] ≤ 0.025 mol/L	83E262
19.66.21.	2-Nitrobenzaldehyde	AN	0.1 mol/L TEAP		1×10^7 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.22.	3-Nitrobenzaldehyde	AN	0.1 mol/L TEAP		1.2×10^8 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.23.	4-Nitrobenzaldehyde	AN	0.1 mol/L TEAP		1.1×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.66.24.	4-Nitroso-*N,N*-dimethylaniline	AN	0.1 mol/L TEAP		5.0×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.67. Ru(phthalocyanine)(pyridine)$_2$							
Inorganic Quenchers							
19.67.1.	$Co(NH_3)_6^{3+}$	AN/H_2O (2.3/1)	0.1 mol/L TEAP		1.6×10^9 (corr)	LP/ABS/SST; OT	83E262
19.67.2.	$Co(NH_3)_5Cl^{2+}$	AN/H_2O (2.3/1)	0.1 mol/L TEAP		1.0×10^9 (corr)	LP/ABS/SST; OT	83E262
19.67.3.	$Co(NH_3)_5(H_2O)^{3+}$	AN/H_2O (2.3/1)	0.1 mol/L TEAP		1.2×10^9 (corr)	LP/ABS/SST; OT	83E262
19.67.4.	Fe^{3+}	AN/H_2O (2.3/1)	0.1 mol/L TEAP		7.4×10^9 (corr)	LP/ABS/SST; OT	83E262
19.67.5.	$Fe(CN)_6^{3-}$	AN/H_2O (2.3/1)	0.1 mol/L TEAP		1.4×10^9 (corr)	LP/ABS/SST; OT	83E262
19.67.6.	$Ru(NH_3)_6^{3+}$	AN/H_2O (2.3/1)	0.1 mol/L TEAP		7.7×10^8 (corr)	LP/ABS/SST; OT	83E262
Organic Quenchers							
19.67.7.	*N,N'*-Bis(2-hydroxyethyl)-vio^{2+}	AN	0.1 mol/L TEAP		2.4×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.67.8.	*N,N'*-Dibenzoyl-vio^{2+}	AN	0.1 mol/L TEAP		2.0×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.67.9.	*N,N'*-Dibutyl-bpy^{2+}	AN	0.1 mol/L TEAP		3.9×10^8 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.67.10.	*N,N'*-Diethyl-bpy^{2+}	AN	0.1 mol/L TEAP		2.5×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.67.11.	*N,N'*-Diethyl-4,4'-dimethyl-bpy^{2+}	AN	0.1 mol/L TEAP		2.8×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.67.12.	*N,N'*-Dimethyl-bpy^{2+}	AN	0.1 mol/L TEAP		1.0×10^8 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.67. Ru(phthalocyanine)(pyridine)$_2$—Continued							
19.67.13.	1,2-Dinitrobenzene	AN	0.1 mol/L TEAP		8.7×10^7 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
	1,2-Dinitrobenzene	CH_2Cl_2			8.7×10^7 (corr)	LP/LUM/SST; τ_0 = ~0.2 μs; OT; [Q] ≤ 0.25 mol/L	82C018
19.67.14.	1,3-Dinitrobenzene	AN	0.1 mol/L TEAP		3.8×10^7 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
	1,3-Dinitrobenzene	CH_2Cl_2			3.8×10^7 (corr)	LP/LUM/SST; τ_0 = ~0.2 μs; OT	82C018
19.67.15.	1,4-Dinitrobenzene	AN	0.1 mol/L TEAP		2.2×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
	1,4-Dinitrobenzene	CH_2Cl_2			2.2×10^9 (corr)	LP/LUM/SST; τ_0 = ~0.2 μs; OT	82C018
19.67.16.	*N,N'*-Dipropyl-bpy^{2+}	AN	0.1 mol/L TEAP		1.2×10^8 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.67.17.	*N,N'*-Ethylene-4,4'-dimethyl-bpy^{2+}	AN	0.1 mol/L TEAP		1.3×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.67.18.	1-Iodo-4-nitrobenzene	AN	0.1 mol/L TEAP		1×10^7 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
	1-Iodo-4-nitrobenzene	CH_2Cl_2			1.0×10^7 (corr)	LP/LUM/SST; τ_0 = ~0.2 μs; OT	82C018
19.67.19.	Methyl 3-nitrobenzoate	AN	0.1 mol/L TEAP		6.8×10^7 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
	Methyl 3-nitrobenzoate	CH_2Cl_2			6.8×10^7 (corr)	LP/LUM/SST; τ_0 = ~0.2 μs; OT	82C018
19.67.20.	Methyl 4-nitrobenzoate	AN	0.1 mol/L TEAP		8.6×10^7 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
	Methyl 4-nitrobenzoate	CH_2Cl_2			8.6×10^7 (corr)	LP/LUM/SST; τ_0 = ~0.2 μs; OT	82C018
19.67.21.	MV^{2+}	AN	0.1 mol/L TEAP		2.0×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
19.67.22.	2-Nitrobenzaldehyde	AN	0.1 mol/L TEAP		1.5×10^7 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
	2-Nitrobenzaldehyde	CH_2Cl_2			1.5×10^7 (corr)	LP/LUM/SST; τ_0 = ~0.2 μs; OT	82C018
19.67.23.	3-Nitrobenzaldehyde	AN	0.1 mol/L TEAP		1.3×10^7 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
	3-Nitrobenzaldehyde	CH_2Cl_2			1.3×10^7 (corr)	LP/LUM/SST; τ_0 = ~0.2 μs; OT	82C018

TABLE 19. Quenching of excited ruthenium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.67. Ru(phthalocyanine)(pyridine)$_2$—Continued							
19.67.24.	4-Nitrobenzaldehyde	AN	0.1 mol/L TEAP		2.6×10^8 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
	4-Nitrobenzaldehyde	CH_2Cl_2			2.6×10^8 (corr)	LP/LUM/SST; τ_0 = ~0.2 μs; OT; [Q] ≤ 0.15 mol/L	82C018
19.67.25.	4-Nitroso-*N,N*-dimethylaniline	AN	0.1 mol/L TEAP		1.2×10^9 (corr)	LP/ABS/SST; τ_0 = 0.17 μs; OT	83E262
	4-Nitroso-*N,N*-dimethylaniline	CH_2Cl_2			1.2×10^9 (corr)	LP/LUM/SST; τ_0 = ~0.2 μs; OT; [Q] ≤ 0.025 mol/L	82C018
19.68. Ru(terpy)(bpy)(NH$_3$)$^{2+}$							
Inorganic Quenchers							
19.68.1.	Fe^{3+}	H_2O	1 mol/L $HClO_4$		3.1×10^9	SS/LUM; τ_0 = 0.43 μs (FP/LUM/SST); OT	76T009
19.69. Ru(1,4,5,8-tetraazaphenanthrene)$_3^{2+}$							
Organic Quenchers							
19.69.1.	Cysteine	H_2O	pH 9		2.2×10^9	RT	85F572
19.69.2.	1,4-Dihydroxybenzene	H_2O		20	4.9×10^9	LP/LUM/SST; τ_0 = 0.20 μs; RT; $k_q = 4.5 \times 10^9$ L mol^{-1} s^{-1} at pH 5 from same lab in 85F572	85S015
19.69.3.	Triethanolamine	H_2O	pH 9		3×10^8	RT	85F572
19.70. Ru(5,10,15,20-tetraphenylporphyrin)							
Organic Quenchers							
19.70.1.	1,4-Benzoquinone	EtOH			3.0×10^9	LP/ABS/SST, SS/LUM; OT; f = 0.07	83F182
19.71. Ru(5,10,15,20-tetraphenylporphyrin)(CO)							
Organic Quenchers							
19.71.1.	4,4′-Bis(*N,N*-dimethylamino)biphenyl	DMSO		~23	2.0×10^7	SS/LUM; τ_0 = 36 μs (LP/LUM/SST); RT	81C001
19.71.2.	*N*-Ethylphenazinium cation	DMSO		~23	2.5×10^9	SS/LUM; τ_0 = 36 μs (LP/LUM/SST); OT	81C001
19.71.3.	*N*-Methyl-4-carbomethoxy-py$^+$	DMSO		~23	2.1×10^5	SS/LUM; τ_0 = 36 μs (LP/LUM/SST); OT	81C001
19.71.4.	*N*-Methyl-4-cyano-py$^+$	DMSO		~23	3.4×10^8	SS/LUM; τ_0 = 36 μs (LP/LUM/SST); OT	81C001
19.71.5.	MV^{2+}	DMSO		~23	6.6×10^8	SS/LUM; τ_0 = 36 μs (LP/LUM/SST); OT	81C001

TABLE 19. Quenching of excited rutherium complexes (except $Ru(bpy)_3^{2+}$)—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
19.72. Ru[2-(thiazol-2-yl)pyridine]$_3^{2+}$							
Organic Quenchers							
19.72.1.	MV^{2+}	H_2O			5.2×10^8	LP/LUM/SST; τ_0 = 0.22 μs; OT; f = ~0.25	83N214

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**						
20.1.1.	Ag^+	AN			1.1×10^5	SS/LUM; OT	80C004
	Ag^+	H_2O	$\mu = 0$ (calc'd)	~21	6.7×10^5	SS/LUM; $\tau_0 = 0.60$ μs (LF/LUM/AVE); [Q] = 0.005-0.012 mol/L	766319
	Ag^+	H_2O			3.5×10^6	SS/LUM; E_a = ~2.5 kJ/mol (23-50°C); OT	80C004
20.1.2.	$Ag(bpy)_2^+$	AN			1.5×10^6	SS/LUM; OT	80C004
20.1.3.	ClO_4^-	H_2O	$\mu = 0$ (calc'd)	~21	$<1 \times 10^6$	SS/LUM; $\tau_0 = 0.60$ μs (LF/LUM/AVE); [Q] = 0.04 mol/L	766319
20.1.4.	Co^{2+}	AN/2-PrOH/H_2O (3/1/1)	CO_2 satd		5×10^6	SS/LUM; OT?	86F230
	Co^{2+}	AN/TEOA/H_2O (3/1/1)			7.1×10^7	SS/LUM; OT?	86F230
	Co^{2+}	H_2O	$\mu = 0$ (calc'd)	~21	$<5 \times 10^5$	SS/LUM; $\tau_0 = 0.60$ μs (LF/LUM/AVE); [Q] = 0.05-0.07 mol/L	766319
20.1.5.	$Co(acac)_2$	MeOH		~21	5.8×10^7	SS/LUM; $\tau_0 = 0.77$ μs (LF/LUM/AVE); ET; [Q] = 0.002-0.008 mol/L	766319
20.1.6.	$Co(acac)_3$	H_2O		16-18	8.0×10^8	LP/LUM/SST; $\tau_0^{air} = 0.38$ μs; OT; [Q] = 0.0013 mol/L	80E566
	$Co(acac)_3$	H_2O		16-18	1.1×10^9	LP/LUM/SST; $\tau_0^{air} = 0.37$ μs; OT; [Q] = 0.0013 mol/L; $p_{app} = 2.3 \times 10^8$ Pa	80E566
	$Co(acac)_3$	H_2O		22	1.1×10^9	SS/LUM; $\tau_0 = 0.60$ μs (765014); OT; [Q] = (5-25) $\times 10^{-4}$ mol/L	78A219
	$Co(acac)_3$	H_2O	0.0054 mol/L PVS	22	4.9×10^8	SS/LUM; $\tau_0 = 0.60$ μs (765014); OT; [Q] = (5-25) $\times 10^{-4}$ mol/L	78A219
	$Co(acac)_3$	MeOH		~21	5.6×10^8	SS/LUM; $\tau_0 = 0.77$ μs (LF/LUM/AVE); OT; [Q] = 0.001-0.010 mol/L	766319
20.1.7.	$Co(AMcapten)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.1×10^9	LP/LUM/SST; $\tau_0 = 0.64$ μs; ET, OT; $f = 0.53$	85F222
	$Co(AMcapten)^{3+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	1.8×10^{10}	LP/LUM/SST; $\tau_0 = 0.64$ μs	85F222

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.8.	$Co(AMMEsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	6×10^7	LP/LUM/SST; τ_0 = 0.64 μs; ET (80%), OT (20%); f = 0.2; same k_q from same lab in 83S090	85F222
	$Co(AMMEsar)^{3+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	3.3×10^8	LP/LUM/SST; τ_0 = 0.64 μs; same k_q from same lab in 83S090	85F222
20.1.9.	$Co(AZAcapten)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.3×10^9	LP/LUM/SST; τ_0 = 0.64 μs; OT; f = 0.97; same k_q from same lab in 83S090	85F222
	$Co(AZAcapten)^{3+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	5.8×10^9	LP/LUM/SST; τ_0 = 0.64 μs; same k_q from same lab in 83S090	85F222
20.1.10.	$Co(AZAMEsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	4.5×10^7	LP/LUM/SST; τ_0 = 0.64 μs; ET (70%), OT (30%); f = 0.3	85F222
20.1.11.	$Co(bpy)^{2+}$	H_2O	0.17 mol/L Na_2SO_4, 0.025 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	4.2×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
	$Co(bpy)^{2+}$	H_2O	0.5 mol/L NaCl, 0.025 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	4.7×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
	$Co(bpy)^{2+}$	H_2O	0.5 mol/L NaF, 0.025 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	4.3×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
	$Co(bpy)^{2+}$	H_2O	0.5 mol/L NaBr, 0.025 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	5.2×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
	$Co(bpy)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	5.5×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
20.1.12.	$Co(bpy)_3^{+}$	AN	0.1 mol/L TEAP	25	6.6×10^9	LP/LUM/AVE; τ_0 = 0.85 μs; RT	86A077
20.1.13.	$Co(bpy)_3^{2+}$	AN	0.01 mol/L TEAP	25	8×10^7	SS/LUM; τ_0 = 0.85 μs (LP/LUM/SST); OT, ET?	86A077

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1. $Ru(bpy)_3^{2+}$—Continued							
	$Co(bpy)_3^{2+}$	AN	0.1 mol/L TEAP	25	1.1×10^8	SS/LUM; τ_0 = 0.85 μs (LP/LUM/AVE); OT, ET?	86A077
	$Co(bpy)_3^{2+}$	H_2O	0.16 mol/L Na_2SO_4, Pbuf; pH 7.8; μ = 0.5; $[Co^{II}]/[L]$ = 0.2	25	5.3×10^8	SS/LUM; τ_0 = 0.60 μs (766404); OT, ET	85S022
	$Co(bpy)_3^{2+}$	H_2O	0.025 mol/L Pbuf; pH 8.0; μ = 0.03 (NaCl); $[Co^{II}]/[L]$ = 0.2	25	2.8×10^8	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
	$Co(bpy)_3^{2+}$	H_2O	0.17 mol/L Na_2SO_4, 0.025 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	5.8×10^8	SS/LUM; τ_0 = 0.60 μs (766404); OT, ET	85S022
	$Co(bpy)_3^{2+}$	H_2O	0.5 mol/L NaCl, 0.025 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	1.0×10^9	SS/LUM; τ_0 = 0.60 μs (766404); OT, ET	85S022
	$Co(bpy)_3^{2+}$	H_2O	0.5 mol/L NaBr, 0.025 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	1.4×10^9	SS/LUM; τ_0 = 0.60 μs (766404); OT, ET	85S022
	$Co(bpy)_3^{2+}$	H_2O	0.025 mol/L Pbuf; pH 8.0; μ = 1.5 (NaCl); $[Co^{II}]/[L]$ = 0.2	25	1.2×10^9	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
	$Co(bpy)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	2.8×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT, ET	85S022
20.1.14.	$Co(bpy)_3^{3+}$	H_2O	0.01 mol/L H_2SO_4, 0.33 mol/L Na_2SO_4	25	2.3×10^9	SS/LUM; τ_0 = 0.60 μs (747635); OT	80A003
	$Co(bpy)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4	25	2.1×10^9	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
	$Co(bpy)_3^{3+}$	H_2O	0.5 mol/L NaCl	25	3.0×10^9	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
	$Co(bpy)_3^{3+}$	H_2O	0.5 mol/L NaBr	25	3.6×10^9	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	$Co(bpy)_3^{3+}$	H_2O	0.33 mol/L Na_2SO_4; 0.028 mol/L $NaHSO_4$; μ = 1.0		1.9×10^9	SS/LUM; τ_0 = 0.60 μs (LP/LUM/SST); OT	82F048
20.1.15.	$Co^{III}(bpy)_2(\mu\text{-}O_2,NH_2)Co^{III}(bpy)_2^{4+}$	H_2O	0.01 mol/L HCl; μ = 0.01	25	3.0×10^9	SS/LUM; τ_0 = 0.5 μs; OT; $[Q] \leq 3 \times 10^{-4}$ mol/L	80F208
	$Co^{III}(bpy)_2(\mu\text{-}O_2,NH_2)Co^{III}(bpy)_2^{4+}$	H_2O	0.11 mol/L HCl; μ = 0.11	25	4.2×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(bpy)_2(\mu\text{-}O_2,NH_2)Co^{III}(bpy)_2^{4+}$	H_2O	0.81 mol/L HCl; μ = 0.81	25	4.5×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
20.1.16.	*cis*-$Co(bzac)_3$	$EtOH/CHCl_3$ (9/1)		23-24	1.1×10^9	SS/LUM; τ_0 = 0.79 μs (J.N. Demas, priv. comm.); OT	77F726
20.1.17.	*trans*-$Co(bzac)_3$	$EtOH/CHCl_3$ (9/1)		23-24	1.1×10^9	SS/LUM; τ_0 = 0.79 μs (J.N. Demas, priv. comm.); OT	77F726
20.1.18.	$Co(C_5H_5)_2^+$	$H_2O/EtOH$ (1/1)		25	1.5×10^8	SS/LUM; τ_0 = ~0.9 μs (FL/LUM/SST); ET	756002
20.1.19.	$Co(C_5H_4COOH)_2^+$	H_2O	pH 1-10; μ = 0.1 (NaCl)		1.5×10^9	LP/LUM/SST	82S072
20.1.20.	$Co(CLHOsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	2.0×10^8	LP/LUM/SST; τ_0 = 0.64 μs; OT; f = 0.95	85F222
	$Co(CLHOsar)^{3+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	7.6×10^8	LP/LUM/SST; τ_0 = 0.64 μs	85F222
20.1.21.	$Co(CLNOsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	4.5×10^8	LP/LUM/SST; τ_0 = 0.64 μs; OT; f = 1	85F222
20.1.22.	$Co(5\text{-}Clphen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	2.3×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
20.1.23.	$Co(5\text{-}Clphen)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	6.3×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
20.1.24.	$Co(CLsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.4×10^8	LF/LUM/SST; τ_0 = 0.64 μs; ET (65%), OT (35%); f = 0.35; same k_q from same lab in 83S090	85F222
	$Co(CLsar)^{3+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	3.0×10^8	LF/LUM/SST; τ_0 = 0.64 μs; same k_q from same lab in 83S090	85F222

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.25.	$Co(CMMEabsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	7×10^7	LP/LUM/SST; τ_0 = 0.64 μs; ET	85F222
	$Co(CMMEabsar)^{3+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	1.5×10^8	LP/LUM/SST; τ_0 = 0.64 μs	85F222
20.1.26.	$Co(CN)_6^{3-}$	H_2O	μ = 0 (calc'd)	~21	3.2×10^7	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); ET; [Q] = 0.17 mol/L	766319
	$Co(CN)_6^{3-}$	H_2O	0.5 mol/L NaCl; pH 4	23	$<1 \times 10^6$	SS/LUM; τ_0^{air} = 0.40 μs (746112); [Q] = 0.05 mol/L	766027
20.1.27.	$Co^{III}(CN)_5(\mu\text{-}O_2)Co^{III}(CN)_5^{5-}$	H_2O	0.1 mol/L HCl; μ = 0.25 (NaCl)	25	4.8×10^9	LP/LUM/SST; OT	82A068
20.1.28.	$Co(CN)_5$(pyrazinecarboxylato)$^{3-}$	H_2O	0.5 mol/L H_2SO_4	25	2.9×10^9	SS/LUM or LP/LUM/AVE; τ_0 = 0.60 μs (766404); OT	776405
20.1.29.	$Co(C_2O_4)_3^{2-}$	H_2O	0.05 mol/L H_2SO_4		6.7×10^9	SS/LUM, LP/LUM/SST; τ_0 = 0.66 μs; OT; [Q] = (1-8) $\times 10^{-4}$ mol/L	737656
20.1.30.	$Co(C_2O_4)_3^{3-}$	H_2O	μ = 0 (calc'd)	~21	3.8×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 0.60 μs (LP/LUM/AVE); [Q] ≤ 1.5×10^{-4} mol/L; some SQ	766319
20.1.31.	*lel*$_3$-Co(diAMchar)$^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	8×10^7	LP/LUM/SST; τ_0 = 0.64 μs; ET (57%), OT (43%); f = 0.43	85F222
	lel$_3$-Co(diAMchar)$^{3+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	4.0×10^8	LP/LUM/SST; τ_0 = 0.64 μs	85F222
20.1.32.	Co(diAMsar)$^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	4.4×10^7	LP/LUM/SST; τ_0 = 0.64 μs; ET (38%), OT (62%); f = 0.62	85F222
20.1.33.	*lel*$_3$-Co(diAZAchar)$^{3+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	4.2×10^8	LP/LUM/SST; τ_0 = 0.64 μs	85F222
	lel$_3$-Co(diAZAchar)$^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.4×10^8	LP/LUM/SST; τ_0 = 0.64 μs; ET (72%), OT (18%); f = 0.18	85F222
20.1.34.	Co(diCLsar)$^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	2.2×10^8	LP/LUM/SST; τ_0 = 0.64 μs; OT; f = 1	85F222
	Co(diCLsar)$^{3+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	9.6×10^8	LP/LUM/SST; τ_0 = 0.64 μs	85F222

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1. $Ru(bpy)_3^{2+}$—Continued							
20.1.35.	$Co(diNOsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	6.1×10^8	LP/LUM/SST; τ_0 = 0.64 μs; ET (9%), OT (91%); f = 0.91	85F222
20.1.36.	$Co(DMG)_2(C_2H_5)(H_2O)$	H_2O		~22	2.0×10^9	LP/LUM/SST; ET?	83E223
20.1.37.	$Co(EDTA)^-$	H_2O		~25	3×10^8	SS/LUM; τ_0 = 0.6 μs (69E219); OT	73F673
20.1.38.	$Co(EFMEoxosar\text{-}H)^{2+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.0×10^8	LP/LUM/SST; τ_0 = 0.64 μs; ET; same k_q from same lab in 83S090	85F222
	$Co(EFMEoxosar\text{-}H)^{2+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	3.6×10^8	LP/LUM/SST; τ_0 = 0.64 μs; same k_q from same lab in 83S090	85F222
20.1.39.	$Co(en)_3^{3+}$	H_2O	0.1 mol/L H_2SO_4	~22	2.0×10^7	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255
	$Co(en)_3^{3+}$	H_2O	0.1 mol/L H_2SO_4	25	4.9×10^7	SS/LUM; τ_0 = 0.60 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
	$Co(en)_3^{3+}$	H_2O	ACbuf; pH 4.7; μ = 0.01 (NaCl)	25	3.4×10^7	SS/LUM; τ_0 = 0.60 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
	$Co(en)_3^{3+}$	H_2O	1 mol/L H_2SO_4		6.2×10^7	LP/LUM/SST; OT	83S001
20.1.40.	*cis*-$Co(en)_2Cl_2^+$	H_2O	0.1 mol/L H_2SO_4	~22	1.4×10^9	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255
20.1.41.	*trans*-$Co(en)_2Cl_2^+$	H_2O	0.1 mol/L H_2SO_4	~22	2.0×10^9	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255
20.1.42.	$Co(en)_2(gly)^{2+}$	H_2O		25	1.2×10^8	SS/LUM; τ_0 = 0.6 μs (766539); OT; [Q] ≤ 0.02 mol/L	85A470
20.1.43.	*cis*-$Co(en)_2(H_2O)Cl^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	6.0×10^8	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255
20.1.44.	*cis*-$Co(en)_2(NCS)_2^+$	H_2O	0.1 mol/L H_2SO_4	~22	7.6×10^8	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255
20.1.45.	*trans*-$Co(en)_2(NCS)_2^+$	H_2O	0.1 mol/L H_2SO_4	~22	4.8×10^8	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255
20.1.46.	*cis*-$Co(en)_2(NCS)Cl^+$	H_2O	0.1 mol/L H_2SO_4	~22	1.6×10^9	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255
20.1.47.	*trans*-$Co(en)_2(NCS)Cl^+$	H_2O	0.1 mol/L H_2SO_4	~22	1.1×10^9	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1. $Ru(bpy)_3^{2+}$—Continued							
20.1.48.	*cis*-$Co(en)_2(NH_3)Cl^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	4.2×10^8	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255
20.1.49.	$Co^{III}(en)_2(\mu\text{-}O_2,NH_2)Co^{III}(en)_2^{4+}$	H_2O	0.01 mol/L HCl; μ = 0.01	25	7.0×10^8	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(en)_2(\mu\text{-}O_2,NH_2)Co^{III}(en)_2^{4+}$	H_2O	0.01 mol/L HCl; μ = 0.51 (NaCl)	25	3.6×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(en)_2(\mu\text{-}O_2,NH_2)Co^{III}(en)_2^{4+}$	H_2O	0.05 mol/L H_2SO_4; μ = 0.25 (NaCl)	25	1.9×10^9	LP/LUM/SST; OT	82A068
	$Co^{III}(en)_2(\mu\text{-}O_2,NH_2)Co^{III}(en)_2^{4+}$	H_2O	0.1 mol/L HCl; μ = 0.1	25	4.4×10^9	SS/LUM; τ_0 = 0.5 μs; OT; [Q] ≤ 3×10^{-4} mol/L	80F208
	$Co^{III}(en)_2(\mu\text{-}O_2,NH_2)Co^{III}(en)_2^{4+}$	H_2O	1 mol/L HCl; μ = 1.0	25	3.2×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
20.1.50.	$Co(HEDTA)Br^-$	H_2O	0.1 mol/L $HClO_4$ or 1 mol/L H_2SO_4		3.0×10^9	SS/LUM; τ_0 = 0.6 μs (69E219); ET?	737081
20.1.51.	$Co(HEDTA)Cl^-$	H_2O	0.1 mol/L $HClO_4$ or 1 mol/L H_2SO_4		8×10^8	SS/LUM; τ_0 = 0.6 μs (69E219); ET?	737081
20.1.52.	$Co(HEDTA)(NO_2)^-$	H_2O	0.1 mol/L $HClO_4$ or 1 mol/L H_2SO_4		1.3×10^9	SS/LUM; τ_0 = 0.6 μs (69E219); ET?	737081
20.1.53.	$Co(HYMEoxosar\text{-}H)^{2+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	7×10^7	LP/LUM/SST; τ_0 = 0.64 μs; ET; same k_q from same lab in 83S090	85F222
	$Co(HYMEoxosar\text{-}H)^{2+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	2.8×10^8	LP/LUM/SST; τ_0 = 0.64 μs; same k_q from same lab in 83S090	85F222
20.1.54.	$Co(4,4'\text{-}Me_2bpy)_3^+$	AN	0.1 mol/L TEAP	25	2.7×10^9	LP/LUM/AVE; τ_0 = 0.85 μs; RT	86A077
20.1.55.	$Co(4,4'\text{-}Me_2bpy)_3^{2+}$	AN	0.1 mol/L TEAP	25	1.6×10^8	SS/LUM; τ_0 = 0.85 μs (LP/LUM/AVE); OT, ET?	86A077
20.1.56.	*trans*-$Co(Me_6cycladiene)(H_2O)_2^{3+}$	H_2O	0.1 mol/L TEOA	25	2.7×10^8	SS/QYP; τ_0 = 0.6 μs (79F045); OT; [Q] ≤ 0.003 mol/L; see Mech. [7]	83A333
20.1.57.	$Co(MENOsar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	2.1×10^8	LP/LUM/SST; τ_0 = 0.64 μs; ET, OT; f = >0.27	85F222
20.1.58.	$Co(4,7\text{-}Me_2phen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	7×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.59.	$Co(4,7\text{-}Me_2phen)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	7.4×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
20.1.60.	$Co(NH_3)_6^{3+}$	H_2O	μ = 0 (calc'd)	~21	$<3 \times 10^6$	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); [Q] = 0.002-0.009 mol/L	766319
	$Co(NH_3)_6^{3+}$	H_2O	0.1 mol/L H_2SO_4	~22	4.0×10^7	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255
	$Co(NH_3)_6^{3+}$	H_2O	0.1 mol/L H_2SO_4	25	3.2×10^7	SS/LUM; τ_0 = 0.60 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
	$Co(NH_3)_6^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	$\sim 1 \times 10^7$	SS/LUM; τ_0 = 0.60 μs (LP/LUM/SPC); OT; [Q] = 0.007 mol/L	747635
	$Co(NH_3)_6^{3+}$	H_2O	ACbuf; pH 4.7; μ = 0.01 (NaCl)	25	1.5×10^7	SS/LUM; τ_0 = 0.60 μs (84A238); ET, OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
20.1.61.	$Co(NH_3)_5(benzoato)^{2+}$	H_2O	Pbuf; pH 5.8; μ = 0.10 ($LiClO_4$)	25	1.5×10^8	SS/LUM, SS/QYP; τ_0 = 0.60 μs (747635); OT; f = 0.5; [Q] = (5-50) × 10^{-4} mol/L; see Mech. [7]	80F058
20.1.62.	$Co(NH_3)_5$[1,2-bis(4-pyridyl)ethane]$^{3+}$	H_2O	0.01 mol/L Pbuf; pH 5.6; μ = 0.1 ($LiClO_4$)	25	2.0×10^8	SS/LUM; τ_0 = 0.60 μs (766404); OT; [Q] = (5-20) × 10^{-4} mol/L	78E293
20.1.63.	$Co(NH_3)_5$[*trans*-1,2-bis(4-pyridyl)ethene]$^{3+}$	H_2O	0.01 mol/L Pbuf; pH 5.6; μ = 0.1 ($LiClO_4$)	25	1.2×10^9	SS/LUM; τ_0 = 0.60 μs (766404); OT; [Q] = (1.3-200) × 10^{-4} mol/L	78E293
20.1.64.	$Co(NH_3)_5Br^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	2.5×10^9	SS/LUM; τ_0 = 0.60 μs (LP/LUM/SPC); OT; [Q] ≤ 0.002 mol/L	747635
	$Co(NH_3)_5Br^{2+}$	H_2O/2-PrOH (1/1)	0.5 mol/L H_2SO_4	25	1.1×10^9	SS/LUM; τ_0 = 0.87 μs (LP/LUM/SPC); OT	747635
20.1.65.	$Co(NH_3)_5Cl^{2+}$	H_2O	μ = 0 (calc'd)	~21	7.2×10^7	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); OT; [Q] = 0.002-0.005 mol/L	766319
	$Co(NH_3)_5Cl^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	5.8×10^8	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT; [Q] = 0.002-0.008 mol/L	84A255
	$Co(NH_3)_5Cl^{2+}$	H_2O	pH 0(H_2SO_4)	~25	6.7×10^8	EMI; τ_0^{air} = 0.46 μs; OT; f = 0.85	82S163

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	$Co(NH_3)_5Cl^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	9.3×10^8	SS/LUM; τ_0 = 0.60 μs (LP/LUM/SPC); OT; [Q] ≤ 0.005 mol/L	747635
	$Co(NH_3)_5Cl^{2+}$	H_2O	ACbuf; pH 4.7; μ = 0.01 (NaCl)	25	3.8×10^8	SS/LUM; τ_0 = 0.60 μs (84A238); OT; [Q] = (3-90) × 10^{-4} mol/L	85F161
	$Co(NH_3)_5Cl^{2+}$	H_2O	ACbuf; pH 4.8; μ = 0.03	25	2.2×10^8	SS/LUM; τ_0 = 0.66 μs (737656); OT	85F089
	$Co(NH_3)_5Cl^{2+}$	H_2O	ACbuf; pH 4.8; μ = 0.05	25	3.4×10^8	SS/LUM; τ_0 = 0.66 μs (737656); OT	85F089
	$Co(NH_3)_5Cl^{2+}$	H_2O	ACbuf; pH 4.8; μ = 0.2	25	8.2×10^8	SS/LUM; τ_0 = 0.66 μs (737656); OT	85F089
	$Co(NH_3)_5Cl^{2+}$	H_2O	0.1 mol/L ACbuf; pH 5		9.3×10^8	SS/LUM; OT	81N178
	$Co(NH_3)_5Cl^{2+}$	H_2O	0.01 mol/L Pbuf; pH 7		2.0×10^8	SS/LUM; τ_0 = 0.6 μs (78Z170); OT; [Q] = 0.001-0.005 mol/L	86F171
	$Co(NH_3)_5Cl^{2+}$	H_2O/2-PrOH (1/1)	0.5 mol/L H_2SO_4	25	4.6×10^8	SS/LUM; τ_0 = 0.87 μs (LP/LUM/SPC); OT	747635
20.1.66.	$Co(NH_3)_5F^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	8.0×10^7	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT; [Q] = 0.002-0.008 mol/L	84A255
20.1.67.	$Co(NH_3)_5(H_2O)^{3+}$	H_2O	0.1 mol/L H_2SO_4	~22	7.5×10^7	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255
	$Co(NH_3)_5(H_2O)^{3+}$	H_2O	0.05 mol/L H_2SO_4; μ = 0.25 (NaCl)	25	1.4×10^8	LP/LUM/SST; ET; $\Delta V^{\ddagger}$ = -2.6×10^{-3} L/mol (0.1-300 MPa)	82A068
	$Co(NH_3)_5(H_2O)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	1.5×10^8	SS/LUM; τ_0 = 0.60 μs (LP/LUM/SPC); OT; [Q] ≤ 0.011 mol/L	747635
20.1.68.	$Co(NH_3)_5(N\text{-Mevio})^{4+}$	H_2O	0.5 mol/L H_2SO_4	25	7.2×10^3	SS/LUM; τ_0 = 0.60 μs (766404); OT; f = 0.9; [Q] = (4.5-16) × 10^{-4} mol/L	78E293
	$Co(NH_3)_5(N\text{-Mevio})^{4+}$	H_2O	0.01 mol/L Pbuf; pH 5.6; μ = 0.1 ($LiClO_4$)	25	1.1×10^9	SS/LUM; τ_0 = 0.60 μs (766404); OT; [Q] = (2.8-23) × 10^{-4} mol/L	78E293
20.1.69.	$Co(NH_3)_5(NCS)^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	3.0×10^3	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT; [Q] = 0.002-0.008 mol/L	84A255

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.70.	$Co(NH_3)_5(NO_2)^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	1.0×10^8	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT; [Q] = 0.002-0.008 mol/L	84A255
20.1.71.	$Co(NH_3)_5[2\text{-}(NO_2)benz]^{2+}$	H_2O	Pbuf; pH 5.8; μ = 0.10 ($LiClO_4$)	25	1.3×10^9	SS/LUM, SS/QYP; τ_0 = 0.60 μs (747635); OT; f = 0.05; [Q] = (5-50) × 10^{-4} mol/L; see Mech. [7]	80F058
20.1.72.	$Co(NH_3)_5[4\text{-}(NO_2)benz]^{2+}$	H_2O	Pbuf; pH 5.8; μ = 0.10 ($LiClO_4$)	25	2.4×10^9	SS/LUM, SS/QYP; τ_0 = 0.60 μs (747635); OT; f = 0.01; [Q] = (5-50) × 10^{-4} mol/L; see Mech. [7]	80F058
20.1.73.	$Co(NH_3)_5[OC(O)CH_3]^{2+}$	H_2O	Pbuf; pH 5.8; μ = 0.10 ($LiClO_4$)	25	2.1×10^8	SS/LUM; τ_0 = 0.60 μs (747635); OT; [Q] = (5-50) × 10^{-4} mol/L	80F058
20.1.74.	$Co(NH_3)_5[OC(O)H]^{2+}$	H_2O	0.1 mol/L H_2SO_4	~22	4.7×10^7	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT; [Q] = 0.002-0.008 mol/L	84A255
20.1.75.	$Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$	H_2O	0.02 mol/L $HClO_4$; μ = 0.02	25	1.3×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$	H_2O	0.02 mol/L $HClO_4$; μ = 0.42 ($NaClO_4$)	25	4.5×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$	H_2O	0.05 mol/L H_2SO_4; μ = 0.25 (NaCl)	25	1.9×10^9	LP/LUM/SST; OT	82A068
	$Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$	H_2O	0.1 mol/L HCl; μ = 0.1	25	7.4×10^8	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$	H_2O	0.1 mol/L $HClO_4$; μ = 0.1	25	2.2×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$	H_2O	0.5 mol/L H_2SO_4	25	4.6×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$	H_2O	1 mol/L HCl; μ = 1.0	25	1.9×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$	H_2O	1 mol/L $HClO_4$; μ = 1.0	25	4.3×10^9	SS/LUM; τ_0 = 0.5 μs; OT; [Q] ≤ 3 × 10^{-4} mol/L	80F208
20.1.76.	$Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$	H_2O	0.01 mol/L HCl; μ = 0.01	25	1.0×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$	H_2O	0.01 mol/L $HClO_4$; μ = 0.21 ($NaClO_4$)	25	3.0×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	$Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$	H_2O	0.01 mol/L HCl; μ = 0.54 (NaCl)	25	2.8×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$	H_2O	0.01 mol/L $HClO_4$; μ = 0.81 ($NaClO_4$)	25	3.5×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$	H_2O	0.01 mol/L HCl; μ = 1.3 (NaCl)	25	4.4×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$	H_2O	0.1 mol/L $HClO_4$; μ = 0.1	25	1.1×10^9	SS/LUM; τ_0 = 0.5 μs; OT; [Q] ≤ 7×10^{-4} mol/L	80F208
	$Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$	H_2O	0.1 mol/L HCl; μ = 0.1	25	2.1×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$	H_2O	1 mol/L $HClO_4$; μ = 1.0	25	8.8×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
	$Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$	H_2O	1 mol/L HCl; μ = 1.0	25	4.0×10^9	SS/LUM; τ_0 = 0.5 μs; OT	80F208
20.1.77.	$Co(NH_3)_5(py)^{3+}$	H_2O	0.01 mol/L Pbuf; pH 5.6; μ = 0.1 ($LiClO_4$)	25	1.7×10^8	SS/LUM; τ_0 = 0.60 μs (756404); OT; [Q] = (4.5-19) × 10^{-4} mol/L	78E293
	$Co(NH_3)_5(py)^{3+}$	H_2O	Pbuf; pH 5.8; μ = 0.10 ($LiClO_4$)	25	2.1×10^8	SS/QYP; τ_0 = 0.60 μs (747635); OT; f = 0.8; [Q] = (5-50) × 10^{-4} mol/L; see Mech. [7]	80F058
20.1.78.	$Co(NH_3)_5(vio)^{3+}$	H_2O	0.094 mol/L $HClO_4$; μ = 0.1	25	1.2×10^9	SS/LUM; τ_0 = 0.60 μs (756404); OT; [Q] = (2-10) × 10^{-4} mol/L	78E293
	$Co(NH_3)_5(vio)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	7.3×10^8	SS/LUM; τ_0 = 0.60 μs (756404); OT; f = 0.9; [Q] = (5.5-16) × 10^{-4} mol/L	78E293
	$Co(NH_3)_5(vio)^{3+}$	H_2O	0.01 mol/L Pbuf; pH 5.6; μ = 1.0 ($LiClO_4$)	25	5.7×10^8	SS/LUM; τ_0 = 0.60 μs (756404); OT; f = 1; [Q] = (2.1-16) × 10^{-4} mol/L	78E293
20.1.79.	$Co(NO_2)_6^{3-}$	H_2O	μ = 0 (calc'd)	~21	~9×10^9	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); OT; [Q] = (2-7) × 10^{-4} mol/L	766319
20.1.80.	$Co[4\text{-}(NO_2)bpy]_3^{3+}$	H_2O	0.33 mol/L Na_2SO_4; 0.028 mol/L $NaHSO_4$; μ = 1.0		9.0×10^8	SS/LUM; τ_0 = 0.60 μs (LP/LUM/SST); OT	82F048

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1. $Ru(bpy)_3^{2-}$—Continued							
20.1.81.	$Co(phen)^{2+}$	H_2O	0.05 mol/L Pbuf; pH 6.0; $[Co^{II}]/[L]$ = 4.5	25	2.7×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
20.1.82.	$Co(phen)_3^{2+}$	H_2O	0.5 mol/L NaCl	25	8.9×10^8	SS/LUM; τ_0 = 0.60 μs (747635); RT	766046
	$Co(phen)_3^{2+}$	H_2O	0.05 mol/L Pbuf; pH 8.0; $[Co^{II}]/[L]$ = 0.2	25	3.0×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT	85S022
20.1.83.	$Co(phen)_3^{3+}$	H_2O	0.1 mol/L H_2SO_4	~22	1.9×10^9	SS/LUM; τ_0^{air} = 0.40 μs (LP/LUM/AVE); OT	84A255
	$Co(phen)_3^{3+}$	H_2O	0.17 mol/L NaCl	25	2.3×10^9	SS/LUM; τ_0 = 0.60 μs (747635); OT	766014
	$Co(phen)_3^{3+}$	H_2O	0.5 mol/L NaCl	25	3.0×10^9	SS/LUM; τ_0 = 0.60 μs (747635); OT; [Q] ≤ 0.025 mol/L	766014
	$Co(phen)_3^{3+}$	H_2O	0.01 mol/L H_2SO_4, 0.33 mol/L Na_2SO_4; μ = 1.0		2.4×10^9	FP/QYP; τ_0 = 0.60 μs (747635); OT, ET; f = 0.53; [Q] = (2.5-20) × 10^{-4} mol/L; see Mech. [8]; k_q = 2.2×10^9 L mol^{-1} s^{-1} for SS/LUM from same lab in 80A003	82F065
20.1.84.	$Co^{III}(phen)_2(\mu\text{-}O_2,NH_2)Co^{III}(phen)_2^{4+}$	H_2O	1 mol/L HCl; μ = 1.0	25	8.1×10^9	SS/LUM; τ_0 = 0.5 μs; OT; [Q] ≤ 9×10^{-4} mol/L	80F208
20.1.85.	$Co(sar)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.6×10^7	LP/LUM/SST; τ_0 = 0.64 μs; ET (80%), OT (20%); f = 0.2	85F222
	$Co(sar)^{3+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	2.2×10^8	LP/LUM/SST; τ_0 = 0.64 μs; same k_q from same lab in 83S090	85F222
20.1.86.	$Co(sep)^{3+}$	H_2O	ACbuf; pH 5; μ = 0.1 ($NaClO_4$)	20	1.5×10^8	LP/LUM/SST; τ_0 = 0.64 μs; ET (75%), OT (25%); f = 0.25; same k_q from same lab in 83S090	85F222
	$Co(sep)^{3+}$	H_2O	ACbuf; 0.5 mol/L $NaClO_4$; pH 5	20	5.5×10^8	LP/LUM/SST; τ_0 = 0.64 μs; same k_q from same lab in 83S090	85F222
	$Co(sep)^{3+}$	H_2O	0.2 mol/L LiCl	25	2.9×10^8	SS/LUM; τ_0 = 0.60 μs (766404); ET, OT; f = 0.51	84A238

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	$Co(sep)^{3+}$	H_2O	0.2 mol/L TEOA; pH 8.1; μ = 0.2 (LiCl)	25	3.4×10^8	SS/LUM; τ_0 = 0.60 μs (766404); ET, OT	84A238
	$Co(sep)^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	2.8×10^8	SS/LUM; τ_0 = 0.60 μs (766404); ET, OT	84A238
	$Co(sep)^{3+}$	H_2O	μ = 0.1 (NaCl)		2.6×10^8	LP/LUM/SST; OT; f = 0.9	82S072
	$Co(sep)^{3+}$	H_2O	1 mol/L H_2SO_4		3.6×10^8	LP/LUM/SST; OT	83S001
20.1.87.	$CoSiW_{11}O_{39}H_2O^{6-}$	H_2O			$\sim 3 \times 10^{10}$ (calc)	SL/LUM/SPC; τ_0^{air} = 0.40 μs; OT; [Q] = (2, 4) × 10^{-4} mol/L; some SQ, see Mech. [11]	85E375
20.1.88.	$Co(terpy)_2^{+}$	AN	0.1 mol/L TEAP	25	2.0×10^9	LP/LUM/AVE; τ_0 = 0.85 μs; RT	86A077
20.1.89.	$Co(terpy)_2^{2+}$	AN	0.1 mol/L TEAP	25	3.3×10^9	SS/LUM; τ_0 = 0.85 μs (LP/LUM/AVE); OT, ET?	86A077
20.1.90.	*cis*-$Co(tfac)_3$	EtOH		23-24	1.8×10^9	SS/LUM; τ_0 = 0.79 μs (J.N. Demas, priv. comm.); OT	77F726
20.1.91.	*trans*-$Co(tfac)_3$	EtOH		23-24	1.8×10^9	SS/LUM; τ_0 = 0.79 μs (J.N. Demas, priv. comm.); OT	77F726
20.1.92.	Cr^{3+}	H_2O	1 mol/L CF_3SO_3Na	15	1.3×10^7 (corr)	LP/LUM/SST; ET	86E096
	Cr^{3+}	H_2O	0.04 mol/L H_2SO_4; μ = 1.0 ($MgCl_2$)	25	1.2×10^7	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); ET	766404
	Cr^{3+}	H_2O			9.7×10^7	LP/LUM/SST; τ_0 = 0.59 μs	85N164
	Cr^{3+}	H_2O	9.4×10^{-5} mol/L PMA; pH 2		9.3×10^7	LP/LUM/SST; τ_0 = 0.59 μs; some SQ	85N164
	Cr^{3+}	H_2O	9.4×10^{-5} mol/L PMA; pH 7		8.4×10^3	LP/LUM/SST; τ_0 = 0.67 μs; some SQ	85N164
20.1.93.	$Cr(acac)_3$	MeOH		~21	3.0×10^3	SS/LUM; τ_0 = 0.77 μs (LP/LUM/AVE); ET; [Q] = 0.001-0.004 mol/L	766319
20.1.94.	$Cr(bpy)_3^{3+}$	H_2O	μ = 0.2	23	3.3×10^9	SS/LUM; τ_0^{air} = 0.40 μs (737633); OT	756325
20.1.95.	*cis*-$Cr(bzac)_3$	EtOH/$CHCl_3$ (9/1)		23-24	8.5×10^3	SS/LUM; τ_0 = 0.79 μs (J.N. Demas, priv. comm.); ET	77F726

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by incrganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.96.	*trans*-$Cr(bzac)_3$	$EtOH/CHCl_3$ (9/1)		23-24	6.3×10^8	SS/LUM; τ_0 = 0.79 μs (J.N. Demas, priv. comm.); ET	77F726
20.1.97.	$Cr(CN)_6^{3-}$	H_2O	μ = 0 (calc'd)	~21	2.5×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 0.60 μs (LP/LUM/AVE); ET; [Q] ≤ 5×10^{-4} mol/L; some SQ	766319
	$Cr(CN)_6^{3-}$	H_2O	μ = 0.5 (KCl)		2.1×10^{10}	SS/LUM, SL/LUM/SST; τ_0^{air} = 0.40 μs; ET; [Q] = (2-20) × 10^{-4} mol/L; k_q calc for μ = 0	737633
20.1.98.	$Cr(C_2O_4)_3^{3-}$	H_2O	μ = 0 (calc'd)	~21	2.1×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 0.60 μs (LP/LUM/AVE); ET; [Q] ≤ 3×10^{-4} mol/L; some SQ	766319
	$Cr(C_2O_4)_3^{3-}$	H_2O			8.5×10^9	SS/LUM, LP/LUM/SST; τ_0 = 0.66 μs; ET; [Q] = (2-8) × 10^{-4} mol/L	737656
20.1.99.	*trans*-Cr(cyclam)$(CN)_2^+$	H_2O	1 mol/L CF_3SO_3Na	15	2.4×10^7 (corr)	LP/LUM/SST; ET	86E096
20.1.100.	$Cr(en)_3^{3+}$	H_2O	1 mol/L CF_3SO_3Na	15	7.2×10^6 (corr)	LP/LUM/SST; ET	86E096
20.1.101.	*cis*-$Cr(en)_2Cl_2^+$	H_2O	1 mol/L CF_3SO_3Na	15	1.0×10^8 (corr)	LP/LUM/SST; ET	86E096
20.1.102.	*trans*-$Cr(en)_2Cl_2^+$	H_2O	1 mol/L CF_3SO_3Na	15	6.6×10^7 (corr)	LP/LUM/SST; ET	86E096
20.1.103.	$Cr(NH_3)_6^{3+}$	H_2O	1 mol/L CF_3SO_3Na	15	$<2 \times 10^7$ (corr)	LP/LUM/SST; ET	86E096
20.1.104.	$Cr(NH_3)_5Br^{2+}$	H_2O	1 mol/L CF_3SO_3Na	15	8.6×10^7 (corr)	LP/LUM/SST; ET	86E096
20.1.105.	$Cr(NH_3)_5(CN)^{2+}$	H_2O	1 mol/L CF_3SO_3Na	15	1.4×10^7 (corr)	LP/LUM/SST; ET	86E096
20.1.106.	$Cr(NH_3)_5Cl^{2+}$	H_2O	1 mol/L CF_3SO_3Na	15	6.2×10^7 (corr)	LP/LUM/SST; ET	86E096
20.1.107.	$Cr(NH_3)_5(H_2O)^{3+}$	H_2O	1 mol/L CF_3SO_3Na	15	1.6×10^7 (corr)	LP/LUM/SST; ET	86E096

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.108.	$Cr(NH_3)_5(N_3)^{2+}$	H_2O	1 mol/L CF_3SO_3Na	15	9.2×10^7 (corr)	LP/LUM/SST; ET	86E096
20.1.109.	$Cr(NH_3)_5(NCS)^{2+}$	H_2O	1 mol/L CF_3SO_3Na	15	3.4×10^3 (corr)	LP/LUM/SST; ET	86E096
20.1.110.	*cis*-$Cr(tfac)_3$	EtOH		23-24	3.6×10^3	SS/LUM; τ_0 = 0.79 μs (J.N. Demas, priv. comm.); ET	77F726
20.1.111.	*trans*-$Cr(tfac)_3$	EtOH		23-24	2.5×10^3	SS/LUM; τ_0 = 0.79 μs (J.N. Demas, priv. comm.); ET	77F726
20.1.112.	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	16.9	5.4×10^7	SS/LUM; τ_0 = 0.65 μs (766539); OT	78A090
	Cu^{2+}	H_2O	μ = 0 (calc'd)	~21	6.6×10^6	SS/LUM and LP/LUM/AVE; τ_0 = 0.60 μs (LP/LUM/AVE); OT; [Q] = 0.05-0.06 mol/L; some SQ	766319
	Cu^{2+}	H_2O	0.25 mol/L H_2SO_4; μ = 0.8-1	25	6.2×10^7	SL/LUM/SPC; τ_0 = 0.57 μs; $\Delta H^{\ddagger}$ = 11 kJ/mol; $\Delta S^{\ddagger}$ = −57 J/mol·K (20-80°C); OT	80A308
	Cu^{2+}	H_2O	0.5 mol/L $HClO_4$	25	6.6×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT; f = 0.68	78A090
	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	25	6.2×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT; f = 0.56	78A090
	Cu^{2+}	H_2O	0.5 mol/L H_2SO_4	34.8	7.2×10^7	SS/LUM; τ_0 = 0.54 μs (766539); OT	78A090
	Cu^{2+}	H_2O			7×10^7	SS/LUM; OT; [Q] = (5-20) × 10^{-4} mol/L	78A215
	Cu^{2+}	H_2O			5.1×10^7	LP/LUM/SST; τ_0 = 0.59 μs	85N164
	Cu^{2+}	H_2O	1 mol/L KCl		8.3×10^8	SS/LUM; τ_0 = 0.62 μs (LP/LUM/AVE); OT	85E218
	Cu^{2+}	H_2O	9.4×10^{-5} mol/L PMA; pH 2		4.4×10^7	LP/LUM/SST; τ_0 = 0.59 μs; some SQ	85N164
	Cu^{2+}	H_2O	9.4×10^{-5} mol/L PMA; pH 7		3.9×10^9	LP/LUM/SST; τ_0 = 0.67 μs; some SQ	85N164
20.1.113.	$Cu(acac)_2$	MeOH		~21	1.1×10^9	SS/LUM; τ_0 = 0.77 μs (LP/LUM/AVE); OT; [Q] = (3-12) × 10^{-4} mol/L	766319

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2-}$**—Continued						
20.1.114.	Cu^{II}-Acetic acid	H_2O	0.5 mol/L HAc; 0.5 mol/L NaAc; μ = 1.0	21	2.8×10^8	LP/LUM/SST; τ_0 = 0.60 μs; OT; [Q] = 0.0025-0.010 mol/L; 90% of Q as $Cu(CH_3COO)_4^{2-}$	78F683
20.1.115.	Cu^{II}-azurin	H_2O	0.027 mol/L Na_2HPO_4; 0.020 mol/L NaH_2PO_4; pH 7; μ = 0.1	25	1.2×10^9	LP/LUM/AVE; ET or OT	85A362
20.1.116.	Cu-azurin	H_2O	Pbuf; pH 7; μ = 0.1	25	6.9×10^8	LP/LUM/SST; τ_0 = 0.61 μs; RT; linear S-V plot only for [Q] < 0.002 mol/L	82A022
20.1.117.	$CuCl^+$	H_2O	0.1 mol/L $HClO_4$; 0.5 mol/L NaCl; μ = 1.0	21	3.3×10^8	LP/LUM/SST; τ_0 = 0.60 μs; OT; f = 0.59; [Q] = 0.0025-0.010 mol/L; 75% of Q as $CuCl^+$	78F683
	$CuCl^+$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	1.1×10^3	SL/LUM/SPC; OT; k_q from k_{obs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031
20.1.118.	$CuCl_2$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	2.0×10^9	SL/LUM/SPC; OT; k_q from k_{obs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031
20.1.119.	Cu^{II}-Formic acid	H_2O	0.5 mol/L HCOOH; 0.5 mol/L HCOONa; μ = 1.0	21	2.7×10^8	LP/LUM/SST; τ_0 = 0.60 μs; OT; f = 0.16; [Q] = 0.0025-0.010 mol/L; 80% of Q as $Cu(HCOO)_4^{2-}$	78F683
20.1.120.	$Cu(H_2O)_n^{2+}$	H_2O	μ = 1.0	21	8×10^7	LP/LUM/SST; τ_0 = 0.60 μs; OT; f = 0.74; [Q] = 0.01-0.04 mol/L	78F683

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1. $Ru(bpy)_3^{2+}$—Continued							
	$Cu(H_2O)_n^{2+}$	H_2O	0.0025 mol/L H_2SO_4 + 0.088 mol/L Cu^{2+} ($CuSO_4$, $CuCl_2$) or 0.005 mol/L HCl + 0.24 mol/L Cl^- ($CuCl_2$, $MgCl_2$); μ = 0.35	25	5.7×10^7	SL/LUM/SPC; OT; k_q from k_{obs} at various [Cu^{II}] and [Cl^-] using known association constants	81A031
20.1.121.	Cu^{II}-plastocyanin	H_2O	0.027 mol/L Na_2HPO_4; 0.020 mol/L NaH_2PO_4; pH 7; μ = 0.1	25	4.2×10^9	LP/LUM/AVE; ET or OT	85A362
20.1.122.	Cu^{I}-plastocyanin	H_2O	Pbuf; pH 7; μ = 0.1	25	1.6×10^9	LP/LUM/SST; τ_0 = 0.61 μs; RT; linear S-V plot only for [Q] < 0.002 mol/L	82A022
20.1.123.	Cu^{II}-stellacyanin	H_2O	0.027 mol/L Na_2HPO_4; 0.020 mol/L NaH_2PO_4; pH 7; μ = 0.1	25	1.3×10^9	LP/LUM/AVE; ET or OT	85A362
20.1.124.	Cu^{I}-stellacyanin	H_2O	Pbuf; pH 7; μ = 0.1	25	4.2×10^8	LP/LUM/SST; τ_0 = 0.61 μs; RT; linear S-V plot only for [Q] < 0.002 mol/L	82A022
20.1.125.	Eu^{2+}	H_2O	0.05 mol/L HCl; μ = 0.5 (NaCl)	10	2.8×10^7	LP/LUM/SST; τ_0 = 0.70 μs; RT; [Q] = 0.01-0.09 mol/L	78A087
	Eu^{2+}	H_2O	0.05 mol/L HCl; μ = 0.5 (NaCl)	24	2.8×10^7	LP/LUM/SST; τ_0 = 0.62 μs; RT; [Q] = 0.01-0.09 mol/L	78A087
	Eu^{2+}	H_2O	0.05 mol/L HCl	25	2.8×10^7	SS/LUM; τ_0 = 0.60 μs (747635); RT; [Q] ≤ 0.08 mol/L	766046
	Eu^{2+}	H_2O	0.05 mol/L HCl; μ = 0.5 (NaCl)	25	2.8×10^7	SS/LUM; τ_0 = 0.60 μs (766404); RT; [Q] = 0.01-0.09 mol/L	78A087
	Eu^{2+}	H_2O	0.5 mol/L $HClO_4$	25	8.2×10^6	LP/LUM/SST; RT; $\Delta V^{\ddagger}$ = -1.1×10^{-2} L/mol (0.1-300 MPa)	82A068
	Eu^{2+}	H_2O	0.05 mol/L HCl; μ = 0.5 (NaCl)	~39	2.2×10^7	LP/LUM/SST; τ_0 = 0.48 μs; RT; [Q] = 0.01-0.09 mol/L	78A087

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1. $Ru(bpy)_3^{2+}$—Continued							
20.1.126.	Eu^{3+}	H_2O	0.025 mol/L HCl, $[MgCl_2] + [Eu^{3+}]$ = 0.9 mol/L	25	$\leq 8 \times 10^4$	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); Q mainly as $EuCl^{2+}$	766404
	Eu^{3+}	H_2O	0.025 mol/L HCl; μ = 2.8 ($MgCl_2$)	25	3.6×10^5	SL/LUM/SPC; τ_0 = 0.57 μs; $\Delta H^{\ddagger}$ = 17 kJ/mol; $\Delta S^{\ddagger}$ = −81 J/mol·K (20-80°C); OT; Q mainly as $EuCl^{2+}$	80A308
20.1.127.	$Eu(crypt)^{2+}$	H_2O	1 mol/L KCl	~22	1.3×10^9	SL/LUM/SPC; RT; [Q] = 0.001-0.01 mol/L	86E195
20.1.128.	$Eu(crypt)^{3+}$	H_2O	1 mol/L KCl	~22	4.9×10^7	SL/LUM/SPC; OT; [Q] = 0.01-0.1 mol/L	86E195
20.1.129.	Fe^{2+}	H_2O	0.5 mol/L $HClO_4$	~20	1.6×10^7	SS/LUM; τ_0^{air} = 0.40 μs (737633); ET; [Q] ≤ 0.04 mol/L	746396
	Fe^{2+}	H_2O	0.05 mol/L H_2SO_4; μ = 0.25 (NaCl)	25	1×10^7	LP/LUM/SST; RT	82A068
	Fe^{2+}	H_2O	0.5 mol/L $HClO_4$; μ = 0.64 ($NaClO_4$)	25	2.8×10^6	SS/LUM; τ_0 = 0.60 μs (747635); RT	766046
	Fe^{2+}	H_2O	1 mol/L KCl		3.3×10^6	SS/LUM; τ_0 = 0.62 μs (LP/LUM/AVE); RT	85E218
20.1.130.	Fe^{3+}	H_2O	0.1 mol/L CF_3SO_3H	18	1.9×10^9	SS/LUM; OT	79A218
	Fe^{3+}	H_2O	0.1 mol/L $HClO_4$	18	1.5×10^9	SS/LUM; OT; f = ~0.7	79A218
	Fe^{3+}	H_2O	0.17 mol/L H_2SO_4	18	1.3×10^9	SS/LUM; OT; f = ~0.7	79A218
	Fe^{3+}	H_2O	0.25 mol/L $HClO_4$	18	1.7×10^9	SS/LUM; OT; f = ~0.7	79A218
	Fe^{3+}	H_2O	0.5 mol/L HCl	18	6.7×10^8	SS/LUM; OT; f = ~0.7	79A218
	Fe^{3+}	H_2O	0.5 mol/L $HClO_4$	18	2.1×10^9	SS/LUM; OT; f = ~0.7	79A218
	Fe^{3+}	H_2O	0.5 mol/L H_3PO_4	18	8.0×10^8	SS/LUM; OT	79A218
	Fe^{3+}	H_2O	0.5 mol/L CF_3SO_3H	18	2.1×10^9	SS/LUM; OT	79A218
	Fe^{3+}	H_2O	0.75 mol/L $HClO_4$	18	2.5×10^9	SS/LUM; OT; f = ~0.7	79A218
	Fe^{3+}	H_2O	1 mol/L $HClO_4$	18	2.8×10^9	SS/LUM; OT; f = ~0.7	79A218
	Fe^{3+}	H_2O	0.5 mol/L $HClO_4$	~20	1.9×10^9	SS/LUM; τ_0^{air} = 0.40 μs (737633); OT; [Q] ≤ 0.01 mol/L	746396

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	Fe^{3+}	H_2O	0.11 mol/L $HClO_4$	25	1.5×10^9	SS/LUM; τ_0 = 0.60 μs (747635); OT; [Q] ≤ 0.003 mol/L; same k_q from same lab in 757640	766014
	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4	25	2.7×10^9	SS/LUM; τ_0 = 0.60 μs (747635); OT; same k_q from same lab in 766404	766014
	Fe^{3+}	H_2O	0.5 mol/L $HClO_4$	25	2.3×10^9	SS/LUM; τ_0 = 0.60 μs (747635); OT; same k_q from same lab in 757640	766014
	Fe^{3+}	H_2O	0.5 mol/L HCl	25	2.7×10^9	SS/LUM; τ_0 = 0.60 μs (747635); OT	766014
	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4		2.7×10^9	FP/PCM/SST; τ_0 = 0.60 μs (766404); OT, ET?; [Q] ≤ 0.002 mol/L; $[Fe^{2+}]$ = $[Fe^{3+}]$; see Mech. [8]	80E224
	Fe^{3+}	H_2O	0.5 mol/L H_2SO_4		2.7×10^9	SS/LUM; τ_0 = 0.60 μs (LP/LUM/SST); OT	82F048
	Fe^{3+}	H_2O	1 mol/L $HClO_4$		2.9×10^9	SS/LUM; τ_0 = 0.62 μs (FP/LUM/SST); OT; same k_q from same lab in 747159	767009
	Fe^{3+}	H_2O	1 mol/L KCl		4.8×10^9	SS/LUM; τ_0 = 0.62 μs (LP/LUM/AVE); OT	85E218
	Fe^{3+}	H_2O	0.1 mol/L ACbuf; pH 5		5.5×10^8	SS/LUM; OT	81N178
20.1.131.	$Fe(bpy)_3^{2+}$	H_2O	μ = 0.5 (Na_2SO_4)	25	1.0×10^9	LP/LUM/SST; τ_0 = 0.60 μs; ET; [Q] ≤ 0.005 mol/L	80E040
20.1.132.	$Fe(C_5H_5)_2$	DMF	0.1 mol/L TBAB		3.2×10^9	LP/LUM; τ_0 = 0.38 μs; ET	85A093
	$Fe(C_5H_5)_2$	DMF	0.1 mol/L TBAC		4.0×10^9	LP/LUM; τ_0 = 0.77 μs; [Q] = (1-6.5) × 10^{-4} mol/L; ET	85A093
	$Fe(C_5H_5)_2$	EtOH		25	5.9×10^9	SS/LUM; τ_0 = ~0.9 μs (FL/LUM/SST); ET	756002
20.1.133.	$Fe(C_5H_5)[C_5H_4C(O)CH_3]$	EtOH		25	3.4×10^9	SS/LUM; τ_0 = ~0.9 μs (FL/LUM/SST); ET	756002
20.1.134.	$Fe(C_5H_5)[C_5H_4C(O)C_6H_5]$	EtOH		25	7.4×10^9	SS/LUM; τ_0 = ~0.9 μs (FL/LUM/SST); ET	756002

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.135.	$Fe(CN)_6^{3-}$	H_2O	μ = 0 (calc'd)	~21	5.1×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 0.60 μs (LP/LUM/AVE); [Q] ≤ 4×10^{-4} mol/L; some SQ	766319
	$Fe(CN)_6^{3-}$	H_2O	0.1 mol/L HCl; μ = 0.25 (NaCl)	25	5.6×10^{9}	LP/LUM/SST; OT	82A068
	$Fe(CN)_6^{3-}$	H_2O	0.5 mol/L NaCl	25	6.5×10^{9}	SS/LUM; τ_0 = 0.60 μs (747635); OT; [Q] ≤ 6×10^{-4} mol/L	766014
	$Fe(CN)_6^{3-}$	H_2O			3.2×10^{10}	LP/LUM/SST; τ_0 = 0.59 μs	85N164
	$Fe(CN)_6^{3-}$	H_2O	9.4×10^{-5} mol/L PMA; pH 2		3.2×10^{10}	LP/LUM/SST; τ_0 = 0.59 μs	85N164
	$Fe(CN)_6^{3-}$	H_2O	9.4×10^{-5} mol/L PMA; pH 8		2.5×10^{9}	LP/LUM/SST	85N164
20.1.136.	$Fe(CN)_6^{4-}$	H_2O	μ = 0 (calc'd)	~21	7.3×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 0.60 μs (LP/LUM/AVE); ET?; [Q] ≤ 1×10^{-4} mol/L; some SQ	766319
	$Fe(CN)_6^{4-}$	H_2O	0.5 mol/L NaCl; pH 4	23	3.3×10^{9}	SS/LUM; τ_0^{air} = 0.40 μs (746112); RT; [Q] = (5-20) × 10^{-4} mol/L	766027
	$Fe(CN)_6^{4-}$	H_2O	μ = 0.001 (NaCl)	25	5.1×10^{10}	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); RT; [Q] ≤ 0.001 mol/L; some SQ, see Mech. [11]	81A250
	$Fe(CN)_6^{4-}$	H_2O	μ = 0.1 (NaCl)	25	7.2×10^{9}	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); RT; [Q] ≤ 0.0015 mol/L; some SQ, see Mech. [11]	81A250
	$Fe(CN)_6^{4-}$	H_2O	0.02 mol/L ACbuf; pH 5	25	3.5×10^{9}	SS/LUM; τ_0 = 0.60 μs (747635); RT; [Q] ≤ 0.0045 mol/L	766046
	$Fe(CN)_6^{4-}$	H_2O	0.02 mol/L Pbuf; pH 5.2; μ = 0.5 (NaCl)	25	3.0×10^{9}	LP/LUM/SST; RT	82A068
	$Fe(CN)_6^{4-}$	H_2O			3.4×10^{10}	SL/LUM/SPC; τ_0^{air} = 0.39 μs; [Q] ≤ 2×10^{-4} mol/L; some SQ	85R098

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	$Fe(CN)_6^{4-}$	H_2O	0.005 mol/L TRbuf; 0.05 mol/L NaCl; pH 7.2		9.0×10^9	SL/LUM/SPC; τ_0^{air} = 0.41 μs; [Q] ≤ 4×10^{-4} mol/L; some SQ	85R098
	$Fe(CN)_6^{4-}$	H_2O	0.005 mol/L TRbuf; 0.05 mol/L NaCl; [DNA-phosphate]/[S] = 40; pH 7.2		7×10^9	SL/LUM/SPC; τ_0^{air} = 0.42 μs	85R098
20.1.137.	$Fe(CN)_5(CO)^{3-}$	H_2O	pH 4-5; μ = 0.50 (NaCl)	25	5×10^6	SS/LUM; τ_0 = 0.60 μs (766404); RT	776405
20.1.138.	$Fe(CN)_5(DMSO)^{3-}$	H_2O	1×10^{-4} mol/L DMSO; pH 4-5; μ = 0.50 (NaCl)	25	5.6×10^7	SS/LUM; τ_0 = 0.60 μs (766404); RT	776405
20.1.139.	$Fe(CN)_5(imidazole)^{3-}$	H_2O	0.001 mol/L IMIDbuf; pH 4-5; μ = 0.50 (NaCl)	25	3.8×10^9	SS/LUM; τ_0 = 0.60 μs (766404); RT; [Q] ≤ 0.0012 mol/L	776405
20.1.140.	$Fe(CN)_5$(*N*-methylpyrazinium)$^{2-}$	H_2O	pH 4-5; μ = 0.50 (NaCl)	25	5.3×10^9	LP/LUM/AVE; OT, ET; [Q] ≤ 0.0015 mol/L	776405
20.1.141.	$Fe(CN)_5(NO)^{2-}$	H_2O	pH 4-5; μ = 0.50 (NaCl)	25	5.0×10^9	SS/LUM; τ_0 = 0.60 μs (766404); OT, ET; [Q] ≤ 0.0015 mol/L	776405
20.1.142.	$Fe(CN)_5(py)^{3-}$	H_2O	0.001 mol/L PYbuf; pH 4-5; μ = 0.50 (NaCl)	25	4.2×10^9	SS/LUM; τ_0 = 0.60 μs (766404); RT	776405
20.1.143.	$Fe(CN)_5$(pyrazinecarboxylato)$^{4-}$	H_2O	pH 4-5; μ = 0.50 (NaCl)	25	1.9×10^9	LP/LUM/AVE; RT; [Q] ≤ 0.0016 mol/L	776405
20.1.144.	$Fe(C_2O_4)_2^-$	H_2O	0.05 mol/L H_2SO_4		3.6×10^9	SS/LUM; τ_0 = 0.66 μs (LP/LUM/SST); OT?; [Q] = (2-12) × 10^{-4} mol/L	737656
20.1.145.	Fe^{III}(cytochrome c)	H_2O	Pbuf; pH 7; μ = 0.1		2.5×10^8	LP/LUM/SST; τ_0 = 0.57 μs; OT; same k_q from same lab in 84A242	82A280
	Fe^{III}(cytochrome c)	H_2O	Pbuf; pH 7		$>2 \times 10^8$	LP/ABS/AVE; τ_0 = 0.60 μs (80E040); OT; [Q] = (1-10) × 10^{-5} mol/L; 10.6% of Q as Fe^{II}	84A306

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.146.	Fe^{III}(cytochrome c)-(histidine-33)$Ru^{III}(NH_3)_5$	H_2O	Pbuf; pH 7; μ = 0.1		7.8×10^8	LP/LUM/SST; τ_0 = 0.57 μs; OT (80% to Ru^{III} and 20% to Fe^{III}); [Q] ≤ 0.0013 mol/L; same k_q from same lab in 84	82A280
20.1.147.	Fe(NTA)	H_2O	pH 2.6	22	3.7×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; [Q] = (1-10) × 10^{-4} mol/L	78A219
	Fe(NTA)	H_2O	2×10^{-4} mol/L NTA; pH 2.6-3.3	22	3.7×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; [Q] ≤ 0.002 mol/L	78A219
	Fe(NTA)	H_2O	2×10^{-4} mol/L NTA; pH 3.8	22	4.1×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; [Q] ≤ 0.002 mol/L	78A219
	Fe(NTA)	H_2O	2×10^{-4} mol/L NTA; pH 4.8	22	4.3×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; [Q] ≤ 0.002 mol/L	78A219
	Fe(NTA)	H_2O	0.0054 mol/L PVS; pH 2.2	22	3.4×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; [Q] ≤ 0.002 mol/L	78A219
	Fe(NTA)	H_2O	0.0054 mol/L PVS; pH 2.7	22	2.7×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; [Q] ≤ 0.002 mol/L	78A219
	Fe(NTA)	H_2O	0.0054 mol/L PVS; 2×10^{-4} - 0.0014 mol/L NTA; pH 2.7-3.4	22	2.0×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; [Q] ≤ 0.002 mol/L	78A219
	Fe(NTA)	H_2O	0.0054 mol/L PVS; 2×10^{-4} mol/L NTA; pH 3.8	22	1.4×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; [Q] ≤ 0.002 mol/L	78A219
	Fe(NTA)	H_2O	0.0054 mol/L PVS; 2×10^{-4} mol/L NTA; pH 4.8	22	6×10^8	SS/LUM; τ_0 = 0.60 μs (766014); OT; [Q] ≤ 0.002 mol/L	78A219
20.1.148.	$Fe(phen)_3^{2+}$	H_2O	μ = 0.1 (NaCl)	25	1.1×10^9	LP/LUM/SST; τ_0 = 0.60 μs; ET, OT?; [Q] ≤ 0.005 mol/L	80E040
20.1.149.	Hg^{2+}	H_2O	0.1 mol/L $HClO_4$; μ = 1.0	21	1.5×10^8	τ_0 = 0.60 μs; OT	80A233

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.063 ($NaNO_3$)	~23	6.7×10^7	LP/LUM/AVE; τ_0 = 0.61 μs; OT	84A148
	Hg^{2+}	H_2O	0.05 mol/L HNO_3; μ = 0.5 ($NaNO_3$)	~23	2.1×10^8	LP/LUM/AVE; τ_0 = 0.59 μs; OT	84A148
	Hg^{2+}	H_2O	0.5 mol/L H_2SO_4		1.5×10^8	LP/LUM/SST; OT; f = 0.32	82A111
	Hg^{2+}	H_2O	0.5 mol/L $HClO_4$; μ = 0.5		1.5×10^8	LP/LUM/SST; OT	82A111
	Hg^{2+}	H_2O	3 mol/L HCl; μ = 3.0		1.9×10^8	LP/LUM/SST; OT; f = <0.01	82A111
20.1.150.	$HgCl_2$	H_2O	0.1 mol/L $HClO_4$; μ = 1.0	21	3.8×10^8	τ_0 = 0.60 μs; OT	80A233
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.09 mol/L $NaNO_3$		1.7×10^8	LP/LUM/AVE; τ_0 = 0.63 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.99 mol/L $NaNO_3$		2.3×10^8	LP/LUM/AVE; τ_0 = 0.63 μs; OT	84A077
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.01 mol/L SLS		3.8×10^6	LP/LUM/AVE; τ_0 = 0.78 μs; OT	84N034
	$HgCl_2$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		1.8×10^6	LP/LUM/AVE; τ_0 = 0.77 μs; OT	84N034
20.1.151.	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, [$NaNO_3$] + [NaCl] = 0.99 mol/L		1.7×10^9	LP/LUM/AVE; τ_0 = 0.63 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
	$HgCl_3^-$	H_2O	0.01 mol/L HNO_3, 0.1 mol/L $NaNO_3$, 0.01 mol/L SLS		$<6 \times 10^4$	LP/LUM/AVE; τ_0 = 0.77 μs; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84N034
20.1.152.	$HgCl_4^{2-}$	H_2O	0.01 mol/L HNO_3, [$NaNO_3$] + [NaCl] = 0.99 mol/L		3.7×10^7	LP/LUM/AVE; τ_0 = 0.63 μs; OT; k_q from Cl^- titration at fixed $[Hg^{II}]_{tot}$	84A077
20.1.153.	I^-	H_2O	μ = 0 (calc'd)	~21	1×10^6	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); [Q] = 0.5-0.7 mol/L	766319
20.1.154.	In^{3+}	H_2O	0.3 mol/L HCl		7.7×10^5	SL/LUM/SPC, SS/LUM	85S227

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.155.	$IrCl_6^{3-}$	H_2O	0.0035 mol/L KCl	~22	1.2×10^{10}	SL/LUM/SST; τ_0^{air} = 0.40 μs; [Q] = (2-5) × 10^{-4} mol/L	746112
	$IrCl_6^{3-}$	H_2O	0.1 mol/L HCl; μ = 0.25 (NaCl)	25	8.3×10^8	LP/LUM/SST; RT; $\Delta V^{\ddagger}$ = 1.1 × 10^{-3} L/mol (0.1-300 MPa)	82A068
	$IrCl_6^{3-}$	MF	0.0035 mol/L NH_4Cl	~22	2×10^9	SL/LUM/SST; τ_0^{air} = 0.31 μs; [Q] = (2-5) × 10^{-4} mol/L	746112
20.1.156.	$Mn(TMePyP)^{5+}$	H_2O	0.01 mol/L Pbuf; pH 7		2.8×10^{10}	SS/LUM; τ_0 = 0.6 μs (78Z170); OT?; [Q] = (1-5) × 10^{-5} mol/L	86F171
20.1.157.	$Mo(CN)_8^{4-}$	H_2O	0.01 mol/L KCl	~22	9×10^6	SL/LUM/SST; τ_0^{air} = 0.40 μs; [Q] = (1-10) × 10^{-4} mol/L; also SQ	746112
	$Mo(CN)_8^{4-}$	H_2O	0.5 mol/L NaCl; pH 4	23	3.4×10^8	SS/LUM; τ_0^{air} = 0.40 μs (746112); RT; [Q] = (5-80) × 10^{-4} mol/L	766027
	$Mo(CN)_8^{4-}$	H_2O	0.1 mol/L HCl; μ = 0.25 (NaCl)	25	6.3×10^8	LP/LUM/SST; RT; $\Delta V^{\ddagger}$ = 2.5 × 10^{-2} L/mol (0.1-300 MPa)	82A068
	$Mo(CN)_8^{4-}$	MF	0.01 mol/L NH_4Cl	~22	4×10^9	SL/LUM/SST; τ_0^{air} = 0.31 μs; [Q] = (2-10) × 10^{-4} mol/L	746112
20.1.158.	NO_3^-	H_2O	μ = 0 (calc'd)	~21	$<4 \times 10^5$	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); [Q] = 0.1 mol/L	766319
20.1.159.	Ni^{2+}	H_2O	μ = 0 (calc'd)	~21	6×10^5	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); [Q] = 0.05-0.07 mol/L	766319
20.1.160.	$Ni(acac)_2$	MeOH		~21	2.7×10^7	SS/LUM; τ_0 = 0.77 μs (LP/LUM/AVE); ET; [Q] = 0.001-0.007 mol/L	766319
20.1.161.	$Ni(CN)_4^{2-}$	H_2O	μ = 0 (calc'd)	~21	2.8×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 0.60 μs (LP/LUM/AVE); ET?; [Q] ≤ 5 × 10^{-4} mol/L; some SQ	766319

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	$Ni(CN)_4^{2-}$	H_2O	0.5 mol/L NaCl; pH 4	23	5.6×10^9	SS/LUM; τ_0^{air} = 0.40 μs (746112); ET or RT; [Q] = (5-15) × 10^{-4} mol/L	766027
20.1.162.	$Ni[S_2C_2(C_6H_5)_2]_2$	DMF			1.3×10^{10}	SL/LUM/SPC, SS/LUM; OT; f = 0.35; [Q] ≤ 3 × 10^{-5} mol/L	86A133
	$Ni[S_2C_2(C_6H_5)_2]_2$	DMF	μ = 0.10 (TEAP)		1.3×10^{10}	SL/LUM/SPC, SS/LUM; OT; f = 0.35; [Q] ≤ 3 × 10^{-5} mol/L	86A133
	$Ni[S_2C_2(C_6H_5)_2]_2$	THF/H_2O (10/1)			8.5×10^9	SS/LUM; τ_0 = 0.80 μs (LP/LUM/SST); OT; [Q] ≤ 3.5 × 10^{-4} mol/L	82N184
20.1.163.	$Ni[S_2C_2(C_6H_5)_2]_2^-$	AN			4.7×10^{10}	SS/LUM	82N184
20.1.164.	$Ni[S_2C_2(CN)_2]_2^{2-}$	AN			1.0×10^{11}	LP/LUM/SST, SS/LUM; τ_0 = 1.0 μs; RT; [Q] ≤ 2.5 × 10^{-5} mol/L	83E621
	$Ni[S_2C_2(CN)_2]_2^{2-}$	AN			1.2×10^{11}	SL/LUM/SPC, SS/LUM; RT or ET	86A133
	$Ni[S_2C_2(CN)_2]_2^{2-}$	AN	μ = 0.001 (TEAP)		8.5×10^{10}	SL/LUM/SPC, SS/LUM; RT or ET	86A133
	$Ni[S_2C_2(CN)_2]_2^{2-}$	AN	μ = 0.01 (TEAP)		2.9×10^{10}	SL/LUM/SPC; RT or ET; some SQ	86A133
	$Ni[S_2C_2(CN)_2]_2^{2-}$	AN	μ = 0.10 (TEAP)		1.4×10^{10}	SL/LUM/SPC; RT or ET; some SQ	86A133
	$Ni[S_2C_2(CN)_2]_2^{2-}$	DMF			4.1×10^{10}	SL/LUM/SPC, SS/LUM; RT or ET; [Q] ≤ 3.5 × 10^{-5} mol/L	86A133
	$Ni[S_2C_2(CN)_2]_2^{2-}$	DMF	μ = 0.001 (TEAP)		2.9×10^{10}	SL/LUM/SPC, SS/LUM; RT or ET	86A133
	$Ni[S_2C_2(CN)_2]_2^{2-}$	DMF	μ = 0.01 (TEAP)		1.6×10^{10}	SL/LUM/SPC, SS/LUM; RT or ET	86A133
	$Ni[S_2C_2(CN)_2]_2^{2-}$	DMF	μ = 0.10 (TEAP)		7.5×10^9	SL/LUM/SPC; RT or ET; [Q] ≤ 3.5 × 10^{-5} mol/L; some SQ	86A133
	$Ni[S_2C_2(CN)_2]_2^{2-}$	DMF	μ = 0.25 (TEAP)		5×10^9	SL/LUM/SPC; RT or ET; some SQ	86A133
	$Ni[S_2C_2(CN)_2]_2^{2-}$	H_2O			2.0×10^{10}	LP/LUM/SST; τ_0 = 0.60 μs; RT; [Q] ≤ 9 × 10^{-6} mol/L; some SQ	83E621

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1. $Ru(bpy)_3^{2+}$—Continued							
	$Ni[S_2C_2(CN)_2]_2^{2-}$	MF			5.8×10^9	LP/LUM/SST, SS/LUM; τ_0 = 0.90 μs; RT	83E621
	$Ni[S_2C_2(CN)_2]_2^{2-}$	MeOH			6.7×10^{10}	LP/LUM/SST; τ_0 = 0.71 μs; RT; [Q] ≤ 6.5×10^{-5} mol/L; some SQ	83E621
20.1.165.	O_2	AN	0.1 mol/L TBAC		6.8×10^8	LP/LUM; τ_0 = 0.74 μs; p_Q = (2-10) × 10^4 Pa; ET	85A093
	O_2	H_2O		16-18	1.7×10^9	LP/LUM/SST; τ_0 = 0.56 μs; ET; p_Q = 1×10^5 Pa	80E566
	O_2	H_2O		16-18	1.6×10^9	LP/LUM/SST; τ_0 = 0.51 μs; ET; p_Q = 1×10^5 Pa; p_{app} = 2.3×10^8 Pa	80E566
	O_2	H_2O		18	2.6×10^9	SS/LUM; τ_0 = 0.60 μs (SL/LUM/SPC, LP/LUM/SST); ET; [Q] = 3×10^{-4} mol/L	86S150
	O_2	H_2O		22	3.7×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT?; [Q] = (2.5-13) × 10^{-4} mol/L; same k_q from same lab in 776406	78A219
	O_2	H_2O	0.0065 mol/L PVS	22	2.7×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT?; [Q] = (2.5-13) × 10^{-4} mol/L	78A219
	O_2	H_2O		25	3.3×10^9	SS/LUM; τ_0 = 0.60 μs (747635); [Q] ≤ 0.0015 mol/L; same k_q from same lab in 766404	766014
	O_2	H_2O	0.5 mol/L HCl	25	3.0×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; p_Q ≤ 1.0×10^5 Pa	80F402
	O_2	H_2O	ACbuf; pH 4.6	25	3.2×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; p_Q = (2-10) × 10^4 Pa	81F401
	O_2	H_2O	0.05 mol/L H_2SO_4	~26	3.5×10^9	SS/LUM; τ_0 = 0.60 μs (76F936); OT, ET	767179
	O_2	H_2O			3.2×10^9	SS/LUM; τ_0 = 0.66 μs (LP/LUM/SST); ET; p_Q = (2-10) × 10^4 Pa; same k_q from same lab in 737658	737656
	O_2	H_2O			3.0×10^9	LP/LUM/SST; τ_0 = 0.59 μs	85N164

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	O_2	H_2O	9.4×10^{-5} mol/L PMA; pH 2		2.9×10^9	LP/LUM/SST; τ_0 = 0.59 μs	85N164
	O_2	H_2O	9.4×10^{-5} mol/L PMA; pH 7		1.8×10^9	LP/LUM/SST; τ_0 = 0.67 μs	85N164
	O_2	H_2O	9.4×10^{-5} mol/L PMA; pH 9		2.9×10^9	LP/LUM/SST; τ_0 = 0.59 μs	85N164
	O_2	H_2O	0.11% PVS		2.7×10^9	SS/LUM; τ_0 = 0.60 μs (766404); p_Q = (2-10) × 10^4 Pa	776406
	O_2	MeOH		~21	1.7×10^9	SS/LUM; τ_0 = 0.81 μs (LP/LUM/SST); ET; same k_q from same lab in 777221	737658
	O_2	MeOH			1.6×10^9	LP/LUM/SST; τ_0 = 0.63 μs; ET	84F005
20.1.166.	$Os(bpy)_3^{2+}$	H_2O	μ = 0.1 (NaCl)	25	1.5×10^9	LP/LUM/SST; τ_0 = 0.60 μs; ET, RT; [Q] ≤ 0.005 mol/L	80E040
20.1.167.	$Os(bpy)_3^{3+}$	H_2O	0.4 mol/L NaCl, 0.1 mol/L HCl	25	3.8×10^9	SS/LUM; τ_0 = 0.60 μs (747635); OT; [Q] ≤ 6 × 10^{-4} mol/L	766014
20.1.168.	$Os(C_5H_5)[C_5H_4C(O)CH_3]$	EtOH		25	$<1 \times 10^7$	SS/LUM; τ_0 = ~0.9 μs (FL/LUM/SST)	756002
20.1.169.	$Os(CN)_6^{1-}$	H_2O	0.5 mol/L NaCl; pH 4	23	1.2×10^9	SS/LUM; τ_0^{air} = 0.40 μs (746112); RT; [Q] = (5-40) × 10^{-4} mol/L	766027
	$Os(CN)_6^{1-}$	H_2O	0.1 mol/L HCl; μ = 0.25 (NaCl)	25	8.4×10^8	LP/LUM/SST; RT; $\Delta V^{\ddagger}$ = 6.8 × 10^{-3} L/mol (0.1-300 MPa)	82A068
20.1.170.	*trans*-$Os(en)_2Cl_2^+$	H_2O	0.13 mol/L HCl, 0.37 mol/L NaCl; μ = 0.5	25	5.2×10^7	SS/LUM; τ_0 = 0.6 μs; [Q] ≤ 0.0075 mol/L	80F334
20.1.171.	*cis*-$Os(en)_2H_2^{2+}$	H_2O	0.13 mol/L HCl, 0.37 mol/L NaCl; μ = 0.5	25	2.3×10^8	SS/LUM; τ_0 = 0.6 μs; [Q] ≤ 0.0064 mol/L	80F334
20.1.172.	*trans*-$Os(en)_2O_2^{2+}$	H_2O	0.13 mol/L HCl, 0.37 mol/L NaCl; μ = 0.5	25	1.7×10^9	SS/LUM; τ_0 = 0.6 μs; OT?; [Q] ≤ 0.001 mol/L	80F334

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.173.	$Os(NH_3)_6^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	$\leq 1.4 \times 10^7$	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT, ET; [Q] = (3-200) × 10^{-4} mol/L	82A145
20.1.174.	$Os(NH_3)_5Cl^{2+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	$\leq 4 \times 10^7$	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT, ET; [Q] = (3-200) × 10^{-4} mol/L	82A145
20.1.175.	$Os(NH_3)_5(H_2O)^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	$\leq 7 \times 10^6$	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT, ET; [Q] = (3-200) × 10^{-4} mol/L	82A145
20.1.176.	$Os(NH_3)_5I^{2+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	3.2×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); ET; [Q] = (3-200) × 10^{-4} mol/L	82A145
20.1.177.	$Os(NH_3)_5(N_2)^{2+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	9×10^7	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); RT; [Q] = (3-200) × 10^{-4} mol/L	82A145
20.1.178.	$Pd(CN)_4^{2-}$	H_2O	0.5 mol/L NaCl; pH 4	23	$<1 \times 10^6$	SS/LUM; τ_0^{air} = 0.40 μs (746112); [Q] = 0.05 mol/L	766027
20.1.179.	$PtBr_4^{2-}$	H_2O	μ = 2 ($HClO_4$)		4.5×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.38 μs; ET	83E719
20.1.180.	$PtBr_6^{2-}$	H_2O	μ = 2 ($HClO_4$)		6.1×10^9	LP/LUM/SST; τ_0^{air} = 0.38 μs; OT; [Q] ≤ 0.001 mol/L	83A403
20.1.181.	$Pt(CN)_4^{2-}$	H_2O	μ = 0 (calc'd)	~21	$<7 \times 10^7$	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); [Q] = 0.006-0.017 mol/L	766319
	$Pt(CN)_4^{2-}$	H_2O	0.5 mol/L NaCl; pH 4	23	$<1 \times 10^6$	SS/LUM; τ_0^{air} = 0.40 μs (746112); [Q] = 0.05 mol/L	766027
20.1.182.	$Pt(C_2O_4)_2^{2-}$	H_2O	μ = 2 ($HClO_4$)		$<2 \times 10^7$	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.38 μs	83E719
20.1.183.	$PtCl_4^{2-}$	DMF	0.0018 mol/L NH_4Cl	~22	1.5×10^{10}	SL/LUM/SST; τ_0^{air} = 0.32 μs; [Q] = (1-5) × 10^{-4} mol/L; also SQ	746112

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1. $Ru(bpy)_3^{2+}$—Continued							
	$PtCl_4^{2-}$	H_2O	μ = 0 (calc'd)	~21	1.5×10^{10}	SS/LUM and LP/LUM/AVE; τ_0 = 0.60 μs (LP/LUM/AVE); ET; [Q] ≤ 6×10^{-4} mol/L; some SQ	766319
	$PtCl_4^{2-}$	H_2O	0.0018 mol/L KCl	~22	1.0×10^{10}	SL/LUM/SST; τ_0^{air} = 0.40 μs; [Q] = (1-5) × 10^{-4} mol/L	746112
	$PtCl_4^{2-}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	2.6×10^9	SS/LUM or LP/LUM/SST; same k_q from same lab in 79A317	81N003
	$PtCl_4^{2-}$	H_2O	0.001 mol/L $HClO_4$		6.5×10^9	SS/LUM, LP/LUM/SST; τ_0 = 0.69 μs; ET; [Q] = (2-12) × 10^{-4} mol/L	717111
	$PtCl_4^{2-}$	H_2O	μ = 2 ($HClO_4$)		1.4×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.38 μs; ET	83E719
	$PtCl_4^{2-}$	MF	0.0018 mol/L NH_4Cl	~22	8×10^8	SL/LUM/SST; τ_0^{air} = 0.31 μs; [Q] = (1-5) × 10^{-4} mol/L	746112
20.1.184.	$PtCl_6^{2-}$	H_2O	μ = 0 (calc'd)	~21	3.4×10^{10}	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); OT, ET?; [Q] = (4-13) × 10^{-5} mol/L	766319
	$PtCl_6^{2-}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	7.2×10^9	SS/LUM or LP/LUM/SST; same k_q from same lab in 79A317	81N003
	$PtCl_6^{2-}$	H_2O	μ = 2 ($HClO_4$)		3.9×10^9	LP/LUM/SST; τ_0^{air} = 0.38 μs; OT; [Q] ≤ 0.001 mol/L	83A403
20.1.185.	PtF_6^{2-}	H_2O	μ = 2 ($HClO_4$)		3.2×10^8	LP/LUM/SST; τ_0^{air} = 0.38 μs; OT; [Q] ≤ 0.001 mol/L	83A403
20.1.186.	$Pt(NH_3)_4Br_2^{2+}$	H_2O	μ = 0.02 ($HClO_4$ or H_2SO_4)		1×10^9	EMI; OT	85A469
20.1.187.	$Pt(NH_3)_5Br^{3+}$	H_2O	μ = 0.1 ($HClO_4$ or H_2SO_4)		1×10^9	EMI; OT	85A469
20.1.188.	$Pt(NH_3)_4Cl_2^{2+}$	H_2O	μ = 0.02 ($HClO_4$ or H_2SO_4)		8×10^8	EMI; OT	85A469
20.1.189.	$Pt(NH_3)_5Cl^{3+}$	H_2O	μ = 0.1 ($HClO_4$ or H_2SO_4)		3×10^8	EMI; OT	85A469
20.1.190.	$Pt[S_2C_2(C_6H_5)_2]_2$	DMF			1.3×10^{10}	SL/LUM/SPC, SS/LUM; OT; f = 0.35	86A133

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.191.	$Pt[S_2C_2(CN)_2]_2^{2-}$	DMF	μ = 0.001 (TEAP)		2.0×10^{10}	SL/LUM/SPC, SS/LUM; RT or ET	86A133
	$Pt[S_2C_2(CN)_2]_2^{2-}$	DMF	μ = 0.10 (TEAP)		6×10^9	SL/LUM/SPC; RT or ET; some SQ	86A133
20.1.192.	$Pt(SCN)_4^{2-}$	H_2O	μ = 4 ($HClO_4$)		5.5×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.38 μs; ET	83E719
20.1.193.	$Pt(SCN)_6^{2-}$	H_2O	μ = 2 ($HClO_4$)		1.9×10^9	LP/LUM/SST; τ_0^{air} = 0.38 μs; OT; [Q] ≤ 0.001 mol/L	83A403
20.1.194.	$Rh(bpy)_3^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	6.2×10^8	SS/LUM or LP/LUM/SST; OT; f = 0.15; same k_q from same lab in 79A317	81N003
	$Rh(bpy)_3^{3+}$	H_2O	0.5 mol/L NaOH; μ = 0.5	25	3.7×10^8	SS/LUM or LP/LUM/SST; OT	81N003
	$Rh(bpy)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	6×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT; $k_q = 3.9 \times 10^8$ L mol^{-1} s^{-1} at 25 °C in 0.17 mol/L Na_2SO_4 at pH 8 with SS/LUM or LP/LUM/SST (f = 0.15) from same lab in 81N003	82A145
	$Rh(bpy)_3^{3+}$	H_2O	0.5 mol/L Pbuf; pH 7.1	25	3.5×10^8	SS/LUM; τ_0 = 0.60 μs (766404); OT; [Q] ≤ 0.003 mol/L	79F206
20.1.195.	*cis*-$Rh(bpy)_2(H_2O)_2^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	4.4×10^8	SS/LUM or LP/LUM/SST; OT	81N003
	cis-$Rh(bpy)_2(H_2O)_2^{3+}$	H_2O	0.5 mol/L Pbuf; pH 3.0	25	3.2×10^8	SS/LUM; τ_0 = 0.60 μs (766404); OT; [Q] ≤ 0.007 mol/L	79F206
20.1.196.	*cis*-$Rh(bpy)_2(H_2O)Cl^{2+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	1.0×10^9	SS/LUM or LP/LUM/SST	81N003
20.1.197.	*cis*-$Rh(bpy)_2(H_2O)(OH)^{2+}$	H_2O		25	2.0×10^7	SS/LUM or LP/LUM/SST; k_q evaluated from pH dependence of k_{obs} for $Rh(bpy)_2(H_2O)_2^{3+}$	81N003
20.1.198.	*cis*-$Rh(bpy)_2(OH)_2^{+}$	H_2O	0.5 mol/L NaOH; μ = 0.5	25	1.2×10^7	SS/LUM or LP/LUM/SST; ET	81N003
	cis-$Rh(bpy)_2(OH)_2^{+}$	H_2O	0.5 mol/L Pbuf; pH 7.1	25	5.2×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT; [Q] ≤ 0.006 mol/L	79F206

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.199.	*cis*-$Rh(bpy)_2(OH)Cl^+$	H_2O	0.5 mol/L NaOH; μ = 0.5	25	4×10^8	SS/LUM or LP/LUM/SST	81N003
20.1.200.	$Rh(5\text{-Brphen})_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.5×10^9	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT	82A145
20.1.201.	$Rh(5\text{-Clphen})_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.5×10^9	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT	82A145
20.1.202.	$Rh(4,4'\text{-Me}_2\text{bpy})_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	3×10^7	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT	82A145
	$Rh(4,4'\text{-Me}_2\text{bpy})_3^{3+}$	H_2O	0.5 mol/L Pbuf; pH 7.1	25	7×10^7	SS/LUM; τ_0 = 0.60 μs (766404); OT; [Q] ≤ 0.004 mol/L	79F206
20.1.203.	$Rh(4,7\text{-Me}_2\text{phen})_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.7×10^9	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT	82A145
20.1.204.	$Rh(5\text{-Mephen})_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	4×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT	82A145
20.1.205.	$Rh(5,6\text{-Me}_2\text{phen})_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	3×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT	82A145
20.1.206.	$Rh(phen)_3^{3+}$	H_2O	0.5 mol/L H_2SO_4; μ = 0.5	25	6.8×10^8	SS/LUM or LP/LUM/SST; OT	81N003
	$Rh(phen)_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	4×10^8	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT	82A145
20.1.207.	$Rh(5\text{-Phphen})_3^{3+}$	H_2O	0.17 mol/L Na_2SO_4; μ = 0.5	25	1.6×10^9	SS/LUM or LP/LUM/SST; τ_0 = 0.60 μs (766404); OT	82A145
20.1.208.	$Ru(acac)_3$	H_2O		22	3.1×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; [Q] = 5×10^{-4} mol/L	78A219
	$Ru(acac)_3$	H_2O	0.0062 mol/L PVS	22	2.0×10^9	SS/LUM; τ_0 = 0.60 μs (766014); OT; [Q] = 5×10^{-4} mol/L	78A219
20.1.209.	$Ru(bpy)_3^{2+}$	H_2O	μ = 1.0 (Na_2SO_4)	25	$\leq 1 \times 10^8$	LP/LUM/SST; τ_0 = 0.60 μs; [Q] ≤ 0.005 mol/L	80E040
	$Ru(bpy)_3^{2+}$	H_2O			1.6×10^{10}	SS/LUM; τ_0 = 0.7 μs (737633); see Mech. [3]; τ_0 at [S] = 1.2×10^{-4} mol/L; τ independent of [S] in the range 1×10^{-5} - 0.07 mol/L (L. Moggi, unpub. obs.)	86E677

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.210.	$Ru(bpy)_3^{3+}$	AN	0.1 mol/L TEAP	25	3.2×10^9	LP/LUM/AVE; τ_0 = 0.85 μs; OT	86A077
	$Ru(bpy)_3^{3+}$	H_2O	0.5 mol/L *t*-BuOH; 0.002 mol/L ACbuf; pH 4.6; μ = 1.5 (Na_2SO_4)	24	1.8×10^9	PR/LUM/AVE; τ_0 = 0.71 μs; OT; *f* = 0.11; [Q] ≤0.00125 mol/L mol/L; *S generated from Q + e_{aq}^-	78A070
20.1.211.	$Ru(C_5H_5)_2$	EtOH		25	$<1 \times 10^7$	SS/LUM; τ_0 = ~0.9 μs (FL/LUM/SST)	756002
20.1.212.	$Ru[C_5H_4C(O)CH_3]_2$	EtOH		25	$<1 \times 10^7$	SS/LUM; τ_0 = ~0.9 μs (FL/LUM/SST)	756002
20.1.213.	$Ru(C_2O_4)_2(H_2O)_2^-$	H_2O	pH 10		9.5×10^8	OT	85M244
20.1.214.	$Ru(EDTA)^-$	H_2O	pH 10		4.9×10^9	OT	85M244
20.1.215.	$Ru(H_2O)Cl_5^{2-}$	H_2O	pH 10		8.2×10^9	OT	85M244
20.1.216.	$Ru(NH_3)_6^{2+}$	H_2O	0.2 mol/L ACbuf; pH 5	25	2.4×10^9	SS/LUM; τ_0 = 0.60 μs (747635); RT; [Q] ≤ 0.005 mol/L	766046
20.1.217.	$Ru(NH_3)_6^{3+}$	H_2O	0.5 mol/L H_2SO_4	25	2.1×10^9	SS/LUM; τ_0 = 0.60 μs (LP/LUM/SPC); OT; [Q] ≤ 0.004 mol/L	747635
	$Ru(NH_3)_6^{3+}$	H_2O	0.5 mol/L NaCl	25	2.7×10^9	SS/LUM; τ_0 = 0.60 μs (747635); OT; [Q] ≤ 0.0015 mol/L	766014
	$Ru(NH_3)_6^{3+}$	H_2O	0.2 mol/L ACbuf; pH 5	25	3.1×10^9	SS/LUM; τ_0 = 0.60 μs (747635); OT	766046
	$Ru(NH_3)_6^{3+}$	H_2O	1 mol/L CF_3CO_2H		$\sim 2 \times 10^9$	SS/LUM; τ_0 = 0.6 μs (69E219); OT; [Q] ≤ 0.001 mol/L	747159
20.1.218.	$Ru(NH_3)_5Cl^{2+}$	H_2O	0.5 mol/L H_2SO_4	25	2.7×10^9	SS/LUM; τ_0 = 0.60 μs (LP/LUM/SPC); OT; [Q] ≤ 0.004 mol/L	747635
	$Ru(NH_3)_5Cl^{2+}$	H_2O	pH 10		2.7×10^9	OT	85M244
20.1.219.	$Ru(NH_3)_5$(histidine)$^{3+}$	H_2O	Pbuf; pH 7; μ = 0.1		1.2×10^9	LP/LUM/SST; τ_0 = 0.57 μs; OT; same k_q from same lab in 84A242	82A280
20.1.220.	$Ru[5\text{-}(NO_2)phen]_3^{2+}$	H_2O	μ = 0.1 (NaCl)	25	2.0×10^9	LP/LUM/SST; τ_0 = 0.60 μs; ET, OT?; [Q] ≤ 0.005 mol/L	80E040

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
20.1.221.	$Ru(terpy)_2^{2+}$	H_2O	μ = 0.1 (NaCl)	25	1.2×10^9	LP/LUM/SST; τ_0 = 0.60 μs; ET; [Q] ≤ 0.005 mol/L	80E040
	$Ru(terpy)_2^{2+}$	H_2O	μ = 1.0 (Na_2SO_4)	25	1.5×10^9	LP/LUM/SST; τ_0 = 0.60 μs; ET; [Q] ≤ 0.005 mol/L	80E040
20.1.222.	$Ru(TPTZ)_2^{2+}$	H_2O	μ = 0.5 (NaCl)	25	1.2×10^9	LP/LUM/SST; τ_0 = 0.60 μs; ET, OT; [Q] ≤ 0.005 mol/L	80E040
20.1.223.	SO_3^{2-}	H_2O		25	$\sim 3 \times 10^5$	LP/ABS/SST; OT; [Q] = 0.1-1 mol/L; also SQ	79F045
20.1.224.	$S_2O_4^{2-}$	H_2O	0.02 mol/L ACbuf; pH 5	25	2.4×10^9	SS/LUM; τ_0 = 0.60 μs (747635); RT; [Q] ≤ 0.0025 mol/L	766046
20.1.225.	$S_2O_8^{2-}$	H_2O	μ = 0.05 ($NaClO_4$)	30	9.4×10^8	SS/LUM; τ_0 = 0.66 μs (737656); OT; [Q] ≤ 0.007 mol/L	85A062
	$S_2O_8^{2-}$	H_2O	μ = 0.1 ($NaClO_4$)	30	7.0×10^8	SS/LUM; τ_0 = 0.66 μs (737656); OT	85A062
	$S_2O_8^{2-}$	H_2O	μ = 0.2 ($NaClO_4$)	30	4.8×10^8	SS/LUM; τ_0 = 0.66 μs (737656); OT	85A062
	$S_2O_8^{2-}$	H_2O	μ = 0.3 ($NaClO_4$)	30	3.3×10^8	SS/LUM; τ_0 = 0.66 μs (737656); OT	85A062
	$S_2O_8^{2-}$	H_2O	μ = 0.4 ($NaClO_4$)	30	2.4×10^8	SS/LUM; τ_0 = 0.66 μs (737656); OT	85A062
	$S_2O_8^{2-}$	H_2O	μ = 0.5 ($NaClO_4$)	30	2.0×10^8	SS/LUM; τ_0 = 0.66 μs (737656); OT; [Q] ≤ 0.01 mol/L	85A062
	$S_2O_8^{2-}$	H_2O			6.8×10^9	LP/LUM/SST; τ_0 = 0.59 μs	85N164
	$S_2O_8^{2-}$	H_2O	0.2 mol/L $(NH_4)_2SO_4$		1.1×10^9	SS/LUM, LP/LUM/AVE; τ_0 = 0.55 μs; OT; [Q] ≤ 0.01 mol/L	84F121
	$S_2O_8^{2-}$	H_2O	0.5 mol/L H_2SO_4		5.3×10^8	SS/LUM; OT	80F128
	$S_2O_8^{2-}$	H_2O	Acbuf; pH 4.7; μ = 0.1		8×10^8	LP/LUM/SST; OT; [Q] ≤ 0.02 mol/L	80U077
	$S_2O_8^{2-}$	H_2O	0.1 mol/L ACbuf; pH 5		8×10^8	SS/LUM; OT	81N178
	$S_2O_8^{2-}$	H_2O	9.4×10^{-5} mol/L PMA; pH 2		4.6×10^9	LP/LUM/SST; τ_0 = 0.59 μs	85N164

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	$S_2O_8^{2-}$	H_2O	9.4×10^{-5} mol/L PMA; pH 8		2.8×10^8	LP/LUM/SST	85N164
	$S_2O_8^{2-}$	H_2O/AN (9/1)	0.2 mol/L $(NH_4)_2SO_4$		4.3×10^8	SS/LUM, LP/LUM/AVE; τ_0 = 0.64 μs; OT; [Q] ≤ 0.02 mol/L	84F121
	$S_2O_8^{2-}$	H_2O/AN (4/1)	0.2 mol/L $(NH_4)_2SO_4$		1.3×10^8	SS/LUM, LP/LUM/AVE; τ_0 = 0.71 μs; OT; [Q] ≤ 0.04 mol/L	84F121
	$S_2O_8^{2-}$	H_2O/AN (2.3/1)	0.2 mol/L $(NH_4)_2SO_4$		6.9×10^7	SS/LUM, LP/LUM/AVE; τ_0 = 0.78 μs; OT; [Q] ≤ 0.07 mol/L	84F121
	$S_2O_8^{2-}$	H_2O/AN (1.5/1)	0.2 mol/L $(NH_4)_2SO_4$		3.4×10^7	SS/LUM, LP/LUM/AVE; τ_0 = 0.81 μs; OT; [Q] ≤ 0.06 mol/L	84F121
20.1.226.	Sm^{3+}	H_2O	0.3 mol/L HCl		2.1×10^6	SL/LUM/SPC, SS/LUM	85S227
20.1.227.	Ti^{3+}	H_2O	1.5 mol/L HCl; μ = 3.0 (LiCl)	25	6.0×10^6	LP/LUM/SST; τ_0 = 0.53 μs; ET; 20-60% Ti^{3+} coordinated by Cl^-	79A183
	Ti^{3+}	H_2O	1 mol/L HCl		6.0×10^6	SL/LUM/SPC; τ_0 = 0.66 μs; OT; [Q] ≤ 0.035 mol/L; $k_q = 7.2 \times 10^6$ with SS/LUM	80F183
20.1.228.	Tl^+	H_2O	0.5 mol/L $HClO_4$	~20	$<1 \times 10^6$	SS/LUM; τ_0^{air} = 0.40 μs (737633); [Q] = 0.01 mol/L	746396
20.1.229.	Tl^{3+}	H_2O	0.5 mol/L $HClO_4$	~20	1.1×10^8	SS/LUM; τ_0^{air} = 0.40 μs (737633); OT; [Q] ≤ 0.01 mol/L	746396
	Tl^{3+}	H_2O	4.8 mol/L $HClO_4$	25	1.0×10^9	LP/LUM/SST; OT	82A068
	Tl^{3+}	H_2O	0.5 mol/L H_2SO_4; μ = 1.5		1.0×10^8	LP/LUM/SST; OT; f = 1	82A111
	Tl^{3+}	H_2O	1 mol/L HCl; μ = 1.0		3.4×10^9	LP/LUM/SST; OT	82A111
	Tl^{3-}	H_2O	3 mol/L HCl; μ = 3.0		4.3×10^9	LP/LUM/SST; OT; f = 0.07(?)	82A111
20.1.230.	UO_2^{2+}	H_2O	pH 2 (HNO_3)		4.4×10^8	LP/LUM/SST; τ_0 = 0.60 μs; OT; f = 0.45; [Q] ≤ 5×10^{-4} mol/L	80A291
	UO_2^{2+}	H_2O	2 mol/L H_3PO_4		3.5×10^8	LP/LUM/SST; τ_0 = 0.50 μs; OT; f = 0.45	80A291

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.2.	**$(-)_D$-$Ru(bpy)_3^{2+}$**						
20.2.1.	$Co(acac)_3$	H_2O		22	9.0×10^8	LP/LUM/SST; τ_0 = 0.65 μs; OT; $k_q = 5.7 \times 10^8$ with SS/QYP, see Mech. [5]	80F228
20.2.2.	$(-)_D$-$Co(EDTA)^-$	H_2O/MeOH (1/1)		25	4.2×10^9	LP/LUM/SST; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	$(-)_D$-$Co(EDTA)^-$	MeOH/H_2O (9/1)		15	1.0×10^{10}	LP/LUM/SST; $\Delta H^\ddagger$ = 14 kJ/mol; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	$(-)_D$-$Co(EDTA)^-$	MeOH/H_2O (9/1)		25	1.4×10^{10}	LP/LUM/SST; $\Delta H^\ddagger$ = 14 kJ/mol; $\Delta G^\ddagger$ = 15 kJ/mol; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	$(-)_D$-$Co(EDTA)^-$	MeOH/H_2O (9/1)		35	1.7×10^{10}	LP/LUM/SST; $\Delta H^\ddagger$ = 14 kJ/mol; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	$(-)_D$-$Co(EDTA)^-$	MeOH/H_2O (9/1)		45	2.1×10^{10}	LP/LUM/SST; $\Delta H^\ddagger$ = 14 kJ/mol; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	$(-)_D$-$Co(EDTA)^-$	MeOH/H_2O (4.3/1)		25	9.1×10^9	LP/LUM/SST; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
20.2.3.	$(+)_D$-$Co(EDTA)^-$	H_2O/MeOH (1/1)		25	3.5×10^9	LP/LUM/SST; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	$(+)_D$-$Co(EDTA)^-$	MeOH/H_2O (9/1)		15	9.7×10^9	LP/LUM/SST; $\Delta H^\ddagger$ = 11 kJ/mol; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	$(+)_D$-$Co(EDTA)^-$	MeOH/H_2O (9/1)		25	1.2×10^{10}	LP/LUM/SST; $\Delta H^\ddagger$ = 11 kJ/mol; $\Delta G^\ddagger$ = 15 kJ/mol; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	$(+)_D$-$Co(EDTA)^-$	MeOH/H_2O (9/1)		35	1.4×10^{10}	LP/LUM/SST; $\Delta H^\ddagger$ = 11 kJ/mol; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	$(+)_D$-$Co(EDTA)^-$	MeOH/H_2O (9/1)		45	1.7×10^{10}	LP/LUM/SST; $\Delta H^\ddagger$ = 11 kJ/mol; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	$(+)_D$-$Co(EDTA)^-$	MeOH/H_2O (4.3/1)		25	8.2×10^9	LP/LUM/SST; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
20.2.4.	*rac*-$Co(EDTA)^-$	H_2O		25	6.7×10^9	LP/LUM/SST; τ_0 = 0.59 μs; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008

TABLE 20. Quenching of $Ru(bpy)_3^{2+}$ by inorganic compounds—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
20.2.	**$(-)_D$-$Ru(bpy)_3^{2+}$**—Continued						
	rac-$Co(EDTA)^-$	H_2O	0.039 mol/L KBr	25	3.7×10^9	LP/LUM/SST; τ_0 = 0.59 μs; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	rac-$Co(EDTA)^-$	H_2O	0.12 mol/L KBr	25	3.0×10^9	LP/LUM/SST; τ_0 = 0.59 μs; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	rac-$Co(EDTA)^-$	H_2O/MeOH (1/1)		25	3.9×10^9	LP/LUM/SST; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	rac-$Co(EDTA)^-$	MeOH/H_2O (9/1)		25	1.3×10^{10}	LP/LUM/SST; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	rac-$Co(EDTA)^-$	MeOH/H_2O (4.3/1)		25	8.5×10^9	LP/LUM/SST; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	rac-$Co(EDTA)^-$	MeOH/H_2O (4.3/1)	0.042 mol/L KBr	25	1.7×10^9	LP/LUM/SST; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
	rac-$Co(EDTA)^-$	MeOH/H_2O (4.3/1)	0.13 mol/L KBr	25	1.1×10^9	LP/LUM/SST; OT; [Q] = (1-5) × 10^{-4} mol/L	85F008
20.2.5.	$Co(phen)_3^{3+}$	H_2O	0.5 mol/L NaCl	22	6.8×10^8	LP/LUM/SST; τ_0 = 0.65 μs; OT; k_q = 3.5 × 10^8 with SS/QYP, see Mech. [5]	80F228
20.2.6.	Fe^{3+}	H_2O	0.1 mol/L $NaClO_4$, 0.01 mol/L $HClO_4$	22	8.3×10^8	LP/LUM/SST; τ_0 = 0.65 μs; OT; k_q = 1.3 × 10^8 with SS/QYP, see Mech. [5]	80F228
20.2.7.	$Fe(CN)_6^{1-}$	H_2O	0.5 mol/L NaCl	22	1.1×10^9	LP/LUM/SST; τ_0 = 0.65 μs; RT; k_q = 3.3 × 10^8 with SS/QYP, see Mech. [5]	80F228

TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except MV^{2+})

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
21.1. $Ru(bpy)_3^{2+}$							
21.1.1.	Acetate ion	H_2O	Pbuf; pH 5.8; μ = 0.10 ($LiClO_4$)	25	$<1 \times 10^7$	SS/LUM; τ_0 = 0.60 μs (747635); OT; [Q] = (5-50) × 10^{-4} mol/L	80F058
21.1.2.	*cis*-α-Acetoxystilbene	MeOH			1.1×10^9	SS/LUM; τ_0 = 0.83 μs (LP/LUM/SST); ET?	84F069
21.1.3.	4-Acetylphenol	H_2O	0.05 mol/L NaOH	23	$\sim 3 \times 10^6$	SS/LUM; τ_0 = 0.60 μs (LP/LUM/AVE); RT	82A365
21.1.4.	*cis*-α-Acetylstilbene	MeOH			1.1×10^7	SS/LUM; τ_0 = 0.83 μs (LP/LUM/SST)	84F069
21.1.5.	1-Aminonaphthalene	AN		18	8.5×10^7	SS/LUM, FP/LUM/SST; τ_0^{air} = 0.22 μs; RT	84E192
	1-Aminonaphthalene	AN		~22	1.2×10^8	SS/LUM; τ_0 = 0.85 μs (77A240); RT	777106
	1-Aminonaphthalene	AN		25	1.6×10^8	SS/LUM; $\Delta H^\ddagger$ = 9.2 kJ/mol; $\Delta S^\ddagger$ = −57 J/mol·K	86A165
	1-Aminonaphthalene	EtOH		18	1.4×10^9	SS/LUM, FP/LUM/SST; τ_0^{air} = 0.29 μs; RT	84E192
	1-Aminonaphthalene	MeOH		25	2.0×10^9	SS/LUM; $\Delta H^\ddagger$ = 7.9 kJ/mol; $\Delta S^\ddagger$ = −39 J/mol·K	86A165
21.1.6.	2-Aminonaphthalene	AN		18	1.5×10^7	SS/LUM, FP/LUM/SST; τ_0^{air} = 0.22 μs; RT	84E192
	2-Aminonaphthalene	AN		25	2.1×10^7	SS/LUM; $\Delta H^\ddagger$ = 13 kJ/mol; $\Delta S^\ddagger$ = −59 J/mol·K	86A165
	2-Aminonaphthalene	EtOH		18	3.9×10^8	SS/LUM, FP/LUM/SST; τ_0^{air} = 0.29 μs; RT	84E192
	2-Aminonaphthalene	MeOH		25	3.6×10^8	SS/LUM; $\Delta H^\ddagger$ = 12 kJ/mol; $\Delta S^\ddagger$ = −41 J/mol·K	86A165
21.1.7.	4-Aminophenol	H_2O	pH 7; μ = 0.05	23	3.8×10^8	LP/LUM/AVE; τ_0 = 0.60 μs; RT; f = 0.68	82A365
21.1.8.	*N*-(4-Aminophenyl)aniline	AN	0.1 mol/L TEAP	~22	6.7×10^9	SS/LUM; τ_0^{air} = 0.15 μs (SL/LUM/SPC); RT	78E518
	N-(4-Aminophenyl)aniline	AN	$\mu = 2 \times 10^{-4}$		9.2×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.16 μs; RT	85A248
21.1.9.	Anthracene	C_6H_6/EtOH (15/1)		25	2.2×10^9	SS/LUM; τ_0 = 0.69 μs (717111); ET; [Q] = 0.003-0.015 mol/L	736244

TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except MV^{2+})—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
21.1.	**$Ru(bpy)_3^{2+}$**—Continued						
21.1.10.	Anthracene-9-carboxylate ion	H_2O	ACbuf; pH 5		5.0×10^9	LP/LUM/SST, SS/LUM; τ_0 = 0.63 μs (81S134); ET; [Q] ≤ 0.002 mol/L	83A008
21.1.11.	9,10-Anthraquinone-2,6-disulfonate ion	H_2O	0.005 mol/L Pbuf; pH 6.9; μ = 0.04		6.0×10^9	SS/LUM or LP/LUM/SST; τ_0 = 0.63 μs; OT; f = <0.01; [Q] = (2-20) × 10^{-4} mol/L	81A042
	9,10-Anthraquinone-2,6-disulfonate ion	H_2O	pH 9.8		1.6×10^{10}	SS/LUM; τ_0^{air} = 0.4 μs (78A002); OT	82N119
	9,10-Anthraquinone-2,6-disulfonate ion	H_2O	0.2% w/w colloidal silica; pH 9.8		1.2×10^8	SS/LUM; τ_0^{air} = 0.4 μs (78A002); OT; S adsorbed	82N119
21.1.12.	9,10-Anthraquinone-2-sulfonate ion	H_2O	pH 9.8		2.5×10^9	SS/LUM; τ_0^{air} = 0.4 μs (78A002); OT	82N119
	9,10-Anthraquinone-2-sulfonate ion	H_2O	0.2% w/w colloidal silica; pH 9.8		1.1×10^8	SS/LUM; τ_0^{air} = 0.4 μs (78A002); OT; S adsorbed	82N119
21.1.13.	Ascorbate ion	H_2O	pH 5; μ = 0.7 (Na_2SO_4)	25	3.0×10^7	SS/LUM; τ_0 = 0.60 μs (766404); RT	82A278
	Ascorbate ion	H_2O			2×10^7	LP/ABS/SST; OT; [Q] = 0.01-0.1 mol/L	79F045
21.1.14.	Benzenediazonium cation	AN	0.1 mol/L TBAP		2.1×10^{10}	SS/LUM; RT	84F366
21.1.15.	Benzenethiolate ion	AN			5.7×10^9	SS/LUM; τ_0 = 0.85 μs (777106); RT; [Q] ≤ 2 × 10^{-4} mol/L	81F266
21.1.16.	Benzoate ion	H_2O	Pbuf; pH 5.8; μ = 0.10 ($LiClO_4$)	25	$<1 \times 10^7$	SS/LUM; τ_0 = 0.60 μs (747635); OT; [Q] = (5-50) × 10^{-4} mol/L	80F058
21.1.17.	1,4-Benzoquinone	DMF			6.3×10^9	SS/LUM; τ_0^{air} = 0.20 μs (LP/LUM/AVE); OT	83E170
	1,4-Benzoquinone	H_2O			1.1×10^{10}	LP/LUM/SST; τ_0 = 0.59 μs	85N164
	1,4-Benzoquinone	H_2O	0.005 mol/L Pbuf; pH 6.9; μ = 0.04		3.7×10^9	SS/LUM or LP/LUM/SST; τ_0 = 0.63 μs; OT; f = 0.08; [Q] = (2-20) × 10^{-4} mol/L	81A042
	1,4-Benzoquinone	H_2O	9.4 × 10^{-5} mol/L PMA; pH 2		8.7×10^9	LP/LUM/SST; τ_0 = 0.59 μs	85N164
	1,4-Benzoquinone	H_2O	9.4 × 10^{-5} mol/L PMA; pH 7		5.6×10^9	LP/LUM/SST; τ_0 = 0.67 μs	85N164

TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except MV^{2+})—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
21.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	1,4-Benzoquinone	H_2O	9.4×10^{-5} mol/L PMA; pH 9		9.0×10^9	LP/LUM/SST; $\tau_0 = 0.59$ μs	85N164
21.1.18.	1-Benzyl-1,4-dihydronicotinamide	AN			3.5×10^8	EMI; $\tau_0 = 0.84$ μs; RT; $k_q = 2.9 \times 10^8$ L mol^{-1} s^{-1} with SS/LUM and $\tau_0 = 1.0$ μs from same lab in 84F069	81F381
	1-Benzyl-1,4-dihydronicotinamide	AN	0.1 mol/L TBAP		4.1×10^8	SS/LUM; $\tau_0 = 0.85$ μs (79C010); RT; $k_q = 4.9 \times 10^8$ with SS/QYP, see Mech. [7]	84F351
	1-Benzyl-1,4-dihydronicotinamide	DMF			2.0×10^8	SS/LUM; $\tau_0 = 0.93$ μs (LP/LUM/SST); RT	84F069
	1-Benzyl-1,4-dihydronicotinamide	MeOH	0.025 mol/L $Mg(ClO_4)_2$	20	1.4×10^8	SS/LUM; $\tau_0 = 0.73$ μs; RT; Q partially bound to Mg^{2+}; $k_q = 1.5 \times 10^8$ for unbound Q; $k_q = 9 \times 10^7$ for bound Q	85F228
	1-Benzyl-1,4-dihydronicotinamide	MeOH			1.5×10^8	SS/LUM; $\tau_0 = 0.83$ μs (LP/LUM/SST); RT	84F069
	1-Benzyl-1,4-dihydronicotinamide	py/MeOH (10/1)	0.1 mol/L $Mg(ClO_4)_2$	20	1.1×10^8	SS/LUM; $\tau_0 = 0.85$ μs; RT; Q partially bound to Mg^{2+}; $k_q = 3.7 \times 10^8$ for unbound Q; $k_q = \sim 5 \times 10^6$ for bound Q	85F228
	1-Benzyl-1,4-dihydronicotinamide	py/MeOH (10/1)			3.5×10^8	SS/LUM; $\tau_0 = 1.0$ μs (LP/LUM/SST); RT	84F069
21.1.19.	2,6-Bis(*tert*-butyl)-1,4-benzoquinone	DMF			2.2×10^9	SS/LUM; $\tau_0^{air} = 0.20$ μs (LP/LUM/AVE); OT	83E170
21.1.20.	3,5-Bis(*tert*-butyl)-1,2-benzoquinone	DMF			3.4×10^9	SS/LUM; $\tau_0^{air} = 0.20$ μs (LP/LUM/AVE); OT	83E170
21.1.21.	*N,N'*-Bis(2-carboxylatoethyl)-(vio^{2+}) zwitterion	H_2O			1.3×10^9	OT	82N022
21.1.22.	1,4-Bis(*N,N*-dimethylamino)benzene	AN		~22	1.2×10^{10}	SS/LUM; $\tau_0 = 0.85$ μs (77A240); RT	777106
	1,4-Bis(*N,N*-dimethylamino)benzene	AN	0.1 mol/L TEAP	~22	1.2×10^{10}	SS/LUM; $\tau_0 = 0.85$ μs (767009); RT	79C010
	1,4-Bis(*N,N*-dimethylamino)benzene	AN	$\mu = 2 \times 10^{-4}$		1.3×10^{10}	LP/LUM/SST, SS/LUM; $\tau_0^{air} = 0.16$ μs; RT	85A248

TABLE 21. Quenching of $Ru(bpy)_3^{2+}$ by organic compounds (except MV^{2+})—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
21.1.	**$Ru(bpy)_3^{2+}$**—Continued						
	1,4-Bis(*N,N*-dimethylamino)benzene	H_2O	pH 8(?)		1×10^9	LP/LUM/SST; τ_0 = 0.6 μs (777296); RT	78A392
	1,4-Bis(*N,N*-dimethylamino)benzene	MeOH		25	6.9×10^9	SL/LUM/SPC; τ_0 = 0.67 μs; $\Delta G^{\ddagger}$ = 17 kJ/mol; RT	83E623
21.1.23.	4,4′-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L TEAP	~22	7.4×10^9	SS/LUM; τ_0^{air} = 0.15 μs (SL/LUM/SPC); RT	78E518
	4,4′-Bis(*N,N*-dimethylamino)biphenyl	AN	0.1 mol/L TEAP	~22	4.3×10^9	SS/LUM; τ_0 = 0.85 μs (767009); RT	79C010
	4,4′-Bis(*N,N*-dimethylamino)biphenyl	MeOH			7.4×10^9	LP/LUM/SST; τ_0 = 0.75 μs; RT	777296
21.1.24.	1,2-Bis(H-3-pyl)ethane dication	AN			6.8×10^6	EMI; ET, OT (10%)	767528
21.1.25.	1,2-Bis(H-4-pyl)ethane dication	AN			2.4×10^9	EMI; OT, ET (1%)	767528
21.1.26.	*N,N*-Bis(2-hydroxyethyl)-vio^{2+}	H_2O			2.1×10^9	SS/LUM; τ_0 = 0.6 μs; OT; [Q] = (2-10) × 10^{-4} mol/L	78A269
	N,N-Bis(2-hydroxyethyl)-vio^{2+}	H_2O	0.5 mol/L ACbuf; pH 5		1.1×10^9	LP/LUM/SST; τ_0 = 0.69 μs; OT; same k_q from same lab in 82C019	80A247
21.1.27.	*trans*-1,2-Bis(Me-4-pyl)ethene dication	AN	0.1 mol/L TEAP or TBAF		2.4×10^9	SS/LUM; τ_0 = 0.85 μs; OT; [Q] ≤ 0.001 mol/L	747159
21.1.28.	*trans*-1,2-Bis(Me-2-pyl)ethene dication	AN	0.1 mol/L TEAP	~22	1.6×10^9	SS/LUM; τ_0 = 0.85 μs (767009); RT	79C010
21.1.29.	*trans*-1,2-Bis(Me-3-pyl)ethene dication	AN	0.1 mol/L TEAP	~22	1.6×10^6	SS/LUM; τ_0 = 0.85 μs (767009); RT, ET; k_q for RT only	79C010
21.1.30.	*trans*-1,2-Bis(Me-4-pyl)ethene dication	AN	0.1 mol/L TEAP	~22	2.4×10^9	SS/LUM; τ_0 = 0.85 μs (767009); RT	79C010
21.1.31.	1,4-Bis(*N*-phenylamino)benzene	AN	0.1 mol/L TEAP	~22	5.8×10^9	SS/LUM; τ_0^{air} = 0.15 μs (SL/LUM/SPC); RT	78E518
	1,4-Bis(*N*-phenylamino)benzene	AN	μ = 2 × 10^{-4}		7.3×10^9	LP/LUM/SST, SS/LUM; τ_0^{air} = 0.16 μs; RT	85A248
21.1.32.	*N,N*-Bis(poly-2,4-ionene)-(vio^{2+}) polycation	H_2O	pH 5-7		5.4×10^8	LP/LUM/AVE; OT; f = 0.14; [Q] = 0.001 mol/L	85B030
	N,N-Bis(poly-2,4-ionene)-(vio^{2+}) polycation	H_2O	2 × 10^{-4} mol/L $Fe(CN)_6^{3-}$; pH 5-7		6.1×10^8	LP/LUM/AVE; OT; [Q] = 0.001 mol/L	85B030
21.1.33.	*N,N*-Bis(2-propyl)-vio^{2+}	H_2O	0.5 mol/L ACbuf; pH 5		5.3×10^8	LP/LUM/SST; τ_0 = 0.69 μs; OT	82C019

TABLE 28. Quenching of excited uranium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
28.1. UO_2^{2+}—Continued							
28.1.65.	Sm^{3+}	H_2SO_4 (66%)		20	5.0×10^6	FP/LUM/SST, SS/LUM; τ_0 = 42 μs; ET; [Q] ≤ 0.005 mol/L	68E121
28.1.66.	Sn^{IV}	H_2O	1 mol/L $HClO_4$	25	1.0×10^6	FP/LUM/SST, SS/LUM; τ_0^{air} = 6.8 μs	77E693
	Sn^{IV}	H_2O	1 mol/L H_3PO_4	25	1.0×10^6	FP/LUM/SST, SS/LUM; τ_0^{air} = 0.18 ms	77E693
28.1.67.	Sn^{2+}	H_2O	1 mol/L H_3PO_4	25	8.9×10^8	FP/LUM/SST, SS/LUM; τ_0^{air} = 0.18 ms; RT	77E693
28.1.68.	$Sn(CH_3)_4$	Acetone			1.6×10^8	LF/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.69.	$Sn(C_2H_5)_4$	Acetone			1.7×10^9	LF/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.70.	$Sn[CH(CH_3)_2]_4$	Acetone			4.6×10^9	LF/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.71.	$Sn(CH_3)_3(C_2H_5)$	Acetone			5.6×10^8	LF/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.72.	$Sn(CH_2CH_2CH_3)_4$	Acetone			1.4×10^9	LF/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.73.	$Sn[CH(CH_3)CH_2CH_3]_4$	Acetone			3.0×10^9	LF/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.74.	$Sn(CH_2CH_2CH_2CH_3)_4$	Acetone			1.7×10^9	LF/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.75.	$Sn(CH_3)_3(CH_2CH_2CH_2CH_3)$	Acetone			8.0×10^8	LF/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.76.	Sr^{2+}	H_2O	1 mol/L H_3PO_4	25	1.5×10^4	FP/LUM/SST, SS/LUM; τ_0^{air} = 0.18 ms	77E693
28.1.77.	Th^{IV}	H_2O	1 mol/L H_2SO_4	25	1.5×10^6	FP/LUM/SST, SS/LUM; τ_0^{air} = 11 μs	77E693
28.1.78.	Tl^+	H_2O	0.5 mol/L H_2SO_4	10	4.1×10^9	FP/LUM/SST, SS/LUM; τ_0 = 27 μs; [Q] = (1-20) × 10^{-5} mol/L; S as SO_4^{2-} salt	74F655
	Tl^+	H_2O	0.01 mol/L HNO_3; μ = 0.034	22	1.7×10^9	LIF; τ_0^{und} = 1.6 μs; [Q] ≤ 1.5×10^{-4} mol/L	81E789
	Tl^+	H_2O	0.5 mol/L H_2SO_4	22	5.2×10^9	FP/LUM/SST, SS/LUM; τ_0 = 12 μs; [Q] = (1-20) × 10^{-5} mol/L; S as SO_4^{2-} salt	74F655

TABLE 28. Quenching of excited uranium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
28.1.	**UO_2^{2+}**—Continued						
	Tl^+	H_2O	1 mol/L $HClO_4$	25	4.5×10^9	FP/LUM/SST, SS/LUM; τ_0^{air} = 6.8 μs; RT	77E693
	Tl^+	H_2O	1 mol/L H_2SO_4	25	5.4×10^9	FP/LUM/SST, SS/LUM; τ_0^{air} = 11 μs; RT	77E693
	Tl^+	H_2O	1 mol/L H_3PO_4	25	6.1×10^9	FP/LUM/SST, SS/LUM; τ_0^{air} = 0.18 ms; RT	77E693
	Tl^+	H_2O	0.5 mol/L H_2SO_4	30	6.8×10^9	FP/LUM/SST, SS/LUM; τ_0 = 6.8 μs; [Q] = (1-20) × 10^{-5} mol/L; S as SO_4^{2-} salt	74F655
	Tl^+	H_2O	0.5 mol/L H_2SO_4	40	8.6×10^9	FP/LUM/SST, SS/LUM; τ_0 = 3.5 μs; [Q] = (1-20) × 10^{-5} mol/L; S as SO_4^{2-} salt	74F655
	Tl^+	H_2O	pH 2.3; μ = 0.007		1.6×10^6	LP/LUM/SST; τ_0^{air} = 1.5 μs; RT; S as NO_3^- salt	81F325
	Tl^+	H_2O	1 mol/L HNO_3; μ = 1		2.3×10^6	LP/LUM/SST; τ_0^{air} = 2.8 μs; RT; S as NO_3^- salt	81F325
	Tl^+	H_2O	1 mol/L H_3PO_4; μ = 0.09		4.0×10^6	LP/LUM/SST; τ_0^{air} = 0.16 ms; RT; S as NO_3^- salt	81F325
28.1.79.	Tl^{3+}	H_2O	1 mol/L H_3PO_4	25	8.7×10^7	FP/LUM/SST, SS/LUM; τ_0^{air} = 0.18 ms	77E693
	Tl^{3+}	H_2O	1 mol/L $HClO_4$	25	8.7×10^7	FP/LUM/SST, SS/LUM; τ_0^{air} = 6.8 μs	77E693
28.1.80.	UO_2^+	H_2O	0.4 mol/L $HClO_4$; 2 mol/L $LiClO_4$	14	5×10^9	SS/LUM; τ_0 = 1.3 μs (747132); [Q] ≤ 2.7 × 10^{-4} mol/L; Q formed *in situ* by the red'n of S with Eu^{2+}, see Mech. [4]	75E452
28.1.81.	UO_2^{2+}	H_2O	1 mol/L H_3PO_4	25	3.4×10^4	FP/LUM/SST	77E693
	UO_2^{2+}	H_2O	0.23 mol/L $HClO_4$		4.0×10^5	LP/ABS/SST; τ_0^{air} = 6.6 μs; [Q] ≤ 2.0 mol/L; τ_0 extrap'd to [S] = 0; S as NO_3^- salt	75E295
28.1.82.	V^V	H_2O	1 mol/L H_3PO_4	25	2.4×10^7	FP/LUM/SST, SS/LUM; τ_0^{air} = 0.18 ms; ET	77E693
28.1.83.	$V(CO)_6$	Acetone or AN or THF			5.8×10^4	LP/LUM/SST, SS/LUM; RT; nonlinear S-V plot; S as NO_3^- salt	79F334

TABLE 28. Quenching of excited uranium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
28.1. UO_2^{2+}—Continued							
28.1.84.	W^{VI}	H_2O	1 mol/L H_3PO_4	25	1.6×10^5	FP/LUM/SST, SS/LUM; τ_0^{air} = 0.18 ms	77E693
28.1.85.	$W(CO)_6$	Acetone or AN or THF			4.2×10^7	LP/LUM/SST, SS/LUM; RT; S as NO_3^- salt	79F334
28.1.86.	Yb^{3+}	H_2O	1 mol/L H_3PO_4	25	5.5×10^5	FP/LUM/SST, SS/LUM; τ_0^{air} = 0.18 ms	77E693
Organic Quenchers							
28.1.87.	2-Acetylthiophene	Acetone	0.3 mol/L $HClO_4$		7.9×10^8	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.88.	3-Acetylthiophene	Acetone	0.3 mol/L $HClO_4$		5.3×10^8	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.89.	2-Aminonaphthalene	H_2O	1 mol/L H_3PO_4		5.4×10^8	FP/ABS/SST; τ_0^{air} = 0.17 ms; RT (30%)	767278
28.1.90.	Aniline	H_2O	1 mol/L H_3PO_4		8.7×10^8	FP/ABS/SST; τ_0^{air} = 0.17 ms	767278
28.1.91.	Ascorbic acid	H_2O	0.5 mol/L H_3PO_4		1×10^8	FP/LUM/SST, FP/ABS/SST; RT; [Q] = 5 × 10^{-5} mol/L	727386
	Ascorbic acid	H_2O	1 mol/L H_3PO_4		1.8×10^8	FP/ABS/SST; τ_0^{air} = 0.17 ms; RT (29%)	767278
28.1.92.	D-Asparagine	H_2O	0.2 mol/L $HClO_4$		2.5×10^6	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.93.	Benzene	H_2O	1 mol/L H_3PO_4		1.6×10^9	FP/ABS/SST; τ_0^{air} = 0.17 ms	767278
28.1.94.	Bromoform	H_2O/Acetone (1/1)	0.3 mol/L $HClO_4$		~2×10^7	LP/LUM/SST; S as ClO_4^- salt	84A465
28.1.95.	3-Bromopropionic acid	H_2O	0.38 mol/L $HClO_4$		1.1×10^8	LP/ABS/SST; τ_0^{und} = 2.5 μs; k_q = 3.6 × 10^7 with SS/LUM; S as NO_3^- salt	756411
28.1.96.	Butanethiol	Acetone	0.3 mol/L $HClO_4$		1.8×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.97.	*tert*-Butyl alcohol	H_2O	1 mol/L H_3PO_4		8.0×10^7	FP/ABS/SST; τ_0^{air} = 0.17 ms; [Q] = (1-10) × 10^{-5} mol/L; same k_q from same lab in 747153 and 74A003	767278
28.1.98.	1-Butyl bromide	H_2O/Acetone (1/1)	0.3 mol/L $HClO_4$		3.1×10^7	LP/LUM/SST; S as ClO_4^- salt	84A465
28.1.99.	2-Butyl bromide	H_2O/Acetone (1/1)	0.3 mol/L $HClO_4$		4.5×10^7	LP/LUM/SST; S as ClO_4^- salt	84A465

TABLE 28. Quenching of excited uranium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
28.1.	UO_2^{2+}—Continued						
28.1.100.	1-Butyl iodide	H_2O/Acetone (1/1)	0.3 mol/L $HClO_4$		1.1×10^9	LP/LUM/SST; S as ClO_4^- salt	84A465
28.1.101.	CDTA	H_2O	0.2 mol/L $HClO_4$		6.2×10^8	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.102.	Chrysoidin	H_2O	1 mol/L H_3PO_4		4×10^9	FP/ABS/SST; τ_0^{air} = 0.17 ms	767278
28.1.103.	Cyclobutanecarboxylic acid	H_2O	0.23 mol/L $HClO_4$		8.2×10^6	LP/ABS/SST; τ_0^{und} = 2.5 μs; [Q] ≤ 0.3 mol/L; k_q = 6.7×10^6 with SS/LUM; S as NO_3^- salt	756411
28.1.104.	Cyclohexanecarboxylic acid	H_2O	0.23 mol/L $HClO_4$		6.7×10^7	LP/ABS/SST; τ_0^{und} = 2.5 μs; k_q = 3.6×10^7 with SS/LUM; S as NO_3^- salt	756411
28.1.105.	Cyclohexanol	H_2O			2.9×10^8	LP/ABS/SST; τ_0^{und} = 1.2 μs; HA; S as ClO_4^- salt	747132
28.1.106.	Cyclohexanol-d_{11}	D_2O			1.3×10^8	LP/ABS/SST; τ_0^{und} = 2.4 μs; HA; S as ClO_4^- salt	747132
28.1.107.	Cyclohexene	H_2O/Acetone (1.1/1)	0.38 mol/L $HClO_4$		1.6×10^6	LP/ABS/SST, SS/LUM; τ_0^{und} = 0.88 μs; EX; S as NO_3^- salt	756411
28.1.108.	Cyclopentanecarboxylic acid	H_2O	0.23 mol/L $HClO_4$		3.8×10^7	LP/ABS/SST; τ_0^{und} = 2.5 μs; k_q = 1.5×10^7 with SS/LUM; S as NO_3^- salt	756411
28.1.109.	Cyclopropanecarboxylic acid	H_2O	0.23 mol/L $HClO_4$		2.6×10^6	LP/ABS/SST, SS/LUM; τ_0^{und} = 2.5 μs; S as NO_3^- salt	756411
28.1.110.	Cysteine	H_2O	0.2 mol/L $HClO_4$		7.5×10^8	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.111.	L-Cystine	H_2O	0.2 mol/L $HClO_4$		5.7×10^8	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.112.	Di-*n*-butyl sulfide	AN/H_2O (3/1)	0.1 mol/L $HClO_4$		9.6×10^8	LP/LUM/SST; RT; S as NO_3^- salt; some SQ	86F357
	Di-*n*-butyl sulfide	Acetone	0.3 mol/L $HClO_4$		1.4×10^6	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
	Di-*n*-butyl sulfide	Acetone/H_2O (1.3/1)	0.1 mol/L H_2SO_4		3.1×10^8	SS/LUM; τ_0^{und} = 3.5 μs (LP/LUM/SST); RT; S as $CH_3CO_2^-$ salt	86F357
28.1.113.	Diethyl sulfide	AN/H_2O (3/1)	0.1 mol/L $HClO_4$		1.7×10^6	LP/LUM/SST; RT; S as NO_3^- salt; some SQ	86F357

TABLE 28. Quenching of excited uranium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
28.1.	UO_2^{2+}—Continued						
	Diethyl sulfide	Acetone/H_2O (9/1)	0.1 mol/L H_2SO_4		4.0×10^8	SS/LUM; τ_0^{air} = 3.5 μs; RT; S as $CH_3CO_2^-$ salt; K_{SV} from 84F346; k_q may not have been corrected for SQ	86F357
28.1.114.	1,4-Dihydroxybenzene	H_2O	0.5 mol/L H_3PO_4		8×10^8	FP/LUM/SST, FP/ABS/SST; RT; [Q] = 1×10^{-5} mol/L	727386
	1,4-Dihydroxybenzene	H_2O	1 mol/L H_3PO_4		1.0×10^9	FP/ABS/SST, FP/LUM/SST; τ_0^{air} = 0.17 ms	767278
28.1.115.	Dimethyl disulfide	Acetone	0.3 mol/L $HClO_4$		2.8×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.116.	Dimethyl sulfide	AN/H_2O (3/1)	0.1 mol/L $HClO_4$		4.1×10^9	LP/LUM/SST; RT; S as NO_3^- salt; some SQ	86F357
28.1.117.	1,4-Dioxane	H_2O	0.38 mol/L $HClO_4$		1.6×10^8	LP/ABS/SST; τ_0^{und} = 2.5 μs; $k_q = 9.7 \times 10^7$ with SS/LUM; S as NO_3^- salt	756411
28.1.118.	Diphenylamine	H_2O	1 mol/L H_3PO_4		1.1×10^9	FP/ABS/SST; τ_0^{air} = 0.17 ms; RT	767278
28.1.119.	Di-*n*-propyl sulfide	AN/H_2O (3/1)	0.1 mol/L $HClO_4$		1.2×10^9	LP/LUM/SST; RT; [Q] ≤ 8×10^{-4} mol/L; S as NO_3^- salt; some SQ	86F357
	Di-*n*-propyl sulfide	Acetone/H_2O (9/1)	0.1 mol/L H_2SO_4		2.3×10^8	SS/LUM; τ_0^{air} = 3.5 μs; RT; S as $CH_3CO_2^-$ salt; K_{SV} from 84F346; k_q may not have been corrected for SQ	86F357
28.1.120.	1,3-Dithiane	Acetone	0.3 mol/L $HClO_4$		2.1×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.121.	1,4-Dithiane	Acetone	0.3 mol/L $HClO_4$		1.6×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.122.	EDTA	H_2O	0.2 mol/L $HClO_4$		4.8×10^8	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.123.	Ethanol	H_2O	0.5 mol/L H_3PO_4		2×10^8	FP/LUM/SST, FP/ABS/SST; RT; [Q] = 3×10^{-5} mol/L	727386

TABLE 28. Quenching of excited uranium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
28.1.	UO_2^{2+}—Continued						
	Ethanol	H_2O	1 mol/L H_3PO_4		1.4×10^9	FP/ABS/SST, FP/LUM/SST; τ_0^{air} = 0.17 ms; RT (20%); [Q] = (1-10) × 10^{-6} mol/L; same k_q from same lab in 747153 and 74A003	767278
28.1.124.	Ethyl bromide	H_2O/Acetone (1/1)	0.3 mol/L $HClO_4$		3.3×10^7	LP/LUM/SST; S as ClO_4^- salt	84A465
28.1.125.	Ethylene sulfide	Acetone	0.3 mol/L $HClO_4$		2.1×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.126.	Ethyl iodide	H_2O/Acetone (1/1)	0.3 mol/L $HClO_4$		8.5×10^8	LP/LUM/SST; S as ClO_4^- salt	84A465
28.1.127.	2-Ethylthiophene	Acetone	0.3 mol/L $HClO_4$		1.5×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.128.	Formic acid	H_2O	1 mol/L H_3PO_4		1.1×10^6	FP/ABS/SST; τ_0^{air} = 0.17 ms	767278
28.1.129.	L-Glutamine	H_2O	0.2 mol/L $HClO_4$		2.5×10^6	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.130.	Histidine	H_2O	0.2 mol/L $HClO_4$		1.8×10^8	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.131.	Isoleucine	H_2O	0.2 mol/L $HClO_4$		4.8×10^6	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.132.	Lactic acid	H_2O	0.5 mol/L H_2SO_4	10	2.8×10^6	FP/LUM/SST, SS/LUM; τ_0 = 27 μs; RT; [Q] = 0.01-0.05 mol/L; S as SO_4^{2-} salt	74F655
	Lactic acid	H_2O	0.5 mol/L H_2SO_4	22	4.1×10^6	FP/LUM/SST, SS/LUM; τ_0 = 12 μs; RT; [Q] = 0.01-0.05 mol/L; S as SO_4^{2-} salt	74F655
	Lactic acid	H_2O	0.5 mol/L H_2SO_4	30	5.6×10^6	FP/LUM/SST, SS/LUM; τ_0 = 6.8 μs; RT; [Q] = 0.01-0.05 mol/L; S as SO_4^{2-} salt	74F655
	Lactic acid	H_2O	0.5 mol/L H_2SO_4	40	8.2×10^6	FP/LUM/SST, SS/LUM; τ_0 = 3.5 μs; RT; [Q] = 0.01-0.05 mol/L; S as SO_4^{2-} salt	74F655
28.1.133.	DL-Leucine	H_2O	0.2 mol/L $HClO_4$		5.7×10^6	LP/LUM/SST; RT; S as ClO_4^- salt	86A101

TABLE 28. Quenching of excited uranium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
28.1.	UO_2^{2+}—Continued						
28.1.134.	Methanol	H_2O			6.4×10^6	LP/ABS/SST; τ_0^{und} = 1.2 μs; HA; [Q] ≤ 0.5 mol/L; $k_q = 4.5 \times 10^6$ with SL/LUM/SPC; S as ClO_4^- salt	747132
	Methanol	H_2O	1 mol/L H_2SO_4		1.5×10^6	FP/ABS/SST; τ_0^{air} = 67 μs; RT (13%); [Q] = (1-10) × 10^{-6} mol/L; same k_q from same lab in 747153	767278
	Methanol	H_2O	1 mol/L H_3PO_4		7.1×10^6	FP/ABS/SST; τ_0^{air} = 0.17 ms; RT (20%); [Q] = (1-10) × 10^{-6} mol/L; same k_q from same lab in 747153 and 7	767278
	Methanol	H_2O	1 mol/L $HClO_4$		5.3×10^6	FP/ABS/SST; τ_0^{air} = 17 μs; RT (72%); [Q] = (1-10) × 10^{-6} mol/L; same k_q from same lab in 747153	767278
28.1.135.	Methanol-d_1	D_2O			6.5×10^6	LP/ABS/SST; τ_0^{und} = 2.4 μs; HA; S as ClO_4^- salt	747132
28.1.136.	Methanol-d_3	H_2O			2.3×10^6	LP/ABS/SST; τ_0^{und} = 1.2 μs; HA; [Q] ≤ 2.2 mol/L; $k_q = 1.7 \times 10^6$ with SL/LUM/SPC; S as ClO_4^- salt	747132
28.1.137.	Methanol-d_1	D_2O			2.7×10^6	LP/ABS/SST; τ_0^{und} = 2.4 μs; HA; S as ClO_4^- salt	747132
28.1.138.	DL-Methionine	H_2O	0.2 mol/L $HClO_4$		1.3×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.139.	Methyl iodide	H_2O/Acetone (1/1)	0.3 mol/L $HClO_4$		5.1×10^8	LP/LUM/SST; S as ClO_4^- salt	84A465
28.1.140.	Methylthioacetonitrile	Acetone	0.3 mol/L $HClO_4$		1.8×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.141.	Methyl thiocyanate	Acetone	0.3 mol/L $HClO_4$		3.9×10^8	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.142.	2-Naphthol	H_2O	1 mol/L H_3PO_4		9.9×10^7	FP/ABS/SST; τ_0^{air} = 0.17 ms; RT	767278
28.1.143.	Oxalic acid	H_2O	1 mol/L H_3PO_4		1.6×10^5	FP/ABS/SST; τ_0^{air} = 0.17 ms	767278

TABLE 28. Quenching of excited uranium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
28.1.	UO_2^{2+}—Continued						
28.1.144.	Pentamethylene sulfide	Acetone	0.3 mol/L $HClO_4$		1.7×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.145.	Pent-4-enoic acid	H_2O/Acetone (1.1/1)	0.38 mol/L $HClO_4$		1.2×10^9	LP/ABS/SST; τ_0^{und} = 0.88 μs; $k_q = 1.7 \times 10^9$ with SS/LUM; S as NO_3^- salt	756411
28.1.146.	Phenol	H_2O	1 mol/L H_3PO_4		1.7×10^8	FP/ABS/SST; τ_0^{air} = 0.17 ms; RT (35%)	767278
28.1.147.	L-Phenylalanine	H_2O	0.2 mol/L $HClO_4$		7.9×10^8	LP/LUM/SST; RT; [Q] ≤ 0.0035 mol/L; S as ClO_4^- salt	86A101
28.1.148.	Propanethiol	Acetone	0.3 mol/L $HClO_4$		1.4×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.149.	2-Propanol	H_2O			8.5×10^7	LP/ABS/SST; τ_0^{und} = 1.2 μs; HA; S as ClO_4^- salt	747132
	2-Propanol	H_2O	1 mol/L H_3PO_4		2.3×10^9	FP/ABS/SST; τ_0^{air} = 0.17 ms; RT (23%); [Q] = (1-10) × 10^{-6} mol/L; same k_q from same lab in 747153 and 7	767278
28.1.150.	2-Propanol-2-*d*	H_2O			3.5×10^7	LP/ABS/SST; τ_0^{und} = 1.2 μs; HA; S as ClO_4^- salt	747132
28.1.151.	1-Propyl bromide	H_2O/Acetone (1/1)	0.3 mol/L $HClO_4$		2.7×10^7	LP/LUM/SST; S as ClO_4^- salt	84A465
28.1.152.	2-Propyl bromide	H_2O/Acetone (1/1)	0.3 mol/L $HClO_4$		3.9×10^7	LP/LUM/SST; S as ClO_4^- salt	84A465
28.1.153.	1-Propyl iodide	H_2O/Acetone (1/1)	0.3 mol/L $HClO_4$		1.1×10^9	LP/LUM/SST; S as ClO_4^- salt	84A465
28.1.154.	2-Propyl iodide	H_2O/Acetone (1/1)	0.3 mol/L $HClO_4$		1.3×10^9	LP/LUM/SST; S as ClO_4^- salt	84A465
28.1.155.	2-Propylthiophene	Acetone	0.3 mol/L $HClO_4$		1.9×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.156.	Serine	H_2O	0.2 mol/L $HClO_4$		1.9×10^6	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.157.	Tetramethylene sulfide	Acetone	0.3 mol/L $HClO_4$		1.8×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.158.	Thiolacetic acid	Acetone	0.3 mol/L $HClO_4$		4.8×10^8	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.159.	Thiophene	Acetone	0.3 mol/L $HClO_4$		1.5×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465

TABLE 28. Quenching of excited uranium complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
28.1.	UO_2^{2+}—Continued						
28.1.160.	Thiophene-2-carbonitrile	Acetone	0.3 mol/L $HClO_4$		2.4×10^8	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.161.	Threonine	H_2O	0.2 mol/L $HClO_4$		4.3×10^6	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.162.	Trimethylene sulfide	Acetone	0.3 mol/L $HClO_4$		2.8×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	84A465
28.1.163.	Triton X-100	H_2O		22	1.5×10^9	LP/LUM/SST; [Q] ≤ 2×10^{-4} mol/L; [Q] below CMC; S as NO_3^- salt	85N143
28.1.164.	L-Tryptophan	H_2O	0.2 mol/L $HClO_4$		3.0×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.165.	Tyrosine	H_2O	0.2 mol/L $HClO_4$		1.7×10^9	LP/LUM/SST; RT; S as ClO_4^- salt	86A101
28.1.166.	DL-Valine	H_2O	0.2 mol/L $HClO_4$		1.1×10^6	LP/LUM/SST; RT; S as ClO_4^- salt	86A101

TABLE 29. Quenching of excited zinc complexes

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.1. Zn(etioporphyrin I)(pyridine) [singlet]							
Organic Quenchers							
29.1.1.	*cis*-4-Nitrostilbene	Benzene	0.005 mol/L py		4.2×10^9	SS/LUM; τ_0 = 4 ns (assumed); EX; nonlinear S-V plot at high [Q]	707320
29.2. Zn(etioporphyrin I)(pyridine) [triplet]							
Organic Quenchers							
29.2.1.	*cis*-4-Nitrostilbene	Benzene	0.005 mol/L py		2.6×10^7	FP/ABS/SST; EX	707320
29.3. Zn(etioporphyrin I) [singlet]							
Organic Quenchers							
29.3.1.	1,4-Benzoquinone	Benzene			1.3×10^{10} (calc)	SS/LUM; τ_0 = 4.3 ns (assumed); EX	68A001
29.3.2.	1-Methoxy-4-nitrobenzene	EtOH			6.0×10^9 (calc)	SS/LUM; τ_0 = 4.3 ns (assumed); EX	68A001
29.3.3.	4-Nitroaniline	Benzene			4.9×10^9 (calc)	SS/LUM; τ_0 = 4.3 ns (assumed); EX	68A001
29.3.4.	Nitrobenzene	Benzene			3.4×10^9	SS/LUM; τ_0 = 4.3 ns (assumed); EX	68A001
	Nitrobenzene	Benzene	1 mol/L PPh_3		2.8×10^9	SS/LUM; τ_0 = 4.3 ns (assumed); EX; S partially bound to PPh_3	68A001
	Nitrobenzene	EtOH			7.3×10^9	SS/LUM; τ_0 = 4.3 ns (assumed); EX; [Q] ≤ 0.20 mol/L	68A001
	Nitrobenzene	MeCH			4.8×10^9	SS/LUM; τ_0 = 4.3 ns (assumed); EX	68A001
	Nitrobenzene	Piperidine			3.4×10^9	SS/LUM; τ_0 = 4.3 ns (assumed); EX; [Q] ≤ 0.20 mol/L	68A001
29.3.5.	*cis*-4-Nitrostilbene	Benzene			3.7×10^9	SS/LUM; τ_0 = 4 ns (LP/LUM/SST); EX; nonlinear S-V plot at high [Q]; K_{SV} = 29 L/mol in 68A001	707320
29.3.6.	*trans*-4-Nitrostilbene	Benzene			8.9×10^9	SS/LUM; τ_0 = 4 ns (LP/LUM/SST); EX; nonlinear S-V plot at high [Q]	707320
29.3.7.	4-Nitrotoluene	EtOH			7.2×10^9 (calc)	SS/LUM; τ_0 = 4.3 ns (assumed); EX	68A001

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.4. Zn(etioporphyrin I) [triplet]							
Organic Quenchers							
29.4.1.	Azulene	Benzene	0.01 mol/L 4-nitrotoluene		2.6×10^9	FP/ABS/SST; ET; S* is an exciplex with nitrotoluene	72E284
29.4.2.	α-Bromo-4-nitrotoluene	Benzene		25	1.5×10^9	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293
29.4.3.	Carbon tetrachloride	Benzene		25	3×10^7	FP/ABS/SST; E_a = 14 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −54 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293
	Carbon tetrachloride	Benzene		25	$\leq 2 \times 10^5$	FP/ABS/SST; see also 85E593	82A389
29.4.4.	1-Chloro-4-nitrobenzene	Benzene		25	2.4×10^9	FP/ABS/SST; E_a = 1.9 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −71 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293
29.4.5.	DDT	Benzene		25	8.2×10^7	FP/ABS/SST; E_a = 5.9 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −96 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; τ constant at higher [Q]	747293
	DDT	Benzene		25	$\leq 1 \times 10^6$	FP/ABS/SST; see also 85E593	82A389
29.4.6.	1,4-Dichlorobenzene	Benzene		25	4×10^7	FP/ABS/SST; E_a = 13 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −67 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; τ increases at higher [Q]	747293
29.4.7.	1,4-Dinitrobenzene	Benzene		25	4.2×10^9	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293
29.4.8.	*cis*-4,4′-Dinitrostilbene	Benzene		25	3.1×10^9	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; same k_q from same lab in 707320; τ increases at higher [Q]	747293

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.4.	**Zn(etioporphyrin I) [triplet]**—Continued						
29.4.9.	*trans*-4,4′-Dinitrostilbene	Benzene			2.7×10^9	FP/ABS/SST; EX	707320
29.4.10.	Hexachlorobenzene	Benzene		25	6.7×10^7	FP/ABS/SST; E_a = 6.3 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −88 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; τ increases at higher [Q]	747293
	Hexachlorobenzene	Benzene		25	$\leq 5 \times 10^3$	FP/ABS/SST; see also 85E593	82A389
29.4.11.	Hexachloroethane	Benzene		25	1.4×10^8	FP/ABS/SST; E_a = 5.0 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −100 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; τ constant at higher [Q]	747293
	Hexachloroethane	Benzene		25	3.8×10^4	FP/ABS/SST; see also 85E593	82A389
29.4.12.	1-Methoxy-4-nitrobenzene	Benzene		25	1.0×10^9	FP/ABS/SST; E_a = 2.1 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −59 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; τ increases at higher [Q]	747293
29.4.13.	Naphthacene	Benzene	0.01 mol/L 4-nitrotoluene		5.1×10^3	FP/ABS/SST; ET; S* is an exciplex with nitrotoluene	72E284
29.4.14.	4-Nitroaniline	Benzene		25	1.2×10^8	FP/ABS/SST; E_a = 3.1 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −71 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293
29.4.15.	9-Nitroanthracene	Benzene		25	4.5×10^9	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293
29.4.16.	4-Nitrobenzaldehyde	Benzene		25	3.4×10^9	FP/ABS/SST; E_a = 1.5 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −71 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.4. Zn(etioporphyrin I) [triplet]—Continued							
29.4.17.	Nitrobenzene	Benzene		25	2.0×10^9	FP/ABS/SST; E_a = 3.9 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −67 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; τ constant at higher [Q]	747293
29.4.18.	*trans*-4-Nitro-β-methylstilbene	Benzene		25	2.0×10^9	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293
29.4.19.	*cis*-4-Nitrostilbene	Benzene			1.7×10^9	FP/ABS/SST; EX	707320
29.4.20.	*trans*-4-Nitrostilbene	Benzene		25	1.6×10^9	FP/ABS/SST; E_a = 5.6 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −71 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; same k_q from same lab in 707320; τ increases at higher [Q]	747293
29.4.21.	4-Nitrotoluene	Benzene		25	3.0×10^9	FP/ABS/SST; E_a = 2.0 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −71 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; same k_q from same lab in 72E284; τ increases at higher [Q]	747293
	4-Nitrotoluene	Benzene		25	3.3×10^9	FP/ABS/SST; EX?; see also 85E593	82A389
	4-Nitrotoluene	Benzene	0.01 mol/L MF		2×10^8	FP/ABS/SST; OT?	72E284
	4-Nitrotoluene	MF			1.3×10^8	FP/ABS/SST; OT?	72E284
29.4.22.	Perylene	Benzene	0.01 mol/L 4-nitrotoluene		1.3×10^9	FP/ABS/SST; ET; S* is an exciplex with nitrotoluene	72E284
29.4.23.	1,2,4,5-Tetrachlorobenzene	Benzene		25	$\leq 1 \times 10^3$	FP/ABS/SST; see also 85E593	82A389
29.5. Zn(mesoporphyrin IX dimethyl ester) [singlet]							
Organic Quenchers							
29.5.1.	*cis*-4,4′-Dinitrostilbene	Benzene			8.1×10^9	SS/LUM; τ_0 = 4.3 ns (67E121); EX; nonlinear S-V plot at high [Q]	707320
	cis-4,4′-Dinitrostilbene	EtOH			1.3×10^{10}	SS/LUM; τ_0 = 4.3 ns (67E121); EX; nonlinear S-V plot at high [Q]	707320

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.5. Zn(mesoporphyrin IX dimethyl ester) [singlet]—Continued							
29.5.2.	*cis*-4-Nitrostilbene	Benzene			3.9×10^9	SS/LUM; τ_0 = 4.3 ns (67E121); EX; nonlinear S-V plot at high [Q]	707320
	cis-4-Nitrostilbene	EtOH			7.2×10^9	SS/LUM; τ_0 = 4.3 ns (67E121); EX; nonlinear S-V plot at high [Q]	707320
29.6. Zn(mesoporphyrin IX dimethyl ester) [triplet]							
Inorganic Quenchers							
29.6.1.	O_2	Toluene			3.4×10^9	LP/ABS/SST; ET; [Q] = 0.0011 mol/L	81E738
29.7. Zn[5-(1-methylpyridinium-4-yl)-10,15,20-tris(4-tolyl)porphyrin]$^+$							
Organic Quenchers							
29.7.1.	MV^{2+}	EtOH			2.1×10^7	FP/ABS/SST; τ_0 = 0.57 ms; OT; f = 0.11	82A161
29.8. Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [singlet]							
Organic Quenchers							
29.8.1.	Acrylamide	AN			5.7×10^8	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM)	84F091
29.8.2.	1-Aminonaphthalene	AN			2.5×10^9	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM); RT	84F091
29.8.3.	2-Aminophenol	AN			3.5×10^6	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM); RT	84F091
29.8.4.	9,10-Anthraquinone	Toluene			2.0×10^{10}	SS/LUM; τ_0^{air} = 1.9 ns (MS/LUM/PM)	84F091
29.8.5.	Benzaldehyde	AN			1.6×10^6	SS/LUM, MS/LUM/PM; τ_0^{air} = 2.1 ns (MS/LUM/PM); OT	84F091
	Benzaldehyde	Toluene			1.0×10^6	SS/LUM; τ_0^{air} = 1.9 ns (MS/LUM/PM)	84F091
29.8.6.	Benzoic acid	AN			7×10^8	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM)	84F091
29.8.7.	1,4-Benzoquinone	AN			1.8×10^{10}	SS/LUM, MS/LUM/PM; τ_0^{air} = 2.1 ns (MS/LUM/PM); OT	84F091
	1,4-Benzoquinone	Toluene			2.2×10^{10}	SS/LUM, MS/LUM/PM; τ_0^{air} = 1.9 ns (MS/LUM/PM)	84F091
29.8.8.	1,4-Diaminobenzene	AN			1.0×10^{10}	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM); RT	84F091

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.8. Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [singlet]—Continued							
29.8.9.	*N,N*-Diethylaniline	AN			7×10^8	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM); RT?	84F091
	N,N-Diethylaniline	Toluene			6×10^8	SS/LUM; τ_0^{air} = 1.9 ns (MS/LUM/PM)	84F091
29.8.10.	1,4-Dihydroxybenzene	AN			1.7×10^9	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM)	84F091
29.8.11.	3,4-Dimethylphenol	AN			1.8×10^9	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM); RT	84F091
29.8.12.	Naphthalene	AN			$<1 \times 10^7$	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM)	84F091
29.8.13.	1-Naphthol	AN			1.3×10^9	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM)	84F091
29.8.14.	1,4-Naphthoquinone	AN			2.0×10^{10}	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM); OT	84F091
	1,4-Naphthoquinone	Toluene			1.7×10^{10}	SS/LUM; τ_0^{air} = 1.9 ns (MS/LUM/PM)	84F091
29.8.15.	Phenol	AN			3.3×10^8	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM)	84F091
29.8.16.	Tetramethyl-1,4-benzoquinone	AN			1.6×10^{10}	SS/LUM; τ_0^{air} = 2.1 ns (MS/LUM/PM); OT	84F091
	Tetramethyl-1,4-benzoquinone	Toluene			1.0×10^{10}	SS/LUM; τ_0^{air} = 1.9 ns (MS/LUM/PM)	84F091
29.9. Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [triplet]							
Inorganic Quenchers							
29.9.1.	Zn(OEP)	1,2-$C_2H_4Cl_2$		25	2.0×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	1,2-Dichloro-benzene		25	2.7×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	1-Chloro-naphthalene		25	2.0×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	AN		25	2.0×10^8	LP/ECM/AVE; τ_0 = ~16 ms; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	Anisole		25	2.3×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	Benzene		25	$\sim 2 \times 10^8$	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.9. Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [triplet]—Continued							
	Zn(OEP)	Butyronitrile		25	2.2×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	DMSO		25	4.0×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	Di-*i*-propyl ether		25	2.3×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	Di-*n*-pentyl ether		25	1.8×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	Di-*n*-butyl ether		25	1.8×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	Diethyl ether		25	2.0×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	Ethyl acetate		25	1.6×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	MP		25	1.4×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	Propionitrile		25	2.3×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	THF		25	1.6×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
	Zn(OEP)	Toluene		24	1.1×10^7	LP/ABS/SST (decay of delayed fluorescence); [Q] ≤ 9×10^{-6} mol/L; k_q = ~2 $\times 10^8$ L mol$^-$ s$^-$ at 25 °C with LP/ECM/AVE (see Mech. [8] in 80A023)	82E152
	Zn(OEP)	*N*-Methyl valeronitrile		25	2.2×10^8	LP/ECM/AVE; OT or RT; see Mech. [8]	80A023
Organic Quenchers							
29.9.2.	1,4-Benzoquinone	Toluene		−50	3.0×10^9	LP/ABS/SST (decay of delayed fluorescence); OT; [Q] = (9.5-25) $\times 10^{-8}$ mol/L	82E152
	1,4-Benzoquinone	Toluene		−25	5.0×10^9	LP/ABS/SST (decay of delayed fluorescence); OT; [Q] = (9.5-25) $\times 10^{-8}$ mol/L	82E152

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.9.	**Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [triplet]**—Continued						
	1,4-Benzoquinone	Toluene		0	6.7×10^9	LP/ABS/SST (decay of delayed fluorescence); OT; [Q] = (9.5-25) × 10^{-8} mol/L	82E152
	1,4-Benzoquinone	Toluene		24	9.0×10^9	LP/ABS/SST (decay of delayed fluorescence); E_a = 9.4 kJ/mol (−50 to 24°C); OT; [Q] = (9.5-25) × 10^{-8} mol/L	82E152
29.9.3.	1-Chloro-4-nitrobenzene	Benzene		25	1.3×10^9	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293
29.9.4.	DDT	Benzene		25	3×10^7	FP/ABS/SST; E_a = 13 kJ/mol (20-78°C); $\Delta S^{\ddagger}$ = −67 J/mol·K; EX; [Q] = (1-50) × 10^{-5} mol/L; τ constant at higher [Q]	747293
29.9.5.	Hexachlorobenzene	Benzene		25	4×10^7	FP/ABS/SST; E_a = 46 kJ/mol (20-78°C); EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293
29.9.6.	Hexachloroethane	Benzene		25	7.1×10^8	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; τ constant at higher [Q]	747293
29.9.7.	1-Methoxy-4-nitrobenzene	Benzene		25	8×10^8	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293
29.9.8.	4-Nitroaniline	Benzene		25	6×10^7	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293
29.9.9.	4-Nitrotoluene	Benzene		25	1.9×10^9	FP/ABS/SST; EX; [Q] = (1-50) × 10^{-5} mol/L; nonlinear S-V plot at higher [Q]	747293

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.10. Zn[5-phenyl-10,15,20-tris(4-sulfonatophenyl)porphyrin]$^{3-}$							
Organic Quenchers							
29.10.1.	*N,N'*-Bis(3-sulfonato-1-propyl)-(vio^{2+}) zwitterion	H_2O	μ = 0 (extrap'd; NaCl)		2.6×10^9	LP/ABS/SST; τ_0 = 1.6 ms; OT; [Q] = 4.9×10^{-4} mol/L	85A101
29.10.2.	*N,N'*-Dimethyl-bpy^{2+}	H_2O	0.02 mol/L Pbuf; pH 7.0		2.5×10^9	LP/ABS/SST; τ_0 = 1.6 ms (84A184); OT	85F030
29.10.3.	DQ^{2+}	H_2O	0.02 mol/L Pbuf; pH 7.0		9.9×10^9	LP/ABS/SST; τ_0 = 1.6 ms (84A184); OT	85F030
29.10.4.	2-Mercaptoethanol	H_2O			$\sim 5 \times 10^4$	LP/ABS/SST; τ_0 = 1.6 ms; RT?	85A101
29.10.5.	MV^{2+}	H_2O	μ = 0 (extrap'd; NaCl)		1.5×10^{10}	LP/ABS/SST; τ_0 = 1.6 ms; OT; [Q] = 4.9×10^{-5} mol/L	85A101
	MV^{2+}	H_2O	0.02 mol/L Pbuf; pH 7.0		1.5×10^{10}	LP/ABS/SST; τ_0 = 1.6 ms (84A184); OT	85F030
29.10.6.	*N,N'*-(Tetramethylene)-bpy^{2+}	H_2O	0.02 mol/L Pbuf; pH 7.0		5.3×10^9	LP/ABS/SST; τ_0 = 1.6 ms (84A184); OT	85F030
29.10.7.	*N,N'*-(Trimethylene)-bpy^{2+}	H_2O	0.02 mol/L Pbuf; pH 7.0		8.7×10^9	LP/ABS/SST; τ_0 = 1.6 ms (84A184); OT	85F030
29.11. Zn(phthalocyanine)							
Inorganic Quenchers							
29.11.1.	Co(bpy)$_3^{2+}$	DMA/H_2O (2.3/1)		~15	2.2×10^7	LP/ABS/AVE; ET?; [Q] < 0.001 mol/L	84A122
29.11.2.	Co(bpy)$_3^{3+}$	DMA/H_2O (2.3/1)		~15	2.8×10^8	LP/ABS/AVE; OT; f = 0.51; [Q] < 2×10^{-4} mol/L	84A122
29.11.3.	Co(phen)$_3^{2+}$	DMA/H_2O (2.3/1)		~15	3.3×10^7	LP/ABS/AVE; ET?; [Q] < 0.001 mol/L	84A122
29.11.4.	Co(phen)$_3^{3+}$	DMA/H_2O (2.3/1)		~15	3.4×10^8	LP/ABS/AVE; OT; f = 0.56; [Q] < 2×10^{-4} mol/L	84A122
29.11.5.	Co(terpy)$_2^{2+}$	DMA/H_2O (2.3/1)		~15	1.3×10^8	LP/ABS/AVE; ET?; [Q] < 0.001 mol/L	84A122
29.11.6.	Co(terpy)$_2^{3+}$	DMA/H_2O (2.3/1)		~15	5.0×10^8	LP/ABS/AVE; OT; f = 0.75; [Q] < 2×10^{-4} mol/L	84A122
	Co(terpy)$_2^{3+}$	DMA/H_2O (2.3/1)	μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		5.3×10^8	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 0.70	82A290

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.11.	**Zn(phthalocyanine)**—Continued						
	$Co(terpy)_2^{3+}$	DMA/H_2O (2.3/1)	0.01 mol/L $HClO_4$; μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		1.4×10^8	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 0.37	82A290
29.11.7.	$Fe(C_5H_5)_2^+$	DMA/H_2O (2.3/1)	0.01 mol/L $HClO_4$; μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		1.0×10^9	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 0	82A290
29.11.8.	$Fe(CN)_6^{3-}$	DMA/H_2O (2.3/1)	μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		1.9×10^7	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 0	82A290
	$Fe(CN)_6^{3-}$	DMA/H_2O (2.3/1)	0.01 mol/L $HClO_4$; μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		2.9×10^8	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 0	82A290
Organic Quenchers							
29.11.9.	1,4-Benzoquinone	DMA/H_2O (2.3/1)	μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		5.0×10^8	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 0.78	82A290
	1,4-Benzoquinone	DMA/H_2O (2.3/1)	0.01 mol/L $HClO_4$; μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		5.0×10^8	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 0.90	82A290
29.11.10.	MV^{2+}	DMA/H_2O (2.3/1)	μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		3.6×10^6	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 1.0	82A290
	MV^{2+}	DMA/H_2O (2.3/1)	0.01 mol/L $HClO_4$; μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		5×10^5	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 0.43	82A290
	MV^{2+}	DMF/H_2O (9/1)			5.5×10^7	LP/ABS/AVE; τ_0 = 0.18 ms; OT; f = 0.62	84A272
29.11.11.	1,4-Naphthoquinone	DMA/H_2O (2.3/1)	0.01 mol/L $HClO_4$; μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		3×10^7	LP/ABS/SST; τ_0 = 0.20 ms; OT	82A290
29.11.12.	Tetrachloro-1,4-benzoquinone	DMA/H_2O (2.3/1)	μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		8.3×10^8	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 0.75	82A290
	Tetrachloro-1,4-benzoquinone	DMA/H_2O (2.3/1)	0.01 mol/L $HClO_4$; μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		1.3×10^9	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 0.27	82A290

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.11. Zn(phthalocyanine)—Continued							
29.11.13.	2,4,7-Trinitro-9-fluorenone	DMA/H_2O (2.3/1)	0.01 mol/L $HClO_4$; μ = 1-1.5 ($MgCl_2$ or $NaClO_4$)		1.0×10^9	LP/ABS/SST; τ_0 = 0.20 ms; OT; f = 0	82A290
29.12. Zn(protoporphyrin)							
Inorganic Quenchers							
29.12.1.	O_2	EtOH/H_2O (1.2/1)	0.001 mol/L Pbuf; pH 8		8×10^9	LP/LUM/AVE (decay of delayed fluorescence); τ_0 = 1.3 ms; [Q] = (2-12) × 10^{-7} mol/L	86E020
29.12.2.	Zn(protoporphyrin)	EtOH/H_2O (1.2/1)	0.001 mol/L Pbuf; pH 8		4×10^7	LP/LUM/AVE (decay of delayed fluorescence); τ_0 = ~3 ms; τ_0 extrap'd to [S] = 0	86E020
Organic Quenchers							
29.12.3.	1,4-Benzoquinone	EtOH			7×10^9	LP/LUM/AVE (decay of delayed fluorescence); τ_0 = 0.28 ms	86E020
29.12.4.	Naphthoquinone sulfonate	EtOH/H_2O (1.2/1)	0.001 mol/L Pbuf; pH 8		8×10^8	LP/LUM/AVE (decay of delayed fluorescence); τ_0 = 1.3 ms	86E020
29.13. Zn(tetrabenzoporphyrin)							
Inorganic Quenchers							
29.13.1.	Yb(etioporphyrin I)$^+$	py			4×10^7	FP/ABS/SST; ET	76E693
29.14. Zn[tetrakis(4-*tert*-butyl)phthalocyanine]							
Organic Quenchers							
29.14.1.	Tetrachloro-1,4-benzoquinone	Hexane			8×10^9	FP/ABS/SST	80F472
29.15. Zn[5,10,15,20-tetrakis(1-methylpyridinium-3-yl)porphyrin]$^{4+}$							
Inorganic Quenchers							
29.15.1.	Co(EDTA)$^-$	H_2O			5.4×10^9	LP/ABS/SST; f = 0.04; [Q] = (2-5) × 10^{-4} mol/L; OT?	85A430
29.15.2.	Co(EDTA)$^{2-}$	H_2O			1.5×10^9	LP/ABS/SST; [Q] = (2-8) × 10^{-4} mol/L	85A430
29.15.3.	Cu^{2+}	H_2O			1.5×10^6	LP/ABS/SST; τ_0 = 1.8 ms; CD; [Q] = 0.001-0.008 mol/L	84A264
29.15.4.	Fe^{3+}	H_2O	0.02 mol/L HCl; 0.02 mol/L KCl; pH 1.8		6.3×10^7	LP/ABS/SST; OT; f = 1; [Q] = 0.001 mol/L	85A430

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.15. Zn[5,10,15,20-tetrakis(1-methylpyridinium-3-yl)porphyrin]$^{4+}$—Continued							
29.15.5.	O_2	H_2O			1.2×10^9	LP/ABS/SST; τ_0 = 1.8 ms; $p_Q = 2 \times 10^4$ Pa	84A264
Organic Quenchers							
29.15.6.	*N,N'*-Diheptyl-vio^{2+}	H_2O			5.0×10^6	LP/ABS/SST; OT; [Q] = 0.001, 0.002 mol/L; nonlinear S-V plot; k_q cal'd from the initial slope	85A430
29.15.7.	EDTA	H_2O			3.7×10^5	LP/ABS/SST; τ_0 = 1.8 ms; RT; [Q] = 0.005 mol/L	84A264
29.15.8.	MV^{2+}	H_2O			2.0×10^6	LP/ABS/SST; τ_0 = 1.9 ms; OT; [Q] = (2-50) × 10^{-4} mol/L; nonlinear S-V plot at higher [Q]	86A174
	MV^{2+}	H_2O	μ = 0 (extrap'd)		1.0×10^6	LP/ABS/SST; τ_0 = 1.8 ms; OT; [Q] = (5-100) × 10^{-4} mol/L	84A264
	MV^{2+}	H_2O	μ = 0 (extrap'd, NaCl)		1.9×10^6	LP/ABS/SST; τ_0 = 1.8 ms; OT; [Q] = 0.001 mol/L	84A264
	MV^{2+}	H_2O	0.01 mol/L NaCl		4.8×10^6	LP/ABS/SST; τ_0 = 1.8 ms; OT; [Q] = 0.001 mol/L	84A264
	MV^{2+}	H_2O	0.02 mol/L NaCl		7.6×10^6	LP/ABS/SST; τ_0 = 1.8 ms; OT; [Q] = 0.001 mol/L	84A264
	MV^{2+}	H_2O	0.05 mol/L NaCl		1.2×10^7	LP/ABS/SST; τ_0 = 1.8 ms; OT; [Q] = 0.001 mol/L	84A264
	MV^{2+}	H_2O	0.08 mol/L NaCl		2.2×10^7	LP/ABS/SST; τ_0 = 1.8 ms; OT; [Q] = 0.001 mol/L	84A264
	MV^{2+}	H_2O	0.1 mol/L NaCl		2.4×10^7	LP/ABS/SST; τ_0 = 1.8 ms; OT; [Q] = 0.001 mol/L	84A264
	MV^{2+}	H_2O	6% dextran		2.0×10^6	LP/ABS/SST; τ_0 = 0.85 ms; OT; [Q] = (2-200) × 10^{-4} mol/L	86A174
	MV^{2+}	H_2O	20% dextran		1.4×10^6	LP/ABS/SST; τ_0 = 0.79 ms; OT; [Q] = (2-200) × 10^{-4} mol/L	86A174
	MV^{2+}	H_2O	42% dextran		4.2×10^5	LP/ABS/SST; τ_0 = 1.3 ms; OT; [Q] = (2-200) × 10^{-4} mol/L	86A174

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.15.	**Zn[5,10,15,20-tetrakis(1-methylpyridinium-3-yl)porphyrin]$^{4+}$**—Continued						
	MV^{2+}	H_2O	45% dextran		1.9×10^5	LP/ABS/SST; τ_0 = 1.4 ms; OT; [Q] = (2-200) × 10^{-4} mol/L	86A174
	MV^{2+}	H_2O	47% dextran		1.9×10^5	LP/ABS/SST; τ_0 = 1.5 ms; OT; [Q] = (2-200) × 10^{-4} mol/L	86A174
29.16.	**Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [singlet]**						
	Organic Quenchers						
29.16.1.	*N,N'*-Bis(3-sulfonato-1-propyl)-(vio^{2+}) zwitterion	H_2O		25	7.1×10^{10}	SS/LUM; OT	86N075
29.17.	**Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [triplet]**						
	Inorganic Quenchers						
29.17.1.	$Co(NH_3)_5Cl^{2+}$	H_2O			1.5×10^8	FP/ABS/SST; τ_0 = 1.2 ms; OT; same k_q at pH 5 with FP/ABS/SST and τ_0 = 0.66 ms from same lab in 82A199	83A133
29.17.2.	Fe^{3+}	H_2O			1.9×10^8	FP/ABS/SST; τ_0 = 1.2 ms; OT; $k_q = 2.2 \times 10^8$ L mol^{-1}s^{-1} at pH 5 with FP/ABS/SST and τ_0 = 0.66 ms from same lab in 82A199	83A133
	Fe^{3+}	H_2O	pH 2; μ = 0.01		1.3×10^{10}	LP/ABS/SST; OT; f = 1	81S157
29.17.3.	$S_2O_8^{2-}$	H_2O			9.0×10^8	FP/ABS/SST; τ_0 = 1.2 ms; OT; same k_q at pH 5 with FP/ABS/SST and τ_0 = 0.66 ms from same lab in 82A199	83A133
	Organic Quenchers						
29.17.4.	*N,N'*-Bis(3-sulfonato-1-propyl)-(vio^{2+}) zwitterion	H_2O		25	2.5×10^8	LP/ABS/SST; OT; [Q] = (5-40) × 10^{-6} mol/L	86N075
	N,N'-Bis(3-sulfonato-1-propyl)-(vio^{2+}) zwitterion	H_2O			2.0×10^8	FP/ABS/SST; τ_0^{und} = 3 ms; OT	84N212
29.17.5.	*N,N'*-Didodecyl-vio^{2+}	H_2O			2×10^6	FP/ABS/SST; τ_0^{und} = 3 ms; OT	84N212
29.17.6.	*N,N'*-Dihexyl-vio^{2+}	H_2O			3×10^6	FP/ABS/SST; τ_0^{und} = 3 ms; OT; [Q] ≤ 0.015 mol/L	84N212
29.17.7.	*N,N'*-Dipropyl-vio^{2+}	H_2O			3×10^6	FP/ABS/SST; τ_0^{und} = 3 ms; OT	84N212

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.17. Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [triplet]—Continued							
29.17.8.	EDTA	H_2O	PHTHbuf; pH 5; μ = 0.05 (NaCl)		1.7×10^5	FP/ABS/SST; τ_0 = 0.66 ms; RT	81F164
	EDTA	H_2O			4×10^5	LP/ABS/SST; τ_0 = 1.3 ms; RT; [Q] = 0.02 mol/L; Q mainly as monoprotonated anion	80A074
29.17.9.	*N*-Methyl-*N'*-tetradecyl-vio^{2+}	H_2O	0.05 mol/L TEOA; pH 7.8	23	5×10^7	LP/ABS/SST; OT	83N158
	N-Methyl-*N'*-tetradecyl-vio^{2+}	H_2O			1.8×10^7	LP/ABS/SST; τ_0 = 1.3 ms; OT; k_q at low [Q], where effects of μ are negligible	81N002
29.17.10.	MV^{2+}	H_2O			2×10^6	LP/ABS/SST; τ_0 = 1.3 ms; OT; [Q] = 0.005 mol/L	80A074
	MV^{2+}	H_2O			1.8×10^7	FP/ABS/SST; τ_0 = 1.2 ms; OT; same k_q with FP/ABS/SST and τ_0 = 0.66 ms (f = 0.83) from same lab in 82A161	83A133
	MV^{2+}	H_2O			2×10^6	FP/ABS/SST; τ_0^{und} = 3 ms; OT	84N212
	MV^{2+}	H_2O	μ = 0 (calc'd)		2.7×10^5	FP/ABS/SST; OT	82A161
	MV^{2+}	H_2O	Pbuf; pH 6.9; μ = 0 (calc'd)		1.6×10^6	LP/ABS/SST; OT	86A072
	MV^{2+}	H_2O	Pbuf; pH 6.9; μ = 0.05 (NaCl)		1.4×10^7	LP/ABS/SST; OT; f = 0.57	86A072
	MV^{2+}	H_2O	Pbuf; pH 6.9; μ = 0.1 (NaCl)		2.0×10^7	LP/ABS/SST; OT; f = 0.60; $k_q = 2.9 \times 10^7$ L mol^{-1} s^{-1} with LP/ABS/SST and [Q] = (1-10) $\times 10^{-4}$ mol/L from same lab in 86S027	86A072
	MV^{2+}	H_2O	0.001 mol/L AQN; Pbuf; pH 6.9; μ = 0 (calc'd)		1.1×10^6	LP/ABS/SST; OT	86A072
	MV^{2+}	H_2O	0.001 mol/L AQN; Pbuf; pH 6.9; μ = 0.1 (NaCl)		3.0×10^7	LP/ABS/SST; OT; f = 0.54	86A072
	MV^{2+}	H_2O	PHTHbuf; pH 5; μ = 0.05 (NaCl)		1.8×10^7	FP/ABS/SST; τ_0 = 0.66 ms; OT; f = ~0.8; ϕ = 0.9	81F164

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.17. Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [triplet]—Continued							
29.17.11.	PolyVio3	H_2O	Pbuf; pH 6.9; μ = 0 (calc'd)		2.5×10^6	LP/ABS/SST; OT; [Q] based on viologen units	86A072
	PolyVio3	H_2O	Pbuf; pH 6.9; μ = 0.05 (NaCl)		1.1×10^7	LP/ABS/SST; OT; f = 0.61; [Q] based on viologen units	86A072
	PolyVio3	H_2O	Pbuf; pH 6.9; μ = 0.1 (NaCl)		2.4×10^7	LP/ABS/SST; OT; f = 0.86; [Q] based on viologen units	86A072
29.17.12.	PolyVio4	H_2O	Pbuf; pH 6.9; μ = 0 (calc'd)		1.3×10^6	LP/ABS/SST; OT; [Q] based on viologen units	86A072
	PolyVio4	H_2O	Pbuf; pH 6.9; μ = 0.05 (NaCl)		2.1×10^7	LP/ABS/SST; OT; [Q] based on viologen units	86A072
	PolyVio4	H_2O	Pbuf; pH 6.9; μ = 0.1 (NaCl)		3.6×10^7	LP/ABS/SST; OT; f = 0.85; [Q] based on viologen units	86A072
29.17.13.	PolyVio5	H_2O	Pbuf; pH 6.9; μ = 0 (calc'd)		4.6×10^5	LP/ABS/SST; OT; [Q] based on viologen units	86A072
	PolyVio5	H_2O	Pbuf; pH 6.9; μ = 0.1 (NaCl)		2.0×10^7	LP/ABS/SST; OT; f = 0.77; [Q] based on viologen units	86A072
29.17.14.	PolyVio6	H_2O	Pbuf; pH 6.9; μ = 0 (calc'd)		4.9×10^5	LP/ABS/SST; OT; [Q] based on viologen units	86A072
	PolyVio6	H_2O	Pbuf; pH 6.9; μ = 0.05 (NaCl)		6.3×10^6	LP/ABS/SST; OT; f = 0.83; [Q] based on viologen units	86A072
	PolyVio6	H_2O	Pbuf; pH 6.9; μ = 0.1 (NaCl)		1.3×10^7	LP/ABS/SST; OT; f = 0.96; [Q] based on viologen units	86A072
29.17.15.	PolyVio7	H_2O	Pbuf; pH 6.9; μ = 0 (calc'd)		4.4×10^6	LP/ABS/SST; OT; [Q] based on viologen units	86A072
	PolyVio7	H_2O	Pbuf; pH 6.9; μ = 0.05 (NaCl)		1.2×10^7	LP/ABS/SST; OT; f = 0.62; [Q] based on viologen units	86A072
	PolyVio7	H_2O	Pbuf; pH 6.9; μ = 0.1 (NaCl)		3.0×10^7	LP/ABS/SST; OT; f = 0.70; [Q] based on viologen units	86A072
29.17.16.	PolyVio8	H_2O	Pbuf; pH 6.9; μ = 0 (calc'd)		4.4×10^6	LP/ABS/SST; OT; [Q] based on viologen units	86A072

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.17. Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [triplet]—Continued							
	PolyVio8	H_2O	Pbuf; pH 6.9; μ = 0.05 (NaCl)		1.0×10^7	LP/ABS/SST; OT; f = 0.46; [Q] based on viologen units	86A072
	PolyVio8	H_2O	Pbuf; pH 6.9; μ = 0.1 (NaCl)		2.6×10^7	LP/ABS/SST; OT; f = 0.53; [Q] based on viologen units	86A072
29.17.17.	PolyVio9	H_2O	Pbuf; pH 6.9; μ = 0 (calc'd)		2.1×10^6	LP/ABS/SST; OT; [Q] based on viologen units	86A072
	PolyVio9	H_2O	Pbuf; pH 6.9; μ = 0.05 (NaCl)		7.3×10^6	LP/ABS/SST; OT; f = 0.82; [Q] based on viologen units	86A072
	PolyVio9	H_2O	Pbuf; pH 6.9; μ = 0.1 (NaCl)		1.2×10^7	LP/ABS/SST; OT; f = 0.93; [Q] based on viologen units	86A072
29.17.18.	Triethanolamine	H_2O	pH 7.8; μ = 0.50 (TMAC)	23	4×10^3	LF/ABS/SST; RT; [Q] = 0.05-1.0 mol/L	83N158
	Triethanolamine	H_2O		25	3.6×10^5	LF/ABS/SST; RT; [Q] = 0.002-0.004 mol/L	86N075
29.18. Zn[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$ [singlet]							
Organic Quenchers							
29.18.1.	Nitrobenzene	H_2O		~22	4.7×10^{10}	SS/LUM; τ_0 = 1.7 ns (84A048); OT; [Q] ≤ 0.008 mol/L	85F141
29.18.2.	Tetramethyl-1,4-benzoquinone	Benzene	0.1 mol/L BHDC		1.9×10^9	LIF; OT; in presence of reversed micelles; S at the interface	86N292
	Tetramethyl-1,4-benzoquinone	Benzene	0.1 mol/L BHDC, 1.5 mol/L H_2O		1.5×10^9	LIF; OT; in presence of reversed micelles; S at the interface	86N292
29.19. Zn[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$ [triplet]							
Inorganic Quenchers							
29.19.1.	Br_2^-	H_2O	0.001 mol/L Pbuf, 0.1 mol/L NaBr, N_2O satur'd; pH 7		5×10^9	LP/ABS/SST; OT; Q produced *in situ* by electron pulse after the laser pulse	82A279
29.19.2.	Cd^+	H_2O	0.01 mol/L $CdSO_4$, N_2 satur'd		1×10^{10}	LP/ABS/SST; RT; Q produced *in situ* by electron pulse after the laser pulse	82A279

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.19. Zn[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$ [triplet]—Continued							
29.19.3.	H	H_2O	0.001 mol/L Pbuf, 0.25 mol/L *t*-BuOH, N_2O sat'd; pH 7		~1 × 10^{10}	LP/ABS/SST; CR; Q produced *in situ* by electron pulse after the laser pulse	82A279
29.19.4.	OH	H_2O	0.001 mol/L Pbuf, N_2O sat'd; pH 7		~1 × 10^{10}	LP/ABS/SST; CR; Q produced *in situ* by electron pulse after the laser pulse	82A279
29.19.5.	$S_2O_8^{2-}$	H_2O			6.9 × 10^6	FP/ABS/SST; τ_0 = 1.4 ms; OT	83A133
Organic Quenchers							
29.19.6.	Cysteine	H_2O	0.1 mol/L Pbuf; pH 7	20	3 × 10^5	LP/ABS/SST; τ_0 = 0.83 ms; RT	82A306
29.19.7.	2-Hydroxy-2-propyl radical	H_2O	0.001 mol/L Pbuf, 0.25 mol/L 2-PrOH, N_2O satur'd; pH 7		3 × 10^9	LP/ABS/SST; RT; Q produced *in situ* by electron pulse after the laser pulse	82A279
29.19.8.	2-Methyl-2-hydroxypropyl radical	H_2O	0.001 mol/L Pbuf, 0.25 mol/L *t*-BuOH, N_2O sat'd; pH 7		1.8 × 10^9	LP/ABS/SST; CR; Q produced *in situ* by electron pulse after the laser pulse	82A279
29.19.9.	MV^{2+}	H_2O	0.1 mol/L Pbuf; pH 7	20	6.9 × 10^9	LP/ABS/SST; τ_0 = 0.83 ms; OT; f = 0.5; some SQ	82A306
	MV^{2+}	H_2O			1.4 × 10^{10}	FP/ABS/SST; τ_0 = 1.4 ms; OT	83A133
29.19.10.	Nitrobenzene	H_2O		~22	1.6 × 10^9	LP/ABS/AVE; τ_0 = 2.2 ms; OT; [Q] = (1-80) × 10^{-4} mol/L	85F141
29.19.11.	Tetrathiafulvalene	MeOH			1.1 × 10^8	LP/ABS/AVE; τ_0 = 80 μs; RT; [Q] = (1-2) × 10^{-4} mol/L	82N068
29.20. Zn{5,10,15,20-tetrakis[1-(3-sulfonato-1-propyl)pyridinium-4-yl]porphyrin}							
Organic Quenchers							
29.20.1.	9,10-Anthraquinone-2,6-disulfonate ion	H_2O	0.02 mol/L Pbuf; 0.005 mol/L CTAB; pH 6		7.5 × 10^7	LP/ABS/SST; τ_0 = 0.50 ms; OT; Q in micelles	85N254
29.20.2.	9,10-Anthraquinone-2-sulfonate ion, β-CD complex	H_2O	0.01 mol/L β-CD		3.3 × 10^6	LP/ABS/SST; τ_0^{und} = 0.5 ms; OT	86N119

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.21. Zn{5,10,15,20-tetrakis[4-(trimethylammonio)phenyl]porphyrin}$^{4+}$							
Inorganic Quenchers							
29.21.1.	$Co(NH_3)_5Cl^{2+}$	H_2O			1.9×10^7	LP/ABS/SPC; τ_0 = 1.2 ms; OT	83E462
29.21.2.	$Co(sep)^{3+}$	H_2O			1.6×10^7	LP/ABS/SPC; τ_0 = 1.2 ms; OT	83E462
29.21.3.	O_2	H_2O			1.3×10^9	LP/ABS/SPC; τ_0 = 1.2 ms; ET?	83E462
Organic Quenchers							
29.21.4.	MV^{2+}	H_2O	μ = <0.005		5.4×10^7	LP/ABS/SPC; τ_0 = 1.2 ms; OT	83E462
	MV^{2+}	H_2O	0.05 mol/L ACbuf		2.0×10^8	LP/ABS/SPC; τ_0 = 1.2 ms; OT	83E462
29.22. Zn(*N,N',N'',N'''*-tetramethyltetra-2,3-pyridinoporphyrazine)$^{4+}$							
Organic Quenchers							
29.22.1.	EDTA	H_2O			1.4×10^3	LP/ABS/SST; τ_0^{und} = 0.17 ms; RT	85F520
29.22.2.	MV^{2+}	H_2O			4.0×10^7	LP/ABS/SST; τ_0^{und} = 0.17 ms; OT	85F520
29.23. Zn(5,10,15,20-tetraphenylporphyrin) [singlet]							
Inorganic Quenchers							
29.23.1.	Eu^{3+}	AN			1.6×10^{10}	FP/ABS/SST; OT, ET?; see Mech. [9]	79A220
Organic Quenchers							
29.23.2.	Benzenediazonium cation	Acetone		25	1.8×10^{10}	SS/LUM; τ_0 = 1.9 ns (LP/LUM/SST); OT	85A136
29.23.3.	1,4-Benzoquinone	DMF			2.3×10^9	SS/LUM; EX	79F712
	1,4-Benzoquinone	Dioxane			1.0×10^9	SS/LUM; τ_0 = 3.9 ns (573002); OT; [Q] ≤ 0.1 mol/L	67A003
	1,4-Benzoquinone	EtOH			1.5×10^9	SS/LUM; τ_0 = 2.5 ns (SL/LUM/SPC); EX	79F712
	1,4-Benzoquinone	Toluene			2.2×10^9	SS/LUM; τ_0 = 2.7 ns (SL/LUM/SPC); EX	79F712
29.23.4.	4-Bromobenzenediazonium cation	Acetone		25	2.6×10^{10}	SS/LUM; τ_0 = 1.9 ns (LP/LUM/SST); OT	85A136
29.23.5.	4-Chlorobenzenediazonium cation	Acetone		25	2.3×10^{10}	SS/LUM; τ_0 = 1.9 ns (LP/LUM/SST); OT	85A136

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.23. Zn(5,10,15,20-tetraphenylporphyrin) [singlet]—Continued							
29.23.6.	4-(*N,N*-Diethylamino)benzenediazonium cation	Acetone		25	1.0×10^{10}	SS/LUM; τ_0 = 1.9 ns (LP/LUM/SST); OT; [Q] = 0.07 mol/L	85A136
29.23.7.	1,4-Dinitrobenzene	Dioxane			3.0×10^{9}	SS/LUM; τ_0 = 3.9 ns (573002); OT; [Q] ≤ 0.15 mol/L	67A003
29.23.8.	4-Methoxybenzenediazonium cation	Acetone		25	1.2×10^{10}	SS/LUM; τ_0 = 1.9 ns (LP/LUM/SST); OT; [Q] ≤ 0.07 mol/L	85A136
29.23.9.	4-Methylbenzenediazonium cation	Acetone		25	1.8×10^{10}	SS/LUM; τ_0 = 1.9 ns (LP/LUM/SST); OT; [Q] ≤ 0.07 mol/L	85A136
29.23.10.	Nitrobenzene	Dioxane			1.2×10^{8}	SS/LUM; τ_0 = 3.9 ns (573002); OT; [Q] ≤ 0.5 mol/L	67A003
29.23.11.	Nitromethane	Dioxane			7.5×10^{6}	SS/LUM; τ_0 = 3.9 ns (573002); OT	67A003
29.23.12.	Tetramethyl-1,4-benzoquinone	Benzene	0.1 mol/L BHDC		8.5×10^{9}	LIF; OT; [Q] = 0.005-0.06 mol/L; in presence of reversed micelles; S at the interface	86N292
	Tetramethyl-1,4-benzoquinone	Benzene	0.1 mol/L BHDC, 1 mol/L H_2O		3.7×10^{9}	LIF; OT; [Q] = 0.005-0.06 mol/L; in presence of reversed micelles	86N292
29.24. Zn(5,10,15,20-tetraphenylporphyrin) [triplet]							
Inorganic Quenchers							
29.24.1.	Ag(TPP)	Toluene			3.6×10^{8}	FP/ABS/SST; EX	76E693
29.24.2.	Co^{2+}	py			1.4×10^{6}	FP/ABS/SST; τ_0 = ~1.1 ms (60E006); Q as Cl^- salt; see Mech. [10]	60A002
29.24.3.	Cu^{2+}	THF			2.0×10^{8}	FP/ABS/SST; τ_0 = 1.9 ms; Q as Cl^- salt; see Mech. [10]	60A002
	Cu^{2+}	py			1.2×10^{3}	FP/ABS/SST; τ_0 = ~1.1 ms (60E006); Q as Cl^- salt; see Mech. [10]	60A002
29.24.4.	Eu^{3+}	AN			4.8×10^{5}	FP/ABS/SST; OT; [Q] ≤ 0.023 mol/L	79A220

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.24.	**Zn(5,10,15,20-tetraphenylporphyrin) [triplet]**—Continued						
	Eu^{3+}	Acetone			5×10^5	FP/ABS/SST; τ_0 = 0.94 ms; OT	84E316
29.24.5.	Eu(benzo-15-crown-5)$^{3+}$	Acetone			3×10^6	FP/ABS/SST; τ_0 = 0.94 ms; OT	84E316
29.24.6.	Ni^{2+}	THF			2.5×10^7	FP/ABS/SST; τ_0 = 1.9 ms; Q as Cl^- salt; see Mech. [10]	60A002
	Ni^{2+}	py			9.8×10^6	FP/ABS/SST; τ_0 = ~1.1 ms (60E006); Q as Cl^- salt; see Mech. [10]	60A002
29.24.7.	O_2	H_2O	BObuf; pH 9.2	20	1.5×10^9	LP/ABS/SST; OT	86A063
29.24.8.	Zn(TPP)	Toluene			2×10^7	FP/ABS/SST; τ_0 = ~1.2 ms; [Q] = (2.4-14) × 10^{-6} mol/L; τ_0 extrap'd to [S] = 0; see Mech. [10]	60E006
Organic Quenchers							
29.24.9.	Benzenediazonium cation	Acetone		25	1.0×10^9	FP/ABS/SST; τ_0 = 1.4 ms; OT; no first-order decay due to loss of Q; k_q eval'd at t = 0	85A136
29.24.10.	1,4-Benzoquinone	Benzene		25	3.4×10^9	FP/ABS/SST; EX?; see also 85E593	82A389
	1,4-Benzoquinone	DMF			1.9×10^9	FP/ABS/SST	79F712
	1,4-Benzoquinone	Dioxane			4.2×10^8	FP/ABS/SST; τ_0 = 0.17 ms; OT; [Q] ≤ 1.5 × 10^{-4} mol/L	67A003
	1,4-Benzoquinone	EtOH			1.2×10^9	FP/ABS/SST; τ_0 = 1.2 ms; OT; f = 0.24 (83F182)	79F712
	1,4-Benzoquinone	Toluene		25	2.3×10^9	FP/ABS/SST; EX?; see also 85E593	82A389
	1,4-Benzoquinone	Toluene			1.3×10^9	FP/ABS/SST; τ_0 = 1.3 ms; EX	79F712
29.24.11.	4-Bromobenzenediazonium cation	Acetone		25	2.3×10^9	FP/ABS/SST; τ_0 = 1.4 ms; OT; no first-order decay due to loss of Q; k_q eval'd at t = 0	85A136

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.24.	**Zn(5,10,15,20-tetraphenylporphyrin) [triplet]**—Continued						
29.24.12.	4-Chlorobenzenediazonium cation	Acetone		25	1.5×10^9	FP/ABS/SST; τ_0 = 1.4 ms; OT; no first-order decay due to loss of Q; k_q eval'd at t = 0	85A136
29.24.13.	4-(*N,N*-Diethylamino)benzenediazonium cation	Acetone		25	5×10^8	FP/ABS/SST; τ_0 = 1.4 ms; OT; no first-order decay due to loss of Q; k_q eval'd at t = 0	85A136
29.24.14.	1,4-Dinitrobenzene	Dioxane			7.6×10^7	FP/ABS/SST; τ_0 = 0.17 ms; OT; [Q] ≤ 5×10^{-4} mol/L	67A003
29.24.15.	4-Methoxybenzenediazonium cation	Acetone		25	1.6×10^9	FP/ABS/SST; τ_0 = 1.4 ms; OT; no first-order decay due to loss of Q; k_q eval'd at t = 0	85A136
29.24.16.	4-Methylbenzenediazonium cation	Acetone		25	1.6×10^9	FP/ABS/SST; τ_0 = 1.4 ms; OT; no first-order decay due to loss of Q; k_q eval'd at t = 0	85A136
29.24.17.	Metronidazole	H_2O	BObuf; pH 9.2	20	2.9×10^9	LP/ABS/SST; OT; f = 0.23	86A063
29.24.18.	Misonidazole	H_2O	BObuf; pH 9.2	20	2.3×10^9	LP/ABS/SST; OT	86A063
29.24.19.	MV^{2+}	EtOH			7×10^8	FP/ABS/SST; τ_0^{und} = 20 μs; OT	80N143
29.24.20.	Nitrobenzene	Dioxane			7.6×10^4	FP/ABS/SST; τ_0 = 0.17 ms; OT	67A003
29.24.21.	Nitromethane	Dioxane			1.7×10^3	FP/ABS/SST; τ_0 = 0.17 ms; OT	67A003
29.24.22.	Tetramethyl-1,4-benzoquinone	EtOH			2×10^9	FP/ABS/SST; τ_0^{und} = 20 μs; OT	80N143
29.25.	**Zn[4,4',4'',4'''-tetra(sulfomorpholide)phthalocyanine] [singlet]**						
	Organic Quenchers						
29.25.1.	4-(*N,N*-Diethylamino)benzenediazonium cation	AN		25	2.3×10^{10}	SS/LUM; τ_0^{air} = 2.8 ns (LP/LUM/AVE); RT; [Q] ≤ 0.015 mol/L	86A508
29.25.2.	4-Methoxybenzenediazonium cation	AN		25	2.5×10^{10}	SS/LUM; τ_0^{air} = 2.8 ns (LP/LUM/AVE); RT; [Q] ≤ 0.015 mol/L	86A508

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.25. Zn[4,4′,4″,4‴-tetra(sulfomorpholide)phthalocyanine] [singlet]—Continued							
29.25.3.	4-Methylbenzenediazonium cation	AN		25	2.1×10^{10}	SS/LUM, LP/LUM/AVE; τ_0^{air} = 2.8 ns; RT; [Q] ≤ 0.015 mol/L	86A508
29.26. Zn[4,4′,4″,4‴-tetra(sulfomorpholide)phthalocyanine] [triplet]							
Organic Quenchers							
29.26.1.	4-(*N,N*-Diethylamino)benzenediazonium cation	AN		25	3.3×10^7	FP/ABS/SST; τ_0 = 0.25 ms; EX; [Q] ≤ 0.3 mol/L	86A508
29.26.2.	4-Methoxybenzenediazonium cation	AN		25	8.5×10^7	FP/ABS/SST; τ_0 = 0.25 ms; EX; [Q] ≤ 0.15 mol/L	86A508
29.26.3.	4-Methylbenzenediazonium cation	AN		25	1.2×10^8	FP/ABS/SST; τ_0 = 0.25 ms; EX; [Q] ≤ 0.1 mol/L	86A508
29.27. Zn(4,4′,4″,4‴-tetrasulfophthalocyanine)$^{4-}$ [singlet]							
Organic Quenchers							
29.27.1.	MV^{2+}	H_2O/py (19/1)			1.0×10^{10}	SS/LUM; τ_0 = 2.9 ns (SL/LUM/SPC); OT; [Q] ≤ 0.0012 mol/L; same k_q from same lab in 80S033; nonlinear S-V plot with negative deviation; SQ proposed, see Mech. [11]	80E669
29.28. Zn(4,4′,4″,4‴-tetrasulfophthalocyanine)$^{4-}$ [triplet]							
Inorganic Quenchers							
29.28.1.	O_2	H_2O	0.1 mol/L Pbuf; 0.01 mol/L CTAB; pH 7.4	25	1.6×10^9	LP/ABS/AVE; τ_0 = 0.24 ms; ET; $p_Q = 2 \times 10^4$ Pa	86F214
Organic Quenchers							
29.28.2.	MV^{2+}	H_2O/py (19/1)			7×10^6	FP/ABS/SST; τ_0^{air} = 0.25 ms; OT; same k_q from same lab in 80S033; some SQ	80E669
29.29. Zn[5,10,15-tris(4-tolyl)-20-(4-carboxylatophenyl)porphyrin]$^-$							
Organic Quenchers							
29.29.1.	MV^{2+}	H_2O			1.0×10^9	FP/ABS/SST; τ_0 = 1.5 ms; OT; f = 0.04; 20% impurities in S	82A161
	MV^{2+}	H_2O	μ = 0 (calc'd)		3.0×10^9	FP/ABS/SST; OT; 20% impurities in S	82A161

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.30. Zn(uroporphyrin I)							
Inorganic Quenchers							
29.30.1.	$Co(CN)_6^{3-}$	H_2O	0.1 mol/L KCN; pH 10.8	~25	2.6×10^3	FP/ABS/AVE; OT, ET?; f = 0; 75% isomeric purity of S	75A245
29.30.2.	$Cr(CN)_6^{3-}$	H_2O	0.1 mol/L KCN; pH 10.8	~25	2.3×10^5	FP/ABS/AVE; OT, ET?; f = 0; 75% isomeric purity of S	75A245
29.30.3.	$Fe(CN)_6^{3-}$	H_2O	3.8×10^{-5} mol/L K_2HPO_4; pH 7; $\mu = 5.0 \times 10^{-4}$	~25	1.5×10^6	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	$Fe(CN)_6^{3-}$	H_2O	3.8×10^{-5} mol/L K_2HPO_4; pH 7; $\mu = 9.1 \times 10^{-4}$ (KCl)	~25	2.4×10^6	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	$Fe(CN)_6^{3-}$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; pH 7; $\mu = 0.0013$ (KCl)	~25	2.2×10^6	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	$Fe(CN)_6^{3-}$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; pH 7; $\mu = 0.0016$ (KCl)	~25	2.6×10^6	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	$Fe(CN)_6^{3-}$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; pH 7; $\mu = 0.0021$ (KCl)	~25	5.7×10^6	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	$Fe(CN)_6^{3-}$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; pH 7; $\mu = 0.011$ (KCl)	~25	1.9×10^7	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	$Fe(CN)_6^{3-}$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; 0.1 mol/L KCl; pH 7	~25	8.1×10^7	FP/ABS/AVE; τ_0 = ~3 ms; OT; f = 0.97; [Q] ≤ 1.8×10^{-5} mol/L; 75% isomeric purity of S	75A245
	$Fe(CN)_6^{3-}$	H_2O	0.1 mol/L KCN; pH 10.8	~25	1.9×10^7	FP/ABS/AVE; OT; f = 0.68; 75% isomeric purity of S	75A245
29.30.4.	$Fe(CN)_6^{4-}$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; 0.10 mol/L KCl; pH 7	~25	3.1×10^7	FP/ABS/AVE; τ_0 = ~3 ms; RT; 75% isomeric purity of S	75A245
29.30.5.	$Mn(CN)_6^{3-}$	H_2O	0.1 mol/L KCN; pH 10.8	~25	4.1×10^7	FP/ABS/AVE; OT; f = 0.31; 75% isomeric purity of S	75A245

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.30. Zn(uroporphyrin I)—Continued							
29.30.6.	Zn(uroporphyrin I)	H_2O	1.1×10^{-4} mol/L K_2HPO_4; 0.1 mol/L KCl; pH 7	~25	3.0×10^6	FP/ABS/AVE; 75% isomeric purity of S and Q	75A245
Organic Quenchers							
29.30.7.	*N*-Benzyl-3-carbamyl-py$^+$	H_2O	3.8×10^{-5} mol/L K_2HPO_4; pH 7; $\mu = 3.3 \times 10^{-4}$	~25	2.1×10^9	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	N-Benzyl-3-carbamyl-py$^+$	H_2O	3.8×10^{-5} mol/L K_2HPO_4; pH 7; $\mu = 7.4 \times 10^{-4}$ (KCl)	~25	2.6×10^9	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	N-Benzyl-3-carbamyl-py$^+$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; pH 7; $\mu = 0.0011$ (KCl)	~25	1.9×10^9	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	N-Benzyl-3-carbamyl-py$^+$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; pH 7; $\mu = 0.0016$ (KCl)	~25	1.8×10^9	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	N-Benzyl-3-carbamyl-py$^+$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; pH 7; $\mu = 0.0017$ (KCl)	~25	1.7×10^9	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	N-Benzyl-3-carbamyl-py$^+$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; pH 7; $\mu = 0.0021$ (KCl)	~25	1.5×10^9	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	N-Benzyl-3-carbamyl-py$^+$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; pH 7; $\mu = 0.011$ (KCl)	~25	8.4×10^8	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
	N-Benzyl-3-carbamyl-py$^+$	H_2O	1.1×10^{-4} mol/L K_2HPO_4; 0.1 mol/L KCl; pH 7	~25	3.5×10^8	FP/ABS/AVE; τ_0 = ~3 ms; OT; f = 0.80; 75% isomeric purity of S	75A245
29.30.8.	Dihydronicotinamide adenine dinucleotide	H_2O	0.1 mol/L KCl; pH 13 (KOH)	~25	1.6×10^4	FP/ABS/AVE; RT; [Q] = 0.0023 mol/L; 75% isomeric purity of S	75A245
29.30.9.	Nicotinamide adenine dinucleotide phosphate trianion	H_2O	3.8×10^{-5} mol/L K_2HPO_4; pH 7; $\mu = 5.0 \times 10^{-4}$	~25	1.3×10^6	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245
29.30.10.	Nicotinamide adenine dinucleotide anion	H_2O	3.8×10^{-5} mol/L K_2HPO_4; pH 7; $\mu = 5.0 \times 10^{-4}$	~25	7.8×10^7	FP/ABS/AVE; OT; 75% isomeric purity of S	75A245

TABLE 29. Quenching of excited zinc complexes—Continued

No.	Quencher	Solvent	Solution Medium	T/°C	k_q /L mol^{-1} s^{-1}	Comments	Ref.
29.30.	**Zn(uroporphyrin I)**—Continued						
	Nicotinamide adenine dinucleotide anion	H_2O	1.1×10^{-4} mol/L K_2HPO_4; 0.1 mol/L KCl; pH 7	~25	1.7×10^8	FP/ABS/AVE; τ_0 = ~3 ms; OT; f = 1.0; 75% isomeric purity of S	75A245
29.30.11.	Nicotinamide adenine dinucleotide phosphate trianion	H_2O	1.1×10^{-4} mol/L K_2HPO_4; 0.1 mol/L KCl; pH 7	~25	4.3×10^7	FP/ABS/AVE; τ_0 = ~3 ms; OT; f = 0.96; 75% isomeric purity of S	75A245

9. Notes on the Tables

In some of the cases reported in this compilation, deviations from the behavior predicted by the simplest mechanism and the approximations of Sec. 2.5 of the Introduction, such as nonlinear Stern–Volmer (S–V) plots and biexponential decays, are experimentally observed, necessitating the use of alternative equations, or the introduction of additional steps to the mechanism in order for values of k_q to be extracted. In other cases, conditions specific to the chemistry of the species involved have led the authors of the papers to invoke mechanisms that have unusual features. In still others, novel experimental approaches have been employed, requiring the development of new relationships between Λ and the concentration of the species.

In the discussions that follow, the details of these other equations and mechanisms are presented in sufficient detail in order to enable the reader to appreciate the basis for the values of k_q in those cases. The specific treatments are preceded by the number of the mechanism (e.g., Mech. [1]) which appears in the Comments column of the tables. Within a particular treatment, there are references to specific papers in which variations on the general theme appear.

For the general treatment of the kinetics of quenching, and the definitions of most of the symbols used here, see Sec. 2 of the Introduction.

Mech. [1] *Nonlinear Stern–Volmer plots*

If the experimental plots of I_l^0/I_l or m_2 vs [Q] show a negative deviation from linearity, the approximate equations (25) or (31) of Sec. 2.5 can no longer be applied; rather the general equations (1) or (2) [equations (24) and (30) of Sec. 2.5] should be used:

$$\frac{I_l^0}{I_l} = \frac{1 + \{k_d k_{de}[\mathrm{Q}]/k_0(k_{-d} + k_{de})\}}{1 + \gamma\{(k_d[\mathrm{Q}]/(k_{-d} + k_{de})\}}, \tag{1}$$

$$m_2 = \tfrac{1}{2}(k_0 + k_{de} + k_{-d} + k_d[\mathrm{Q}]) - \tfrac{1}{2}R^{1/2}, \tag{2}$$

where

$$R = (k_0 + k_{de} + k_{-d} + k_d[\mathrm{Q}])^2 - 4(k_0 k_{-d} + k_0 k_{de} + k_{de} k_d[\mathrm{Q}]).$$

Reference 79E349. This is the only case presented in which a nonlinear plot of emission intensity is reported. With the assumption that $k_{-d} \gg k_{de}$, Eq. (1) reduces to Eq. (3). Values of k_0 and k_{de} were obtained independently from lifetime measurements at $[\mathrm{Q}] = 0$ and at very high [Q], respectively; γ was evaluated through a best-fitting procedure of the experimental data to Eq. (3) and k_q was calulated by use of the reduced form of Eq. (7) of Sec. 2.3: $k_q = k_d k_{de}/k_{-d}$.

$$\frac{I_l^0}{I_l} = \frac{1 + (k_d k_{de}[\mathrm{Q}]/k_{-d} k_0)}{1 + \gamma(k_d[\mathrm{Q}]/k_{-d})}. \tag{3}$$

Reference 84E308. The nonlinear dependence on [Q] of the rate constant k_A for the decay of the excited-state absorbance after a flash excitation was interpreted by means of Eq. (4), which is analogous to Eq. (1). Equation (4) was rearranged to Eq. (5). With k_0 known from lifetime measurements at $[\mathrm{Q}] = 0$, k_q was obtained as the intercept/slope ratio of the linear plot of k_A vs $(k_A - k_0)/[\mathrm{Q}]$.

$$k_A = k_0 + \frac{k_d[\mathrm{Q}](k_{de} - k_0)/(k_{-d} + k_{de})}{1 + k_d[\mathrm{Q}]/(k_{-d} + k_{de})}, \tag{4}$$

$$k_A = k_{de} - \left[\frac{k_{-d} + k_{de}}{k_d}\right]\left[\frac{k_A - k_0}{[\mathrm{Q}]}\right]. \tag{5}$$

Reference 85A013. Results analogous to the previous ones were explained by assuming mechanism 6 in which irreversible quenching and the reversible formation of an exciplex are involved:

$$^*\mathrm{S} \xrightarrow{k_0} \mathrm{S},$$

$$^*\mathrm{S} + \mathrm{Q} \xrightarrow{k_1} \text{quenching},$$

$$^*\mathrm{S} + \mathrm{Q} \underset{k_3}{\overset{k_2}{\rightleftarrows}} {}^*(\mathrm{S}\text{–}\mathrm{Q}),$$

$$^*(\mathrm{S}\text{–}\mathrm{Q}) \xrightarrow{k_4} \mathrm{S} + \mathrm{Q} \text{ and/or } \mathrm{S}^+ + \mathrm{Q}^-. \tag{6}$$

By assuming that equilibration between *S and *(S–Q) exists during the decay $[k_2[\mathrm{Q}], k_3 \gg (k_0 + k_1[\mathrm{Q}]), k_4]$ and $\epsilon(^*\mathrm{S}) = \epsilon[^*(\mathrm{S}\text{–}\mathrm{Q})]$ at the monitoring wavelength, Eq. (7) was obtained, which rearranges to Eq. (8),

$$k_A = \frac{k_0 + [(k_2 k_4/k_3) + k_1][\mathrm{Q}]}{1 + (k_2/k_3)[\mathrm{Q}]}, \tag{7}$$

$$Y = \frac{k_A - k_0}{[\mathrm{Q}]} = \left[\frac{k_2 k_4}{k_3}\right] + k_1 - \left[\frac{k_2}{k_3}\right]k_A. \tag{8}$$

From decay measurements at various [Q], a linear plot of Y vs k_A was obtained; values of k_2/k_3 and $[(k_2 k_4/k_3) + k_1]$ were obtained from the slope and intercept, respectively. The value of k_3 and upper limits for k_1 and k_4 were then calculated by assuming that k_2 is at the diffusion-controlled limit ($\sim 10^{10}$ L mol^{-1} s^{-1}).

The value of the overall quenching constant

$$k_q = k_1 + [k_2 k_4/(k_3 + k_4)]$$

was calculated by us for this compilation by using the values of the specific rate constants quoted in the original paper.

Mech. [2] *Biexponential decay*

References 82E636 and 83A101. In these papers, biexponential decays were reported for the quenching of metalloporphyrins and similar complexes. The optical absorbance of the excited state was found to decrease after the flash according to Eq. (9), where $(\Delta A)_t$ is the difference between the absorbances of the solution at time t after the flash and before the flash, and A_1 and A_2 are preexponential factors.

$$(\Delta A)_t = A_1 \exp(-m_1 t) + A_2 \exp(-m_2 t). \tag{9}$$

A best-fitting procedure was used to evaluate m_1, m_2, A_1, and A_2; the limiting value of m_2 at high [Q] $m_2(\mathrm{lim})$ was also obtained. By assuming that the quenching occurs via mechanism 6, the following relationships were written:

$$m_1 + m_2 = a + b[\mathrm{Q}],$$

where

$$a = k_0 + k_3 + k_4, \quad b = k_1 + k_2,$$

and

$$m_2(\mathrm{lim}) = k_4 + [k_1 k_3/(k_1 + k_2)].$$

The analysis of numerous pieces of data led the authors to suggest that $k_1 \ll k_2$ whenever $m_2(\lim) < k_0$. Under these conditions, therefore, they assumed that $k_2 = b$, $k_4 = m_2(\lim)$, and $k_3 = [a - k_0 - m_2(\lim)]$. The k_q values presented in this compilation were calculated by us, using Eq. (7) of Sec. 2.3, and the values of $k_2(=k_d)$, $k_3(=k_{-d})$, and $k_4(=k_{de})$ quoted in the original papers.

When $m_2(\lim) > k_0$, k_1 was considered to be no longer negligible with respect to k_2. This latter rate constant was evaluated [see E. I. Kapinus, M. M. Aleksankina, V. P. Staryi, V. I. Boghillo, and I. I. Dilung, J. Chem. Soc. Faraday Trans. 2 **81**, 631 (1985)] from the preexponential factors at various [Q] by means of Eq. (10), assuming $\epsilon^*(\text{S–Q}) = \epsilon(^*\text{S})$. The values of the other rate constants could then be obtained from a, b, and $m_2(\lim)$. However, the resulting values of k_q then become so uncertain that they have not been included in this compilation.

$$\left[\frac{A_1 m_2 + A_2 m_1}{A_1 + A_2}\right] = k_2[\text{Q}]\left[\frac{\epsilon^*(\text{S–Q})}{\epsilon(^*\text{S})}\right] + k_3 + k_4. \qquad (10)$$

Mech. [3] *Self-quenching (ground-state quenching)*

Reference 86E677. In this case Q is S and the emission from *S must be measured as a function of [S]. Obviously, I_a is no longer a constant value throughout a set of experiments, but must be evaluated using the Beer–Lambert Law [Eq. (11)], where ϵ is the molar absorptivity of S at the excitation wavelength, l is the optical path length, and I_0 is the intensity of the incident light.

$$I_a = I_0[1 - \exp(-2.303\epsilon l[\text{S}])]. \qquad (11)$$

By assuming that quenching occurs via reaction (5) of Sec. 2.3, and by introducing Eq. (11) into the steady-state treatment, one obtains, Eq. (12), where α is an instrumental factor.

$$\frac{1}{I_l} = \frac{1}{\alpha\beta k_{rd} I_0 \eta^*}\left[\frac{k_0}{1 - \exp(-2.303\epsilon l[\text{S}])} + \frac{k_q[\text{S}]}{1 - \exp(-2.303\epsilon l[\text{S}])}\right]. \qquad (12)$$

Equation (12) predicts that a plot of $1/I_l$ vs [S] will be nonlinear; however, if the absorbance of the solution is <0.1 for all [S] used, Eq. (11) reduces to $I_a = I_0(2.303\epsilon l[\text{S}])$, leading to Eq. (13), which predicts a linear relationship between $1/I_l$ and $1/[\text{S}]$ with an intercept/slope ratio of $k_q/k_0 = K_{\text{SV}}$. The lifetime used to convert K_{SV} to k_q must be the limiting value of τ as $[\text{S}] \to 0$, obtained by extrapolation, for example, from a plot of $1/\tau$ vs [S]. Note that a linear S–V plot should be obtained from decay measurements of self-quenching, inasmuch as the decay kinetics are not affected by the amount of light absorbed by S.

$$\frac{1}{I_l} = \frac{1}{2.303\epsilon l \alpha\beta k_{rd} I_0 \eta^*}\left[\frac{k_0}{[\text{S}]} + k_q\right]. \qquad (13)$$

Mech. [4] *Quenching by an unstable quencher*

Reference 756452. The quencher (UO^{2+}) was produced *in situ* from the substrate (UO_2^{2+}) by means of the following fast reaction:

$$UO_2^{2+} + Eu^{2+} \to UO_2^{+} + Eu^{3+}.$$

Addition of Eu^{2+} to the solution caused an almost instantaneous decrease of the intensity of O_2^{2+} emission; a slow recovery of the intensity was then observed, which was due to the following disproportionation reaction:

$$2UO_2^{+} \to UO_2^{2+} + U^{4+}.$$

A S–V plot was constructed from the emission intensities measured at various times during the recovery; the corresponding [Q] values were calculated from the initial concentration of UO_2^{+} (equal to the concentration of added Eu^{2+}) and the known rate constant for the disproportionation reaction. K_{SV} was evaluated from the slope of this linear plot.

Mech. [5] *Quenching of the photoreaction of *S*

If *S and *S–Q undergo photoreaction to product P, the quantum yield for the formation of P after an appropriate period of continuous irradiation t is given by Eq. (14):

$$\Phi(\text{P}) = \frac{\int_0^t (k_{rx}[^*\text{S}]_{ss} + k'_{rx}[^*\text{S–Q}]_{ss})dt}{\int_0^t I_a\, dt} \qquad (14)$$

If both S and Q are not appreciably consumed during the irradiation period, $[^*\text{S}]_{ss}$, $[^*\text{S–Q}]_{ss}$, and I_a can be considered to be constant. Equation (14) can be integrated to Eq. (15).

$$\Phi(\text{P}) = \frac{k_{rx}\eta^*(k_{-d} + k_{de}) + k'_{rx}\eta^* k_d[\text{Q}]}{k_0(k_{-d} + k_{de}) + k_{de}k_d[\text{Q}]}. \qquad (15)$$

The ratio between the quantum yields in the absence and presence of Q is represented by Eq. (16), where $\Phi^0(\text{P})$ is the quantum yield at $[\text{Q}] = 0$, and $\delta = k'_{rx}/k_{rx}$.

$$\frac{\Phi^0(\text{P})}{\Phi(\text{P})} = \frac{1 + \{k_{de}k_d[\text{Q}]/k_0(k_{-d} + k_{de})\}}{1 + \delta\{k_d[\text{Q}]/(k_{-d} + k_{de})\}}. \qquad (16)$$

By neglecting the contribution of *S–Q to the reaction, Eq. (16) is reduced to the S–V equation (17) for a quenched photoreaction, which is the same as Eq. (21) of Sec. 2.5:

$$\Phi_0/\Phi = 1 + (k_q/k_0)[\text{Q}] = 1 + K_{\text{SV}}[\text{Q}]. \qquad (17)$$

References 80F228 and 82E073. Through the use of equation (17), k_q was evaluated from the slope of a plot of $\Phi^0(\text{P})/\Phi(\text{P})$ vs [Q].

Reference 81E458. Because Q is S, $\Phi^0(\text{P})$ could not be measured; Eq. (18), which again neglects the contribution of *S–Q to the reaction, was used instead of Eq. (17). The slope/intercept ratio of the linear plot of $1/\Phi(\text{P})$ vs [Q] yields K_{SV}.

$$1/\Phi(\text{P}) = (k_0/k_{rx}) + (k_q/k_{rx})[\text{Q}]. \qquad (18)$$

Reference 84A141. A more complex treatment is required when the measured photoreaction is assumed to originate from both the quenched excited state and a higher-energy, unquenchable excited state **S which is directly populated by irradiation. The light absorption step 1 of Sec. 2.2 is substituted by the following steps:

$$S \xrightarrow{I_a} {}^{**}S,$$

$$^{**}S \xrightarrow{k''_{nr}} S,$$

$$^{**}S \xrightarrow{k''_{rx}} \text{products},$$

$$^{**}S \xrightarrow{k''_{ic}} {}^{*}S.$$

A steady-state treatment leads to Eq. (19). However, a plot of $\Phi^0(P)/\Phi(P)$ vs [Q] is no longer linear.

$$\Phi(P) = \frac{k''_{rx}}{k''_{nr} + k''_{rx} + k''_{ic}} + \frac{\eta_{ic} k_{rx}}{k_0 + k_q[Q]}, \tag{19}$$

where $\eta_{ic} = k''_{ic}/(k''_{nr} + k''_{rx} + k''_{ic})$.

At high [Q], $\Phi(P)$ reaches a lower limit given by Eq. (20), which is the quantum yield for the unquenchable reaction from **S.

$$\Phi(\lim) = k''_{rx}/(k''_{nr} + k''_{rx} + k''_{ic}). \tag{20}$$

If $\Phi(\lim)$ can be evaluated, Eq. (21) can be applied, so that a plot of $\Phi^0(P)/[\Phi(P) - \Phi(\lim)]$ vs [Q] is linear with a slope/intercept ratio equal to K_{SV}.

$$\frac{\Phi^0(P)}{\Phi(P) - \Phi(\lim)} = \left[\frac{k_0\Phi(\lim) + \eta_{ic}k_{rx}}{\eta_{ic}k_{rx}}\right] + \left[\frac{(k_0\Phi(\lim) + \eta_{ic}k_{rx})k_q}{k_0\eta_{ic}k_{rx}}\right][Q]. \tag{21}$$

Mech. [6] *Sensitized emission and reaction*

When a quenching process occurs, at least in part, via energy transfer, an excited state of Q, *Q, is produced which may undergo emission and/or photochemical reaction. The overall quenching constant can then be obtained by measuring the intensity of *Q emission or the quantum yield of its photoreaction under continuous irradiation. The following mechanism is used to determine k_q:

$$S \xrightarrow{I_a\eta^*} {}^{*}S,$$

$$^{*}S \xrightarrow{k_0} S \text{ and/or products P},$$

$$^{*}S + Q \underset{k_{-d}}{\overset{k_d}{\rightleftarrows}} {}^{*}S\text{–}Q,$$

$$^{*}S\text{–}Q \xrightarrow{k_1} S + {}^{*}Q,$$

$$^{*}S\text{–}Q \xrightarrow{k_2} \text{other processes},$$

$$^{*}Q \xrightarrow{k_3} Q + \text{heat},$$

$$^{*}Q \xrightarrow{k_4} Q + h\nu'(\text{sensitized emission}),$$

$$^{*}Q \xrightarrow{k_5} \text{products P}' \text{ (sensitized reaction)}.$$

The step represented by k_1 has its analog in the ET step of reactions (12)–(16) in Sec. 2.4; k_2 represents all the other processes involving *S–Q in reactions (8)–(10) of Sec. 2.3. Thus, $k_1 + k_2 = k_{de}$. A steady-state treatment applied to [*S], [*S–Q], and [*Q] leads to Eq. (22) for the emission intensity from *Q, where α is an instrumental factor.

$$\frac{1}{I_l} = \left[\frac{(k_1 + k_2)(k_3 + k_4 + k_5)}{\alpha I_a \eta^* k_1 k_4}\right] + \left[\frac{k_0(k_{-d} + k_1 + k_2)(k_3 + k_4 + k_5)}{\alpha I_a \eta^* k_1 k_4 k_d}\right] \times \left[\frac{1}{[Q]}\right]. \tag{22}$$

Provided that Q does not contribute to the absorption of the exciting light, or that an appropriate correction is made, Eq. (22) indicates that a plot of $1/I_l$ vs $1/[Q]$ (S–V plot for the sensitized emission) should be linear; indeed, such a linearity is considered as evidence for the mechanism. Under these conditions, the intercept/slope ratio equals

$$[k_d(k_1 + k_2)]/[k_0(k_{-d} + k_1 + k_2)] = k_q/k_0 = K_{SV}.$$

In an analogous manner, Eq. (23) for the quantum yield of P′ production can be written:

$$\frac{1}{\Phi(P')} = \left[\frac{(k_1 + k_2)(k_3 + k_4 + k_5)}{\eta^* k_1 k_4}\right] + \left[\frac{k_0(k_{-d} + k_1 + k_2)(k_3 + k_4 + k_5)}{\eta^* k_1 k_4 k_d}\right] \times \left[\frac{1}{[Q]}\right]. \tag{23}$$

Equation (23) implies that a linear relationship exists between $1/\Phi(P')$ and $1/[Q]$ (S–V plot for the sensitized reaction), provided that Q neither absorbs the exciting light nor is substantially consumed during the irradiation period. From Eq. (23), intercept/slope $= k_q/k_0 = K_{SV}$.

References 80E412 and 86E555. Emission intensity from the excited quencher was measured under continuous irradiation conditions, and k_q was calculated by the use of Eq. (22).

References 85F395 and 86A158. The quantum yield for the sensitized photoreaction of Q was measured under continuous illumination conditions, and K_{SV} was evaluated by means of Eq. (23). In the first paper, however, k_q was evaluated from the competition between the quenching of *S by Q and by O_2, where $k_6 = 3\times10^9$ L mol^{-1} s^{-1}:

$$^{*}S + O_2 \xrightarrow{k_6} S + {}^{*}O_2.$$

In the presence of O_2, the steady-state treatment yields Eq. (24),

$$\frac{1}{\Phi(P')} = \left[\frac{(k_1 + k_2)(k_3 + k_4 + k_5)}{\eta^* k_1 k_5}\right]\left[1 + \frac{1}{K_{SV}[Q]}\right] + \left[\frac{(k_1 + k_2)(k_3 + k_4 + k_5)k_6}{\eta^* k_1 k_5 k_q}\right]\left[\frac{[O_2]}{[Q]}\right] \tag{24}$$

Equation (24) predicts that a plot of $1/\Phi(P')$ vs $[O_2]/[Q]$ will be linear at constant [Q] with a slope/intercept ratio of $(k_6/k_q)/[1 + (K_{SV}[Q])^{-1}]$. From K_{SV} determined in the absence of O_2, k_q is obtained.

Mech. [7] *Primary products of electron transfer under continuous irradiation*

If *S–Q undergoes oxidative transfer (OT) to S^+–Q^- or reductive transfer (RT) to S^-–Q^+, consideration must be given to the back electron–transfer reactions of the geminate pair ($S^{\pm}$–$Q^{\mp}$) within the solvent cage when evaluation of k_q is made. The detailed mechanism is as follows:

$$S \xrightarrow{I_a\eta^*} {}^*S,$$

$$S \xrightarrow{k_0} S \text{ and/or } P,$$

$${}^*S + Q \underset{k_{-d}}{\overset{k_d}{\rightleftarrows}} {}^*S\text{–}Q,$$

$${}^*S\text{–}Q \xrightarrow{k_1} S^{\pm}\text{–}Q^{\mp},$$

$${}^*S\text{–}Q \xrightarrow{k_2} \text{other processes},$$

$$S^{\pm}\text{–}Q^{\mp} \xrightarrow{k_3} S^{\pm} + Q^{+},$$

$$S^{\pm}\text{–}Q^{\mp} \xrightarrow{k_4} S + Q.$$

Application of the steady-state treatment to [*S], [*S–Q], and [$S^{\pm}$–$Q^{\mp}$] leads to Eq. (25),

$$[S^{\pm}\text{–}Q^{\mp}]_{ss} = \frac{I_a\eta^* k_1 k_d [Q]}{\{k_0(k_{-d} + k_1 + k_2) + k_d[Q](k_1 + k_2)\}(k_3 + k_4)} \tag{25}$$

The rate of primary production of $S^{\pm}$ and $Q^{\mp}$ in the bulk solution is

$$\frac{d[S^{\pm}]}{dt} = \frac{d[Q^{\mp}]}{dt} = k_3[S^{\pm}\text{–}Q^{\mp}].$$

The evaluation of k_q from the quantum yield of $S^{\pm}$ or $Q^{\mp}$ formation, measured after a finite period of irradiation, is complicated by back electron-transfer reaction (26) between $S^{\pm}$ and $Q^{\mp}$ in the bulk solution, the rate of which increases with increasing [$S^{\pm}$] and [$Q^{\mp}$]. Different approaches have been used to overcome this difficulty.

$$S^{\pm} + Q^{\mp} \xrightarrow{k_5} S + Q. \tag{26}$$

References 78A058 and 80F058. In these cases, Q^- is a Co(II) complex which decomposes via a transformation to P′ much more rapidly than the occurrence of reaction (26), which can be neglected. Equation (27) results, which predicts a linear relationship between $1/\Phi(P')$ and $1/[Q]$, with an intercept/slope ratio equal to

$$[k_d(k_1 + k_2)]/[k_0(k_{-d} + k_1 + k_2)] = k_q/k_0 = K_{SV},$$

$$\frac{1}{\Phi(P')} = \frac{1}{\Phi(Q^-)} = \left[\frac{(k_1 + k_2)(k_3 + k_4)}{\eta^* k_1 k_3}\right] + \left[\frac{k_0(k_{-d} + k_1 + k_2)(k_3 + k_4)}{\eta^* k_1 k_3 k_d}\right] \times \left[\frac{1}{[Q]}\right]. \tag{27}$$

Reference 84F351. In this case, the solution contained a "sacrificial" electron-transfer reagent X which was able to react with S^- to yield S and products with a rate constant k_6. When [X] is sufficiently high such that reaction (26) is of negligible importance and $k_6[X] \gg k_5[Q^+]$, the relationship between $\Phi(Q^+)$ and [Q] is expressed by Eq. (27).

Reference 81A139. In this case, a similar system was used, but with a concentration of X insufficiently high for reaction (26) to be rendered negligible. Under these conditions, and by assuming that $k_2 = k_4 = 0$, Eq. (28) was obtained from a steady-state treatment of [*S], [*S–Q], [$S^{\pm}$–$Q^{\mp}$], and [$S^{\pm}$]:

$$\frac{d[Q^-]}{dt} = I_a\eta^*\left[\frac{k_q[Q]}{k_0 + k_q[Q]}\right]\left[\frac{k_6[X]}{k_5[Q^-] + k_6[X]}\right]. \tag{28}$$

Equation (28) shows that [Q^-] does not increase linearly with the irradiation time. The value of $d[Q^-]/dt$ at a given [Q] was obtained at various [Q] and [X] from the tangent of a plot of [Q^-] versus irradiation time. The value of K_{SV} was then obtained as the intercept/slope ratio from the linear plot of $dt/d[Q^-]$ vs $1/[Q]$ at constant [X], as expressed by Eq. (29),

$$\frac{dt}{d[Q^-]} = \left[\frac{k_5[Q^-] + k_6[X]}{I_a\eta^* k_6[X]}\right] + \left[\frac{k_0(k_5[Q^-] + k_6[X])}{I_a\eta^* k_6[X] k_q}\right]\left[\frac{1}{[Q]}\right]. \tag{29}$$

Reference 83A333. In this case, the same treatment as above was used, but $d[Q^-]/dt$ was evaluated from the initial slope of the plot of [Q^-] versus irradiation time.

Reference 85F328. In this case, back electron-transfer reaction (26) was prevented by means of competitive irreversible reaction (30); this latter reaction substitutes for all the reactions of S^+–Q^- in the previous mechanism.

$$S^+\text{–}Q^- + X \xrightarrow{k_7} S + Q^- + \text{products}. \tag{30}$$

The quantum yield of formation of Q^- as a function of [Q] is given by Eq. (31),

$$\frac{1}{\Phi(Q^-)} = \left[\frac{(k_1 + k_2)(k_4 + k_7[X])}{\eta^* k_1 k_7[X]}\right] + \left[\frac{k_0(k_{-d} + k_1 + k_2)(k_4 + k_7[X])}{\eta^* k_1 k_7[X] k_d}\right] \times \left[\frac{1}{[Q]}\right]. \tag{31}$$

The plot of $1/\Phi(Q^-)$ vs $1/[Q]$ is linear, and the inter-

cept/slope ratio is again equal to K_{SV}. Note that [X] affects $\Phi(Q^-)$, but not K_{SV}.

Mech. [8] *Primary products of electron transfer upon pulsed irradiation*

Reference 82F065. k_q was determined from the measurement of the concentration of a primary product S^+ resulting from the flash. The following mechanism was assumed, in which back electron transfer in the bulk solution is neglected:

$$S \xrightarrow{I_a\eta^*} {}^*S,$$

$${}^*S \xrightarrow{k_0} S,$$

$${}^*S + Q \xrightarrow{k_1} S^+ + Q^-,$$

$${}^*S + Q \xrightarrow{k_2} \text{other quenching processes.}$$

The quantum yield for the production of S^+ during the flash, assuming that the quenching is irreversible, is $\Phi(S^+) = k_1[Q]/(k_0 + k_q[Q])$, where $k_q = k_1 + k_2$;

$$1/\Phi(S^+) = (k_q/k_1) + (k_0/k_1[Q]).$$

Experimentally, $\Phi(S^+) = [S^+]_0/\int I_a\eta^*$, where $[S^+]_0$ is the concentration of S^+ just at the end of the flash, evaluated from absorbance measurements at various times after the flash and extrapolated to $t = 0$ in order to account for back electron transfer. The quantity $\int I_a\eta^*$ was obtained from actinometric measurements, using very complex numerical calculations in order to account for the changes in [S] (and [Q], inasmuch as this species absorbs a fraction of the exciting light) during the flash. From the intercept and slope of the linear plot of $1/\Phi(S^+)$ vs $1/[Q]$, k_q and the efficiency of formation of the primary products in the bulk solution (k_1/k_q) were obtained.

Reference 80A023. The time-dependent variation of the electrical conductivity of the solution after pulsed excitation was used to evaluate k_q for the following ground-state electron-transfer quenching process:

$${}^*S + S \xrightarrow{k_q} S^+ + S^-.$$

With the assumption that *S–Q does not contribute to the reaction, the rate of variation of the conductivity equals the rate of consumption of *S after the flash as given in Eq. (32). k_q was obtained from the slope of the linear plot of $1/t_{1/2}$ (conductivity) vs [S].

$$[{}^*S]_t = [{}^*S]_0 \exp\{-(k_0 + k_q[S])t\}. \quad (32)$$

Reference 80E224. k_q was evaluated by means of photocurrent measurements taken after flash excitation. The proposed mechanism is:

$$S \xrightarrow{I_a\eta^*} {}^*S,$$

$${}^*S \xrightarrow{k_0} S,$$

$${}^*S + Q \underline{\ k_q\ } \begin{cases} \xrightarrow{k_1} S^+ + Q^- \\ \xrightarrow{k_2} S + {}^*Q \end{cases},$$

$$S + {}^*Q \xrightarrow{k_3} S^+ + Q^-,$$

$${}^*Q \xrightarrow{k_4} Q,$$

$$S^+ + Q^- \xrightarrow{k_5} S + Q,$$

$$S^+ + e^- \rightarrow S \text{ (at the electrode).}$$

Inasmuch as the resolution time of the apparatus was of the order of μs, the reactions represented by k_q and k_3 were considered to be complete at $t = 0$ after the flash. If the reaction represented by k_5 is considered to be of negligible importance during the flash, the concentration of S^+ at $t = 0$ is given by Eq. (33), where I_f is the number of photons effectively absorbed by 1 dm^3 of solution during the flash.

$$[S^+]_0 = \frac{I_f[Q]\{k_1 + (k_2k_3[S]/(k_4 + k_3[S]))\}}{(k_0 + k_q[Q])}. \quad (33)$$

By assuming that the reaction at the electrode is diffusion controlled, and by solving the equation describing the diffusion, Eq. (34) is obtained for the intensity of the photocurrent i as a function of time after the flash, from which the product $\lambda[S^+]_0$, where λ is a constant, can be evaluated. Inasmuch as Q^- was initially present in excess before the flash, $[Q^-]$ is a constant value.

$$i = \lambda\,[S^+]_0 t^{-1/2} \exp(-k_5[Q^-]t). \quad (34)$$

A linear plot of $1/\lambda[S^+]_0$ vs $1/[Q]$ was obtained experimentally. The rearrangement of Eq. (33) to Eq. (35) shows that the intercept/slope ratio of this plot is equal to K_{SV}.

$$\frac{1}{\lambda\,[S^+]_0} = \left[\frac{(k_q/\lambda I_f)}{k_1 + \{k_2k_3[S]/(k_4 + k_3[S])\}}\right] + \left[\frac{(k_0/\lambda I_f)}{k_1 + \{k_2k_3[S]/(k_4 + k_3[S])\}}\right] \times \left[\frac{1}{[Q]}\right]. \quad (35)$$

Mech. [9] *Quenching of higher-energy excited states*

If *S is indirectly populated from a higher-energy excited state **S and both *S and **S are quenched by Q, the light absorption step 1 of Sec. 2.2 must be substituted by the following reactions:

$$S \xrightarrow{I_a} {}^{**}S,$$

$${}^{**}S \xrightarrow{k_1} S \text{ and/or } P,$$

$${}^{**}S \xrightarrow{k_2} {}^*S,$$

$${}^{**}S + Q \xrightarrow{k'_q} \text{quenching products.}$$

By making the steady-state approximation for [**S], [*S], and [*S–Q], and neglecting as usual any emission from *S–Q, one obtains Eq. (36) for the emission intensity of *S, where K_{SV} is the S–V constant for the quenching of *S, and $K_h = k'_q/(k_1 + k_2)$. According to Eq. (36), the S–V plot of I_l^0/I_l vs [Q] shows a positive deviation from linearity.

$$I_l^0/I_l = 1 + (K_{SV} + K_h)[Q] + (K_{SV}K_h)[Q]^2. \quad (36)$$

On the other hand, in flash experiments the quenching of **S results in a decrease of $[*S]_0$, but generally has no effect on its decay, provided that the lifetime of **S is much shorter than that of *S.

Reference 74E519. Although the S–V plot for I_l from *S has negative deviation from linearity, its initial slope was taken as equal to $(K_{SV} + K_h)$ because the quadratic term in Eq. (36) is negligible for $[Q] \ll 1$ mol/L. In addition, K_h was considered to be small compared to K_{SV}; it is presumed that $k'_q \sim k_d$, and $(k_1 + k_2) \gg k_0$.

Reference 79A220. k_q for the quenching of *S was obtained from lifetime measurements in the usual way; k_q for the quenching of **S was determined from the measurement of [*S] and $[S^+]$ at 50 μs after the flash. The following quenching modes for **S were assumed:

$$**S + Q \xrightarrow{k_3} *S + Q,$$

$$**S + Q \xrightarrow{k_4} S^+ + Q^-.$$

By assuming that at 50 μs after the flash all the reactions involving **S were completed while those involving *S had proceeded to a negligible extent, Eqs. (37) and (38) were obtained for the concentrations of *S and S^+ at that time ($[*S]_{50}$ and $[S^+]_{50}$, respectively).

$$[*S]_{50} = \frac{(k_2 + k_3[Q])I_a}{k_1 + k_2 + (k_3 + k_4)[Q]}, \quad (37)$$

$$[S^+]_{50} = \frac{k_4[Q]I_a}{k_1 + k_2 + (k_3 + k_4)[Q]}. \quad (38)$$

The ratio of Eq. (37) and (38) yields Eq. (39). From the intercept and slope of the linear plot of $[*S]_{50}/[S^+]_{50}$ vs $1/[Q]$, k_2/k_4 and k_3/k_4 can be evaluated. Values of k_3, k_4, and $k_q (= k_3 + k_4)$ were obtained by assuming that k_2, the rate constant for intersystem crossing between **S and *S, is in the range 10^7–10^8 s^{-1}.

$$\frac{[*S]_{50}}{[S^+]_{50}} = \left[\frac{k_3}{k_4}\right] + \left[\frac{k_2}{k_4}\right]\left[\frac{1}{[Q]}\right]. \quad (39)$$

Mech. [10] *Quenching in the presence of triplet–triplet reactions*

Consider a triplet excited state that undergoes ground-state quenching and triplet–triplet reaction simultaneously:

$$*S \xrightarrow{k_0} S,$$

$$*S + S \xrightarrow{k_q} \text{quenching},$$

$$*S + *S \xrightarrow{k_1} S \text{ and/or products}.$$

The decay of *S after pulsed excitation does not follow first-order kinetics: $-d[*S]/dt = K[*S] + k_1[*S]^2$, where $K = (k_0 + k_q[S])$.

Reference 83A102. K and k_1 were evaluated by a best-fit procedure from the decay curves of the optical absorption of *S using Eq. (40), obtained from the solution of the differential equation above. Conversion of absorbances to concentrations was effected by using the following relationships: $[*S]_0 = (A_0 - A_b)/\epsilon(*S)$ and $[*S]_t = (A_t - A_b)/\epsilon(*S)$, where $\epsilon(*S)$ is the molar absorptivity of *S at the monitoring wavelength, and A_b, A_0, and A_t are the optical absorbances before the flash, just after the flash, and at time t after flash, respectively. k_q was then obtained as the slope of the linear plot of K vs [S].

$$[*S]_t = \frac{(K/k_1)}{\left[\frac{K}{k_1[*S]_0} + 1\right]\exp(Kt) - 1}. \quad (40)$$

Reference 60E006. For similar systems, K was evaluated by means of Eq. (41), where $\epsilon(S)$ is the molar absorptivity at the monitoring wavelength, l is the optical pathlength, and $\epsilon(*S)$, A_b, A_0, and A_t have the same meaning as above.

$$\frac{d\{\ln[(A_0 - A_b)/(A_t - A_b)]\}}{dt} = K + \left[\frac{(k_1 - k_q)(A_t - A_b)}{[\epsilon(*S) - \epsilon(S)]l}\right]. \quad (41)$$

The value of the derivative [left-hand side of Eq. (41)] was determined as the tangent to the plot of $(A_0 - A_b)/(A_t - A_b)$ vs t, and K as the intercept of the plot of the derivative vs $(A_t - A_b)$.

Reference 60A002. The same treatment as above was applied to the quenching of *S by Q. Now, $K = k_0 + k_q[S] + k'_q[Q]$ in Eq. (41); k'_q was evaluated from the plot of K vs [Q] at constant [S]:

$$*S + Q \xrightarrow{k'_q} \text{products}.$$

Mech. [11] *Static quenching*

Static quenching is a nondynamical process that results from the excitation of ground-state adducts between S and Q; static quenching may occur simultaneously with the dynamic quenching reaction, particularly when S and Q are ions of opposite sign:

$$S + Q \overset{K_{eq}}{\rightleftarrows} S\text{–}Q.$$

When the emission from *S (and *S–Q) is measured under steady-state conditions, the light absorption step of Sec. 2.2 must be replaced with the following reactions, where I_a is the intensity of light absorbed by all the various S species, and χ is the fraction of the light absorbed by uncomplexed S; $\chi = (1 + K_{eq}[Q])^{-1}$ if S and S–Q have the same molar absorptivity at the exciting wavelength.

$$S \xrightarrow{I_a\chi} *S,$$

$$S\text{–}Q \xrightarrow{I_a(1-\chi)} *S\text{–}Q.$$

If it is assumed that $K_{eq} = k_d/k_{-d}$, the general steady-

state treatment leads to expressions for the dependence of the emission intensity on [Q]: Eq. (42) for irreversible quenching [reaction (5) in Sec. 2.3], and Eq. (43) for reversible quenching [reaction (6) in Sec. 2.3]:

$$I_l^0/I_l = 1 + (K_{SV} + K_{eq})[Q] + K_{SV}K_{eq}[Q]^2, \tag{42}$$

$$\frac{I_l^0}{I_l} = \frac{1 + (K_{SV} + K_{eq})[Q] + K_{SV}K_{eq}[Q]^2}{1 + (1+\gamma)\{k_d[Q]/(k_{-d} + k_{de})\} + \gamma\{(k_0 + k_d[Q])K_{eq}[Q]/(k_{-d} + k_{de})\}}. \tag{43}$$

Equation (42) is a quadratic equation which shows positive deviation from linearity when I_l^0/I_l is plotted against [Q]. Equation (43), on the other hand, tends toward a limiting value at high [Q]: $I_l^0/I_l(\lim) = k_{de}/k_0\gamma$. Equation (43) reduces to Eq. (42) whenever the denominator of Eq. (43) is close to unity, in particular when $(k_{-d} + k_{de}) \gg k_d[Q]$ and $k_{de} \gg k_0$. If one assumes that $k'_{rd} = k_{rd}$, the condition that $k_{de} \gg k_0$ implies that the quantum yield of emission from *S–Q is much smaller than that from *S.

In pulsed excitation experiments, ground-state complexation between S and Q affects [*S] and [*S–Q] at $t = 0$ after the flash, but not their decay kinetics. Then, only the "dynamic" part of the quenching, which generally is monoexponential and exhibits a linear S–V plot, is monitored.

References 80E669 and 81A250. k_q was obtained from steady-state emission intensity measurements by assuming that I_l^0/I_l follows Eq. (42). In the first paper, however, the S–V plot has a negative deviation from linearity. In the latter paper, a value of K_{eq} obtained from the Debye–Smoluchowski and Eigen equations, was used in the best-fit procedure to evaluate K_{SV}.

Reference 85E375. A biexponential decay of the emission after pulsed excitation was observed in the presence of static quenching. The values of k_d, k_{-d}, and k_{de} were obtained through a best-fit procedure from m_1 and m_2 values at two different [Q], by assuming that $k'_{rd} = k_{rd}$, $k'_{nr} = k_{nr}$, and $k'_{rx} = k_{rx}$. The value of k_q reported in this compilation was calculated by us using the values of k_d, k_{-d}, and k_{de} quoted in this paper.

Mech. [12] *Ion-pairing of the substrate*

Reference 86F346. For the system where the substrate is $Ru(bpy)_3^{2+}$ and the quencher is MV^{2+}, it has been found that the quenching reaction is affected by both the nature and the concentration of added halide ions ($X^- = Cl^-$, I^-). This behavior was attributed to the presence of ion pairs between S and X^-, their excitation, and subsequent quenching. The following mechanism was assumed:

$$S + X^- \overset{K_{eq}}{\rightleftarrows} S\text{–}X,$$

$$S \overset{I_a\gamma}{\rightarrow} {}^*S,$$

$$S\text{–}X^- \overset{I_a(1-\gamma)}{\rightarrow} {}^*S\text{–}X^-,$$

$${}^*S \overset{k_{nr}}{\rightarrow} S + \text{heat},$$

$${}^*S \overset{k_{rd}}{\rightarrow} S + h\nu',$$

$${}^*S\text{–}X^- \overset{k''_{nr}}{\rightarrow} S\text{–}X^- + \text{heat},$$

$${}^*S\text{–}X^- \overset{k''_{rd}}{\rightarrow} S\text{–}X^- + h\nu'',$$

$${}^*S\text{–}X^- + Q \overset{k_q}{\rightarrow} \text{quenching}.$$

The quenching of "free" *S by Q, and ion pairing between Q and X^- were ignored. A steady-state treatment, in which it was assumed that $\epsilon(S) = \epsilon(S\text{–}X^-)$ at the excitation wavelength, $k_{rd} = k''_{rd}$, and $k_{nr} = k''_{nr}$, leads to Eq. (44),

$$\frac{I_l^0}{I_l} = 1 + \frac{K_{eq}[X^-]K_{SV}[Q]}{1 + K_{eq}[X^-] + K_{SV}[Q]}. \tag{44}$$

In this treatment, $[X^-]$ was taken to be equal to $[X^-]_0$, the concentration of X^- in the initially prepared solution, inasmuch as $[S] < [X^-]_0$. Equation (44) is converted easily to Eq. (45),

$$Y = \frac{[Q]}{(I_l^0/I_l) - 1} = \left[\frac{1}{K_{SV}}\right] + \left[\frac{1 + K_{SV}[Q]}{K_{eq}K_{SV}}\right] \times \left[\frac{1}{[X^-]}\right]. \tag{45}$$

A linear plot of Y vs $1/[X^-]$ was obtained at constant [Q]; K_{SV} was calculated directly from the intercept of this plot. It is worth noting that changes in $[X^-]$ also caused changes in the ionic strength of the solution; this fact was not considered in the paper.

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11. Indexes

11.1. Author Index

The six-character codes following an author's name refer to the RCDC reference code, and the loca-

tors *t.m* refer to the table number *t* and excited state number *m* where data for the quenchers in that specific reference can be found.

Abruna, H. 776441: *19.3, 19.4, 19.5, 19.6, 19.8, 19.9, 19.33, 19.34, 22.1*; 77F920: *19.3, 19.4, 19.5, 19.6, 19.8, 19.9, 19.33, 19.34, 21.1, 22.1.*
Adamson, A.W. 717111: *20.1*; 737656: *20.1*; 80E074: *18.5, 18.9*; 80F384: *27.1*; 82E073: *18.2, 18.4*; 82E553: *16.1*; 84E097: *4.9, 4.10.*
Adar, E. 86N119: *21.1, 29.20.*
Addington, J.W. 766319: *19.58, 20.1*; 776220: *19.30, 19.60.*
Ahmad, M. 756411: *28.1.*
Akasheh, T.S. 86B098: *19.26, 19.49.*
Aleksankina, M.M. 83E101: *11.12.*
Allen, D.M. 747132: *28.1.*
Al-Saigh, H.Y. 83E223: *4.14, 4.18, 16.3, 19.58, 20.1, 28.1*; 84A504: *19.46, 19.52.*
Ambrosz, H.B. 84A465: *28.1.*
Amouyal, E. 78A392: *21.1*; 80A247: *21.1, 22.1*; 80U059: *22.1*; 82C019: *21.1, 22.1.*
Anderson, C.P. 777106: *21.1.*
Anderson, S. 85E617: *19.23, 19.32, 19.45, 22.1.*
Anitoff, O. 84A264: *29.15.*
Antipenko, B.M. 68E121: *28.1*; 69E237: *7.1, 24.4*; 71E390: *24.4.*
Aono, S. 85A101: *29.10*; 85F030: *29.10*; 85F520: *29.22.*
Aoyagui, S. 80E224: *14.1, 14.4, 14.10, 19.14, 20.1.*
Asbury, R.P. 80A287: *3.1.*
Atabekyan, L.S. 81F325: *28.1.*
Baggott, J.E. 80A308: *19.1, 19.15, 19.17, 19.58, 20.1*; 81A031: *19.15, 19.17, 19.58, 20.1*; 83E623: *19.17, 19.19, 21.1*; 85E617: *19.23, 19.32, 19.45, 22.1.*
Balashov, K.P. 83A403: *4.14, 14.4, 20.1*; 83E719: *4.14, 14.4, 20.1*; 85A469: *4.14, 9.2, 14.4, 20.1, 28.1.*
Ballard, S.G. 80A023: *29.9.*
Ballardini, R. 736183: *4.15*; 767517: *4.14*; 78E518: *4.14, 9.1, 21.1*; 85E375: *20.1*; 86E555: *9.4, 16.3.*
Balzani, V. 736183: *4.15*; 746112: *20.1*; 746396: *20.1*; 756325: *4.14, 20.1*; 766027: *20.1*; 767517: *4.14*; 776252: *4.16*; 78E518: *4.14, 9.1, 21.1*; 78F122: *4.14*; 81E512: *19.42*; 82S159: *19.2, 19.10, 19.44, 19.51*; 83E586: *4.14*; 83S001: *20.1*; 84A255: *14.10, 19.14, 19.17, 19.58, 20.1*; 84E462: *19.41, 19.42, 19.50, 19.51*; 84F176: *7.3*; 85A248: *19.2, 19.42, 19.51, 21.1*; 85E375: *20.1*; 86E195: *19.13, 19.15, 19.19, 19.36, 19.38, 19.39, 19.42, 19.44, 19.47, 19.48, 19.50, 20.1*; 86E832: *7.1, 7.3, 24.4, 24.17.*
Barboy, N. 84F091: *29.8*; 86E020: *29.12.*
Bard, A.J. 84F121: *20.1.*
Barigelletti, F. 82S159: *19.2, 19.10, 19.44, 19.51.*
Barringer, L.F.,Jr. 81C001: *19.71.*
Barton, J.K. 85R098: *19.21, 19.58, 20.1.*
Basu, A. 82F048: *19.12, 20.1, 21.1.*
Bazin, M. 86A063: *29.24.*
Beaumont, P.C. 86B098: *19.26, 19.49.*
Becker, H.G.O. 85A136: *29.23, 29.24*; 86A508: *29.25, 29.26.*
Becker, J.C. 80N138: *21.1, 22.1.*
Becker, W.G. 84F121: *20.1.*
Belser, P. 81E512: *19.42*; 82S159: *19.2, 19.10, 19.44, 19.51*; 84E462: *19.41, 19.42, 19.50, 19.51*; 85A248: *19.2, 19.42, 19.51, 21.1.*
Bensasson, R.V. 82A306: *29.19.*
Benson, P. 756295: *28.1.*
Benzrogova, E.V. 727386: *28.1.*
Bergaya, F. 85S227: *20.1.*
Bergeron, S.F. 79F173: *9.2, 9.3.*
Berkoff, R. 80A003: *20.1.*
Bernstein, J.S. 81E203: *21.1*; 85F051: *19.27, 19.28, 19.55.*
Bhattacharyya, K. 86A380: *21.1.*
Blaskie, M.W. 80F403: *5.2.*
Blondeel, G. 84E316: *29.24.*
Bock, C.R. 747159: *20.1, 21.1*; 757168: *21.1*; 79C010: *21.1, 22.1.*
Bodunov, E.N. 73E367: *24.4.*
Boettcher, W. 766404: *19.1, 19.11, 19.14, 19.15, 19.16, 19.17, 19.18, 19.19, 19.22, 19.58, 20.1*; 80F058: *20.1, 21.1*; 85F161: *19.11, 19.17, 19.19, 19.58, 20.1.*
Bolletta, F. 737633: *20.1*; 746112: *20.1*; 756325: *4.14, 20.1*; 78F122: *4.14*; 79E270: *4.3, 4.4, 4.5, 4.6, 4.11, 4.12, 4.14, 4.16*; 80F128: *19.58, 20.1*; 83A192: *4.18*; 83E170: *21.1*; 83E317: *4.14, 4.18*; 84A255: *14.10, 19.14, 19.17, 19.58, 20.1*; 84E372: *19.30.*
Bommer, J.C. 86F214: *29.28.*
Bonazzi, A. 84F176: *7.3*; 86E195: *19.13, 19.15, 19.19, 19.36, 19.38, 19.39, 19.42, 19.44, 19.47, 19.48, 19.50, 20.1.*
Bordignon, E. 82A280: *20.1.*
Borgarello, E. 81S157: *29.17.*
Borisevich, Yu.E. 82A389: *29.4, 29.24.*
Bourdelande, J.L. 85S182: *21.1.*
Brandeis, M. 82A353: *28.1.*
Braun, A.M. 81N002: *21.1, 29.17*; 83N178: *19.24*; 85A431: *19.24, 19.25, 19.57, 22.1.*
Brillas, E. 85S182: *21.1.*
Brittain, H.G. 776186: *24.20*; 78E890: *24.6, 24.12*; 79E414: *24.1*; 79E969: *24.9*; 79M270: *24.8, 24.11*; 79M271: *24.13, 24.14*; 81E788: *24.5*; 83E604: *24.2.*
Brubaker, G.R. 83F230: *4.14, 4.18.*
Bruce, D.W. 85F001: *21.1.*
Brugger, P.-A. 80N025: *21.1*; 81N002: *21.1, 29.17*; 82N022: *21.1.*
Brunschwig, B.S. 78F366: *4.1, 4.3, 4.4, 4.6, 4.7, 4.14, 4.18*; 79A183: *19.11, 19.15, 19.17, 19.58, 20.1*; 79F045: *20.1, 21.1*; 83A102: *11.4*; 85A362: *4.18, 20.1*; 85S022: *14.1, 14.2, 14.10,*

19.11, *19.14*, *19.17*, *19.18*, *19.58*, *20.1*; 86A077: *14.18*, *19.17*, *20.1*.
Buckels, H.-W. 83E203: *4.2*.
Bulgakov, R.G. 756452: *28.1*; 77E799: *6.1*, *24.4*.
Burrows, H.D. 766020: *28.1*.
Butler, L.G. 81A344: *16.2*.
Butter, K.R. 84A465: *28.1*; 84F157: *28.1*.
Calvin, M. 86F171: *20.1*.
Camilleri, P. 85F001: *21.1*.
Camps, J. 85S182: *21.1*.
Cano-Yelo, H. 84F159: *19.9*, *21.1*; 84F366: *21.1*; 84F440: *19.9*.
Carapellucci, P.A. 75A245: *29.30*.
Carioli, A. 84B055: *18.13*.
Carroll, F.A. 747293: *11.3*, *29.4*, *29.9*.
Casalbore, G. 80F183: *20.1*.
Caspar, J.V. 84F117: *9.6*; 85E347: *14.3*, *14.6*, *14.7*, *14.8*, *14.9*, *14.10*, *14.11*, *14.15*, *14.16*, *14.17*, *14.18*, *14.19*.
Challal, D. 85S227: *20.1*.
Chan, S.-F. 81N003: *19.11*, *19.14*, *19.17*, *19.58*, *20.1*, *21.1*.
Chandrasekaran, K. 80F208: *20.1*; 85F328: *25.3*.
Chattopadhyay, S.K. 84F005: *20.1*.
Che, C.M. 81A344: *16.2*; 84A306: *14.4*, *14.10*, *19.58*, *20.1*; 86F089: *16.2*.
Cheng, F.C. 84A306: *14.4*, *14.10*, *19.58*, *20.1*.
Cherry, W.R. 85A093: *20.1*.
Chevalier, S. 84N212: *29.17*.
Chibisov, A.K. 727386: *28.1*; 767278: *28.1*; 81F325: *28.1*.
Chiorboli, C. 86A133: *20.1*.
Cho, K.C. 84A306: *14.4*, *14.10*, *19.58*, *20.1*.
Chou, M. 766404: *19.1*, *19.11*, *19.14*, *19.15*, *19.16*, *19.17*, *19.18*, *19.19*, *19.22*, *19.58*, *20.1*; 80E040: *10.1*, *10.2*, *14.1*, *19.11*, *19.17*, *20.1*; 81N003: *19.11*, *19.14*, *19.17*, *19.58*, *20.1*, *21.1*.
Choy, C.L. 84A306: *14.4*, *14.10*, *19.58*, *20.1*.
Chrysochoos, J. 74E518: *24.3*; 74E519: *24.4*; 766551: *24.3*, *24.4*; 79E196: *23.1*.
Chu, D.Y. 85N164: *20.1*, *21.1*, *22.1*.
Ci, X. 86F005: *19.7*.
Ciano, M. 84F176: *7.3*; 86E195: *19.13*, *19.15*, *19.19*, *19.36*, *19.38*, *19.39*, *19.42*, *19.44*, *19.47*, *19.48*, *19.50*, *20.1*.
Cinquantini, A. 78E300: *28.1*.
Clayton, J.S. 85F001: *21.1*.
Cline, J.I.,III 85E012: *19.62*, *19.63*, *19.64*.
Cohen, H. 85F140: *9.2*.
Cole-Hamilton, D.J. 85F001: *21.1*.
Connor, J.A. 79C010: *21.1*, *22.1*.
Constable, E.C. 85E617: *19.23*, *19.32*, *19.45*, *22.1*.
Copeland, R.A. 81E788: *24.5*.
Cosa, J.J. 84E192: *21.1*; 86A165: *21.1*.
Costa, S.M.B. 86N292: *29.18*, *29.23*.
Cox, A. 747132: *28.1*; 756295: *28.1*; 756411: *28.1*.
Creaser, I.I. 85F222: *19.14*, *20.1*, *21.1*, *22.1*.
Creutz, C. 766046: *20.1*; 766404: *19.1*, *19.11*, *19.14*, *19.15*, *19.16*, *19.17*, *19.18*, *19.19*, *19.22*, *19.58*, *20.1*; 776405: *20.1*, *21.1*; 78A087: *19.11*, *19.14*, *19.17*, *19.58*, *20.1*; 79F045: *20.1*, *21.1*; 80E040: *10.1*, *10.2*, *14.1*, *19.11*, *19.17*, *20.1*; 81N003: *19.11*, *19.14*, *19.17*, *19.58*, *20.1*, *21.1*; 82A145: *19.11*, *19.15*, *19.16*, *19.17*, *19.18*, *19.19*, *19.58*, *20.1*, *21.1*, *22.1*; 82A278: *19.1*, *19.11*, *19.14*, *19.15*, *19.16*, *19.18*, *19.19*, *19.58*, *19.62*, *21.1*; 83C017: *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.58*, *21.1*; 84A238: *19.1*, *19.11*, *19.14*, *19.15*, *19.16*, *19.17*, *19.18*, *19.19*, *19.58*, *20.1*; 85S022: *14.1*, *14.2*, *14.10*, *19.11*, *19.14*, *19.17*, *19.18*, *19.58*, *20.1*; 86A077: *14.18*, *19.17*, *20.1*.
Curchod, J.-M. 83N178: *19.24*; 85A431: *19.24*, *19.25*, *19.57*, *22.1*.
Curtis, J.C. 85F051: *19.27*, *19.28*, *19.55*.
Darwent, J.R. 81A042: *21.1*, *22.1*.
Das, P.K. 82A365: *21.1*; 84F005: *20.1*; 86A380: *21.1*.
Degani, Y. 82N119: *19.30*, *21.1*; 85M244: *20.1*; 85N254: *29.20*; 86N119: *21.1*, *29.20*.
DeGraff, B.A. 78F683: *20.1*; 80A233: *20.1*; 84A077: *19.1*, *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.58*, *20.1*; 84A148: *19.11*, *19.14*, *19.17*, *19.18*, *19.19*, *19.58*, *20.1*; 84N034: *19.1*, *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.21*, *19.58*, *20.1*; 84N050: *14.5*, *14.10*, *14.12*, *14.15*, *14.16*, *14.18*; 85E012: *19.62*, *19.63*, *19.64*; 85N199: *19.17*, *19.18*, *19.19*, *19.58*, *19.63*.
Degtyarev, L.S. 84E308: *11.7*.
DeLaive, P.J. 776441: *19.3*, *19.4*, *19.5*, *19.6*, *19.8*, *19.9*, *19.33*, *19.34*, *22.1*; 77F920: *19.3*, *19.4*, *19.5*, *19.6*, *19.8*, *19.9*, *19.33*, *19.34*, *21.1*, *22.1*; 82A022: *20.1*; 85A362: *4.18*, *20.1*.
Dellonte, S. 86E195: *19.13*, *19.15*, *19.19*, *19.36*, *19.38*, *19.39*, *19.42*, *19.44*, *19.47*, *19.48*, *19.50*, *20.1*; 86E832: *7.1*, *7.3*, *24.4*, *24.17*.
de March, P. 85S182: *21.1*.
Demas, J.N. 717111: *20.1*; 737656: *20.1*; 737658: *19.30*, *19.58*, *19.60*, *20.1*; 766319: *19.58*, *20.1*; 776220: *19.30*, *19.60*; 777221: *9.2*, *9.5*, *14.4*, *14.10*, *14.13*, *14.14*, *19.20*, *19.21*, *19.30*, *19.59*, *19.60*, *19.61*, *19.62*, *19.63*; 78F683: *20.1*; 80A233: *20.1*; 83E052: *21.1*; 84A077: *19.1*, *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.58*, *20.1*; 84A148: *19.11*, *19.14*, *19.17*, *19.18*, *19.19*, *19.58*, *20.1*; 84N034: *19.1*, *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.21*, *19.58*, *20.1*; 84N050: *14.5*, *14.10*, *14.12*, *14.15*, *14.16*, *14.18*; 85E012: *19.62*, *19.63*, *19.64*; 85N199: *19.17*, *19.18*, *19.19*, *19.58*, *19.63*.
Deronzier, A. 80A259: *21.1*; 84F159: *19.9*, *21.1*; 84F366: *21.1*; 84F440: *19.9*.
Deschaux, M. 80A331: *28.1*; 81E789: *28.1*.
Di Bernardo, P. 79F334: *28.1*.
Diemente, D. 737658: *19.30*, *19.58*, *19.60*, *20.1*.
Gahan, L.R. 85F222: *19.14*, *20.1*, *21.1*, *22.1*.
Gaines, G.L.,Jr. 79F442: *19.30*, *19.31*, *19.32*, *19.40*, *22.1*.
Gamache, R.E.,Jr. 85E063: *5.3*.

Gandolfi, M.T. 766027: *20.1*; 776252: *4.16*; 83E586: *4.14*; 84A255: *14.10, 19.14, 19.17, 19.58, 20.1*; 85E375: *20.1*.
Garcia, N.A. 84E192: *21.1*; 86A165: *21.1*.
Garrera, H.A. 86A165: *21.1*.
Gaswick, D.C. 83F230: *4.14, 4.18*.
Geiger, T. 82S072: *20.1*.
Gel'fman, M.I. 79E868: *24.4*.
George, M.V. 86A380: *21.1*.
Gershuni, S. 85B030: *19.30, 21.1, 22.1*; 85F140: *9.2*.
Geue, R.J. 85F222: *19.14, 20.1, 21.1, 22.1*.
Ghetti, F. 82A306: *29.19*.
Giannotti, C. 80C004: *20.1*; 86F005: *19.7*.
Giordano, P.J. 79E269: *17.7*.
Giro, G. 80F183: *20.1*.
Gitzel, J. 85F520: *29.22*.
Goldbeck, R.A. 80A270: *18.12*.
Goldberg, M. 85A362: *4.18, 20.1*.
Golovkina, M.T. 79E768: *24.4*.
Goodwin, H.A. 83N214: *19.53, 19.54, 19.72*.
Goodwin, K.V. 85E277: *5.2*.
Goren, Z. 86N119: *21.1, 29.20*.
Graetzel, C.K. 80U077: *20.1*; 82N068: *21.1, 29.19*.
Graetzel, M. 777296: *21.1*; 78A215: *20.1*; 80A074: *29.17*; 80N025: *21.1*; 80U077: *20.1*; 81N002: *21.1, 29.17*; 81S157: *29.17*; 82N022: *21.1*; 82N068: *21.1, 29.19*; 82S072: *20.1*; 83N158: *29.17*.
Gray, H.B. 80A270: *18.12*; 81A315: *17.8*; 81A344: *16.2*; 82A022: *20.1*; 82A280: *20.1*; 83F069: *12.1*; 84F117: *9.6*; 85A362: *4.18, 20.1*; 85E779: *9.6, 16.2*.
Greiner, G. 86A140: *22.1*.
Grutsch, P.A. 86A158: *9.3*.
Gruzdev, V.P. 80E879: *6.1, 6.2, 6.3, 6.4, 23.1, 23.2, 23.3, 24.4, 24.16*.
Gsponer, H.E. 84E192: *21.1*; 86A165: *21.1*.
Guarr, T. 82N022: *21.1*.
Gutierrez, A.R. 767528: *21.1*; 79C010: *21.1, 22.1*.
Haga, M.-A. 85E218: *19.24, 20.1*.
Haim, A. 78E293: *20.1, 21.1*; 80F058: *20.1, 21.1*; 81A250: *14.1, 20.1*; 85F161: *19.11, 19.17, 19.19, 19.58, 20.1*.
Hama, Y. 84B008: *26.1*.
Hammond, G.S. 767179: *20.1*; 80A287: *3.1*.
Harriman, A. 79A218: *20.1*; 79F712: *29.23, 29.24*; 80E669: *29.27, 29.28*; 81A188: *11.8, 11.9*; 81F164: *29.17*; 81N178: *20.1*; 82A161: *29.7, 29.17, 29.29*; 83A133: *15.6, 25.1, 25.2, 29.17, 29.19*; 83F182: *1.2, 2.2, 4.19, 5.6, 11.11, 15.8, 19.70*; 84E316: *29.24*.
Harris, E.W. 737658: *19.30, 19.58, 19.60, 20.1*; 776220: *19.30, 19.60*; 777221: *9.2, 9.5, 14.4, 14.10, 14.13, 14.14, 19.20, 19.21, 19.30, 19.59, 19.60, 19.61, 19.62, 19.63*.
Dilung, I.I. 80F472: *29.14*; 82E636: *1.3, 11.7, 11.11*; 83E101: *11.12*.
Di Marco, P.G. 80F183: *20.1*.
Dodsworth, E.S. 85E218: *19.24, 20.1*.
Doerr, G. 83N178: *19.24*; 85A431: *19.24, 19.25, 19.57, 22.1*.
Dressick, W.J. 82S130: *14.6*; 82S163: *20.1*; 84A148: *19.11, 19.14, 19.17, 19.18, 19.19, 19.58, 20.1*; 84N034: *19.1, 19.11, 19.14, 19.15, 19.17, 19.18, 19.19, 19.21, 19.58, 20.1*; 84N050: *14.5, 14.10, 14.12, 14.15, 14.16, 14.18*; 85E012: *19.62, 19.63, 19.64*; 85E347: *14.3, 14.6, 14.7, 14.8, 14.9, 14.10, 14.11, 14.15, 14.16, 14.17, 14.18, 14.19*; 86S121: *14.6*.
Duerr, H. 83N178: *19.24*; 85A431: *19.24, 19.25, 19.57, 22.1*.
Durham, B. 82S163: *20.1*.
Dzhagarov, B.M. 81E738: *2.1, 5.5, 15.2, 29.6*.
Ebbesen, T. 82A306: *29.19*.
Edel, A. 84S117: *5.3*.
Einaga, H. 85A470: *20.1*.
Endicott, J.F. 737081: *20.1*; 73F673: *20.1*; 83F230: *4.14, 4.18*; 86E096: *19.30, 20.1*.
Endo, E. 83A333: *20.1*.
English, A.M. 82A022: *20.1*; 85A362: *4.18, 20.1*.
Ennis, P.M. 86S150: *20.1, 22.1*.
Ermolaev, V.L. 68E121: *28.1*; 69E237: *7.1, 24.4*; 706153: *6.1, 7.1, 7.5, 7.6, 7.7, 7.8, 7.9, 24.4, 24.15*; 71E390: *24.4*; 72E317: *24.4, 24.19*; 73F674: *24.4*; 75E531: *24.4*.
Eryavec, G. 85E218: *19.24, 20.1*.
Favaro, G. 86E677: *20.1*.
Feitelson, J. 82E152: *29.9*; 84F091: *29.8*; 86E020: *29.12*.
Feldberg, S.W. 83A102: *11.4*.
Ferraudi, G. 81A335: *4.14*; 82C018: *19.67*; 83E262: *19.66, 19.67*.
Ferreira, M.I.C. 79A218: *20.1*.
Fife, D.J. 85F395: *5.1*.
Finkenberg, E. 78A058: *14.4*.
Fisher, P. 78A058: *14.4*.
Fitzpatrick, L.J. 83N214: *19.53, 19.54, 19.72*.
Folcher, G. 84A264: *29.15*; 86A174: *29.15*.
Font, J. 85S182: *21.1*.
Ford, P.C. 84A141: *18.5, 18.6*; 85F123: *18.1, 18.3*.
Foreman, T.K. 80C004: *20.1*.
Formosinho, S.J. 766020: *28.1*; 85N143: *28.1*.
Frank, R. 82N184: *20.1*; 83E621: *20.1*; 86A140: *22.1*.
Fredericks, S.M. 80F316: *17.3, 17.4*.
Frink, M.E. 84A141: *18.5, 18.6*; 85F123: *18.1, 18.3*.
Fripiat, J.J. 85S227: *20.1*.
Fukuda, R.C. 80E074: *18.5, 18.9*.
Fukuzumi, S. 83C021: *18.11*; 83F105: *18.11*; 84F351: *21.1*.
Furlong, D.N. 85N094: *21.1*.
Gafney, H.D. 77F726: *20.1*; 78A058: *14.4*; 80A003: *20.1*; 82F048: *19.12, 20.1, 21.1*; 82F065: *20.1*; 84E347: *19.65*.
Hauenstein, B.L.,Jr. 84A077: *19.1, 19.11, 19.14, 19.15, 19.17, 19.18, 19.19, 19.58, 20.1*; 84A148:

19.11, *19.14*, *19.17*, *19.18*, *19.19*, *19.58*, *20.1*; 84N034: *19.1*, *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.21*, *19.58*, *20.1*.
Hawecker, J. 86F230: *17.5*, *20.1*, *21.1*.
Hebert, E.J. 84E074: *16.2*.
Heeg, M.J. 83F230: *4.14*, *4.18*.
Hendren, R.W. 707320: *11.1*, *11.2*, *11.3*, *29.1*, *29.2*, *29.3*, *29.4*, *29.5*.
Henry, M.S. 78F122: *4.14*; 79E270: *4.3*, *4.4*, *4.5*, *4.6*, *4.11*, *4.12*, *4.14*, *4.18*; 83A192: *4.18*.
Hersey, M.W. 83E110: *4.14*.
Heuer, W.B. 84E074: *16.2*.
Hidaka, J. 85A470: *20.1*.
Hill, R.J. 747132: *28.1*.
Hironaka, K. 83C021: *18.11*; 84F351: *21.1*.
Hoffman, M.Z. 78F122: *4.14*; 79E270: *4.3*, *4.4*, *4.5*, *4.6*, *4.11*, *4.12*, *4.14*, *4.18*; 81E458: *4.1*, *4.3*, *4.4*, *4.5*, *4.6*, *4.7*, *4.8*, *4.11*, *4.12*, *4.13*, *4.14*, *4.18*; 83A192: *4.18*; 83E317: *4.14*, *4.18*; 85A191: *22.1*; 86A120: *19.24*.
Hoselton, M.A. 78A090: *14.2*, *14.4*, *19.1*, *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.22*, *19.58*, *20.1*.
Hoshino, M. 84B008: *26.1*; 85A013: *8.2*, *8.5*; 86A325: *18.15*, *18.17*; 86F247: *8.3*.
Houlding, V. 82S072: *20.1*.
Huang, S.-M.Y. 77F726: *20.1*; 78A058: *14.4*.
Hurst, J.K. 83N158: *29.17*.
Ida, H. 86F247: *8.3*.
Ihama, M. 81F381: *21.1*; 84F069: *21.1*; 85F228: *21.1*.
Ikeda, S. 74F655: *28.1*; 766201: *28.1*; 77E693: *28.1*; 77E694: *28.1*.
Ikezawa, H. 86F060: *21.1*.
Imamura, M. 84B008: *26.1*.
Indelli, A. 83S001: *20.1*.
Indelli, M.T. 78E518: *4.14*, *9.1*, *21.1*; 84B055: *18.13*; 86E555: *9.4*, *16.3*.
Infelta, P.P. 78A215: *20.1*; 81N002: *21.1*, *29.17*.
Inoue, H. 85F328: *25.3*.
Ishikawa, M. 85A470: *20.1*.
Ishitani, O. 84F069: *21.1*; 85F228: *21.1*.
Ito, T. 82A068: *20.1*.
Iyoda, T. 85E075: *19.31*, *19.32*.
Izaki, K. 85E075: *19.31*, *19.32*.
Jamieson, M.A. 79E270: *4.3*, *4.4*, *4.5*, *4.6*, *4.11*, *4.12*, *4.14*, *4.18*; 81E458: *4.1*, *4.3*, *4.4*, *4.5*, *4.6*, *4.7*, *4.8*, *4.11*, *4.12*, *4.13*, *4.14*, *4.18*; 83A192: *4.18*; 83E110: *4.14*; 83E317: *4.14*, *4.18*.
Johansen, O. 80S001: *19.35*, *21.1*, *22.1*; 83A008: *21.1*; 85N094: *21.1*.
Jonah, C.D. 78A070: *20.1*.
Jones, G.,II 85E687: *21.1*, *22.1*.
Joshi, B.D. 746333: *7.2*, *7.4*.
Juris, A. 766027: *20.1*; 776252: *4.16*; 78F263: *4.14*, *14.4*; 80F128: *19.58*, *20.1*; 81E512: *19.42*; 82S159: *19.2*, *19.10*, *19.44*, *19.51*.
Kagan, H.B. 78A392: *21.1*; 80U059: *22.1*.
Kaizu, Y. 85F008: *20.2*.
Kaji, N. 85F030: *29.10*.
Kalyanasundaram, K. 80A074: *29.17*; 80U077: *20.1*; 81A042: *21.1*, *22.1*; 81S157: *29.17*; 82A111: *20.1*, *21.1*, *22.1*; 83E462: *29.21*; 85A161: *16.2*; 86A134: *19.24*.
Kane-Maguire, N.A.P. 83E674: *18.10*.
Kapinus, E.I. 80F472: *29.14*; 81F368: *8.4*; 82E636: *1.3*, *11.7*, *11.11*; 83E101: *11.12*; 84E308: *11.7*.
Karyakin, A.V. 727386: *28.1*; 767278: *28.1*.
Kato, S. 82A290: *29.11*; 83E088: *1.1*; 84A122: *1.1*, *8.1*, *11.6*, *29.11*; 84A272: *11.6*, *29.11*; 84E387: *4.12*, *4.14*.
Kawanishi, Y. 83E209: *19.25*, *19.57*; 83F371: *19.24*, *19.25*, *19.26*, *19.57*, *22.1*.
Kazakov, V.P. 756452: *28.1*; 77E799: *6.1*, *24.4*.
Keller, A.D. 82A145: *19.11*, *19.15*, *19.16*, *19.17*, *19.18*, *19.19*, *19.58*, *20.1*, *21.1*, *22.1*.
Keller, P. 78A392: *21.1*; 80A247: *21.1*, *22.1*; 80U059: *22.1*.
Kelly, J.M. 86S150: *20.1*, *22.1*.
Kemp, T.J. 747132: *28.1*; 756295: *28.1*; 756411: *28.1*; 78E300: *28.1*; 79F334: *28.1*; 83E223: *4.14*, *4.18*, *16.3*, *19.58*, *20.1*, *28.1*; 84A465: *28.1*; 84A504: *19.46*, *19.52*; 84F157: *28.1*; 86A101: *28.1*; 86F357: *28.1*.
Kim-Thuan, N. 81A139: *19.17*, *22.1*.
Kimura, M. 85A062: *20.1*; 85F089: *20.1*.
Kirch, M. 79F206: *20.1*.
Kirchhoff, J.R. 85E277: *5.2*.
Kirk, A.D. 80E566: *20.1*; 82F278: *4.17*.
Kirsch-de Mesmaeker, A. 85F572: *19.69*; 85S015: *19.56*, *19.69*.
Kisch, H. 86A133: *20.1*.
Kita, T. 85F030: *29.10*.
Kitamura, N. 82A189: *21.1*; 83E209: *19.25*, *19.57*; 83F371: *19.24*, *19.25*, *19.26*, *19.57*, *22.1*.
Kliger, D.S. 767179: *20.1*; 80A270: *18.12*.
Kobayashi, H. 85F008: *20.2*.
Kobayashi, T. 84A272: *11.6*, *29.11*; 86S089: *11.10*.
Kober, E.M. 85E347: *14.3*, *14.6*, *14.7*, *14.8*, *14.9*, *14.10*, *14.11*, *14.15*, *14.16*, *14.17*, *14.18*, *14.19*.
Koelle, U. 82S072: *20.1*.
Koulkes-Pujo, A.M. 86A174: *29.15*.
Krause, K. 84E347: *19.65*.
Krause, R.A. 84E347: *19.65*.
Krishnan, C.V. 82A278: *19.1*, *19.11*, *19.14*, *19.15*, *19.16*, *19.18*, *19.19*, *19.58*, *19.62*, *21.1*; 83C017: *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.58*, *21.1*; 85S022: *14.1*, *14.2*, *14.10*, *19.11*, *19.14*, *19.17*, *19.18*, *19.58*, *20.1*.
Krist, K. 80A003: *20.1*; 82F065: *20.1*.
Krueger, R. 86A508: *29.25*, *29.26*.
Krug, W.P. 83E052: *21.1*.
Kumar, C.V. 84F005: *20.1*; 85R098: *19.21*, *19.58*, *20.1*.
Kurimura, Y. 80F402: *20.1*; 81F401: *20.1*; 83A333: *20.1*.
Kutal, C. 86A158: *9.3*; 86F060: *21.1*.

Kuwabara, A. 86A072: *29.17*.
Kuz'min, V.A. 82A389: *29.4*, *29.24*.
Langford, C.H. 83E110: *4.14*.
Larson, M. 80E074: *18.5*, *18.9*; 82E073: *18.2*, *18.4*.
Lattanzi, G. 86E832: *7.1*, *7.3*, *24.4*, *24.17*.
Launikonis, A. 80S001: *19.35*, *21.1*, *22.1*; 82S257: *21.1*, *22.1*; 83N214: *19.53*, *19.54*, *19.72*; 85F222: *19.14*, *20.1*, *21.1*, *22.1*; 85N094: *21.1*; 86F456: *21.1*.
Laurence, G.S. 746396: *20.1*.
Lay, P.A. 85F222: *19.14*, *20.1*, *21.1*, *22.1*.
Lee, J.T. 776441: *19.3*, *19.4*, *19.5*, *19.6*, *19.8*, *19.9*, *19.33*, *19.34*, *22.1*; 77F920: *19.3*, *19.4*, *19.5*, *19.6*, *19.8*, *19.9*, *19.33*, *19.34*, *21.1*, *22.1*.
Lee, L.Y.C. 83N158: *29.17*; 86F005: *19.7*.
Lee, P.C. 82N117: *21.1*.
Lee, P.H.P. 80A287: *3.1*.
Lee, W.-M. 86F089: *16.2*.
Lees, A.J. 80F384: *27.1*.
Lehmann, T. 85A136: *29.23*, *29.24*.
Lehn, J.-M. 79F206: *20.1*; 86F230: *17.5*, *20.1*, *21.1*.
Leopold, K.R. 78E293: *20.1*, *21.1*.
Lerebours, B. 84N212: *29.17*.
Le Roux, D. 84A264: *29.15*; 85A430: *29.15*.
Levanon, H. 82A279: *29.19*.
Lever, A.B.P. 82F217: *18.16*; 85E218: *19.24*, *20.1*.
Levin, G. 79A220: *11.11*, *29.23*, *29.24*.
Levshin, L.V. 767278: *28.1*.
Lichtin, N.N. 82A290: *29.11*.
Licoccia, S. 82F217: *18.16*.
Lin, C-T. 766014: *14.4*, *20.1*; 766404: *19.1*, *19.11*, *19.14*, *19.15*, *19.16*, *19.17*, *19.18*, *19.19*, *19.22*, *19.58*, *20.1*; 78A090: *14.2*, *14.4*, *19.1*, *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.22*, *19.58*, *20.1*.
Linschitz, H. 60A002: *29.24*; 60E006: *29.24*.
Liu, D.K. 86A077: *14.18*, *19.17*, *20.1*.
Loder, J.W. 82S257: *21.1*, *22.1*; 85N094: *21.1*.
Lopes, J.M.F.M. 86N292: *29.18*, *29.23*.
Lopp, I.G. 68A001: *11.2*, *29.3*; 707320: *11.1*, *11.2*, *11.3*, *29.1*, *29.2*, *29.3*, *29.4*, *29.5*.
Lotnik, S.V. 756452: *28.1*.
Lum, V.R. 82A022: *20.1*.
Luong, J.C. 78E397: *17.2*, *17.6*.
Lydon, J.D. 85F222: *19.14*, *20.1*, *21.1*, *22.1*.
Lyubimov, E.I. 79E768: *24.4*.
MacKenzie, D. 83F069: *12.1*.
Maecke, H. 80E074: *18.5*, *18.9*; 82E073: *18.2*, *18.4*.
Maestri, M. 737633: *20.1*; 746112: *20.1*; 756325: *4.14*, *20.1*; 777296: *21.1*; 78A215: *20.1*; 78F122: *4.14*; 78F263: *4.14*, *14.4*; 79E270: *4.3*, *4.4*, *4.5*, *4.6*, *4.11*, *4.12*, *4.14*, *4.18*; 80F128: *19.58*, *20.1*; 81E237: *19.60*; 83A192: *4.18*; 83E586: *4.14*; 84A255: *14.10*, *19.14*, *19.17*, *19.58*, *20.1*; 84E372: *19.30*; 84E462: *19.41*, *19.42*, *19.50*, *19.51*; 84F249: *4.14*; 85A248: *19.2*, *19.42*, *19.51*, *21.1*.
Maetens, D. 85F572: *19.69*; 85S015: *19.56*, *19.69*.
Magde, D. 84A141: *18.5*, *18.6*.
Magon, L. 78E300: *28.1*.
Mahajan, D. 82A278: *19.1*, *19.11*, *19.14*, *19.15*, *19.16*, *19.18*, *19.19*, *19.58*, *19.62*, *21.1*.
Malba, V. 85E687: *21.1*, *22.1*.
Malin, J.M. 80F334: *20.1*.
Maliyackel, A.C. 86F171: *20.1*.
Mandal, K. 83E052: *21.1*; 84A077: *19.1*, *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.58*, *20.1*; 85A191: *22.1*.
Manfrin, M.F. 766027: *20.1*; 78F263: *4.14*, *14.4*.
Marcantonatos, M.D. 80A331: *28.1*; 81E789: *28.1*.
Margerum, L.D. 86A052: *19.43*.
Markham, J. 736244: *21.1*.
Marnot, P.A. 84S117: *5.3*.
Marshall, J.L. 82S130: *14.6*; 85E347: *14.3*, *14.6*, *14.7*, *14.8*, *14.9*, *14.10*, *14.11*, *14.15*, *14.16*, *14.17*, *14.18*, *14.19*; 85E779: *9.6*, *16.2*; 86S121: *14.6*.
Martins, M.J.T. 86N292: *29.18*, *29.23*.
Matheson, M.S. 776406: *20.1*; 78A070: *20.1*; 78A219: *20.1*, *21.1*; 82N117: *21.1*.
Matsubara, T. 81N003: *19.11*, *19.14*, *19.17*, *19.58*, *20.1*, *21.1*.
Matsuda, M. 81F266: *21.1*; 83N153: *19.21*, *19.58*; 85F408: *21.1*.
Matsuo, T. 78A269: *19.58*, *21.1*; 80N125: *19.37*; 80N169: *19.37*; 81S011: *21.1*, *22.1*; 85F007: *21.1*; 86N075: *29.16*, *29.17*.
Mau, A.W.-H. 80S001: *19.35*, *21.1*, *22.1*; 82S257: *21.1*, *22.1*; 83A008: *21.1*; 83N214: *19.53*, *19.54*, *19.72*; 85F222: *19.14*, *20.1*, *21.1*, *22.1*; 85N094: *21.1*; 86F456: *21.1*.
Mauzerall, D.C. 75A245: *29.30*; 80A023: *29.9*; 82E152: *29.9*.
Maverick, A.W. 83F069: *12.1*.
Mayer, E. 85A431: *19.24*, *19.25*, *19.57*, *22.1*.
Mayo, S.L. 85A362: *4.18*, *20.1*.
McBride, R.P. 777221: *9.2*, *9.5*, *14.4*, *14.10*, *14.13*, *14.14*, *19.20*, *19.21*, *19.30*, *19.59*, *19.60*, *19.61*, *19.62*, *19.63*.
McCarthy, M.G. 85F222: *19.14*, *20.1*, *21.1*, *22.1*.
McLendon, G. 82N022: *21.1*.
McMillin, D.R. 80F403: *5.2*; 85E063: *5.3*; 85E277: *5.2*.
Meares, C.F. 81E787: *24.7*, *24.18*.
Meisel, D. 776406: *20.1*; 78A070: *20.1*; 78A219: *20.1*, *21.1*; 82N117: *21.1*.
Mercer-Smith, J.A. 78A101: *15.4*, *15.8*, *16.4*; 79E349: *15.8*.
Meyer, T.J. 747159: *20.1*, *21.1*; 757168: *21.1*; 767009: *7.5*, *15.4*, *19.30*, *19.58*, *19.68*, *20.1*, *22.1*; 767528: *21.1*; 776441: *19.3*, *19.4*, *19.5*, *19.6*, *19.8*, *19.9*, *19.33*, *19.34*, *22.1*; 777106: *21.1*; 77F920: *19.3*, *19.4*, *19.5*, *19.6*, *19.8*, *19.9*, *19.33*, *19.34*, *21.1*, *22.1*; 79C010: *21.1*, *22.1*; 80A259: *21.1*; 81C001: *19.71*; 81E203: *21.1*; 82S130: *14.6*; 82S163: *20.1*; 85E347: *14.3*, *14.6*, *14.7*, *14.8*, *14.9*, *14.10*, *14.11*, *14.15*, *14.16*, *14.17*, *14.18*, *14.19*; 85F051: *19.27*, *19.28*, *19.55*; 86A052: *19.43*; 86S121: *14.6*.
Meyerstein, D. 78A219: *20.1*, *21.1*; 85F140: *9.2*.
Mialocq, J.C. 84A264: *29.15*; 85A430: *29.15*;

86A174: *29.15.*
Miedlar, K. 82A365: *21.1.*
Miguel, M.G. 766020: *28.1*; 85N143: *28.1.*
Milder, S.J. 80A270: *18.12.*
Miller, D.B. 83E674: *18.10.*
Miller, P.K. 83E674: *18.10.*
Mironov, A.F. 82A389: *29.4, 29.24.*
Miyama, H. 86A072: *29.17.*
Miyashita, T. 81F266: *21.1*; 83N153: *19.21, 19.58*; 85F408: *21.1.*
Miyauchi, Y. 81F381: *21.1*; 84F069: *21.1*; 85F228: *21.1.*
Moggi, L. 736183: *4.15*; 737633: *20.1*; 746112: *20.1*; 756325: *4.14, 20.1*; 78F122: *4.14*; 83A192: *4.18*; 84F249: *4.14.*
Mok, C.-Y. 84A238: *19.1, 19.11, 19.14, 19.15, 19.16, 19.17, 19.18, 19.19, 19.58, 20.1.*
Moore, W.M. 85F395: *5.1.*
Moradpour, A. 78A392: *21.1*; 80A247: *21.1, 22.1*; 80U059: *22.1.*
Mori, T. 85F008: *20.2.*
Moriyasu, M. 74F655: *28.1*; 766201: *28.1*; 77E693: *28.1*; 77E694: *28.1.*
Morse, D.L. 746021: *17.1*; 756002: *20.1.*
Morse, K.W. 85F395: *5.1.*
Muneer, M. 86A380: *21.1.*
Murakata, T. 83N153: *19.21, 19.58.*
Muraki, Y. 81F401: *20.1.*
Muralidharan, S. 81A335: *4.14.*
Murray, R.W. 86A052: *19.43.*
Myasoedov, B.F. 727386: *28.1.*
Nadjo, L. 78E397: *17.2, 17.6.*
Nagamura, T. 80N169: *19.37*; 81S011: *21.1, 22.1*; 86N075: *29.16, 29.17.*
Nagle, J.K. 79C010: *21.1, 22.1*; 81C001: *19.71*; 81E203: *21.1*; 84E074: *16.2.*
Nahor, G.S. 85F141: *29.18, 29.19.*
Najdzionek, J.S. 83F069: *12.1.*
Napier, G.D.R. 756252: *24.15.*
Nasielski-Hinkens, R. 85F572: *19.69*; 85S015: *19.56, 19.69.*
Natarajan, P. 737081: *20.1*; 73F673: *20.1*; 80F208: *20.1.*
Navon, G. 747635: *20.1.*
Neilson, J.D. 756252: *24.15*; 766073: *24.15.*
Nemodruk, A.A. 727386: *28.1.*
Neta, P. 82A279: *29.19.*
Netzel, T.L. 80E040: *10.1, 10.2, 14.1, 19.11, 19.17, 20.1*; 81A250: *14.1, 20.1.*
Neumann-Spallart, M. 80U077: *20.1*; 82A111: *20.1, 21.1, 22.1.*
Neyhart, G.A. 82S130: *14.6*; 86S121: *14.6.*
Nikitin, V.P. 79E768: *24.4.*
Nikitina, S.A. 84E828: *28.1.*
Nishida, S. 85A062: *20.1*; 85F089: *20.1.*
Nishijima, T. 80N125: *19.37*; 81S011: *21.1, 22.1.*
Nishizawa, N. 83C021: *18.11*; 83F105: *18.11.*
Nocera, D.G. 81A315: *17.8*; 82A280: *20.1*; 83F069: *12.1.*
Nosaka, Y. 86A072: *29.17.*
Ochiai, E.-I. 86F346: *22.1.*
O'Connell, C.M. 86S150: *20.1, 22.1.*
Ogata, Y. 82F153: *21.1.*
Ohno, T. 82A290: *29.11*; 83E088: *1.1*; 84A122: *1.1, 8.1, 11.6, 29.11*; 84A272: *11.6, 29.11*; 84E387: *4.12, 4.14*; 85F184: *18.7, 18.8, 18.13, 18.14*; 86S089: *11.10.*
Ohsako, T. 85F007: *21.1.*
Ohsawa, Y. 80E224: *14.1, 14.4, 14.10, 19.14, 20.1.*
Ohtani, H. 84A272: *11.6, 29.11*; 86S089: *11.10.*
Okamoto, K. 85A470: *20.1.*
Okano, S. 82A189: *21.1.*
Okumura, M. 80E040: *10.1, 10.2, 14.1, 19.11, 19.17, 20.1.*
Okuno, Y. 81S157: *29.17.*
Okura, I. 81A139: *19.17, 22.1*; 85A101: *29.10*; 85F030: *29.10*; 85F520: *29.22.*
Ollino, M. 85A093: *20.1.*
Onimura, R. 80F402: *20.1.*
Otruba, J.P. 86S121: *14.6.*
Otvos, J.W. 86F171: *20.1.*
Pac, C. 81F381: *21.1*; 84F069: *21.1*; 85F228: *21.1.*
Page, A.G. 746333: *7.2, 7.4.*
Parsons, B.J. 86B098: *19.26, 19.49.*
Patel, B.M. 746333: *7.2, 7.4.*
Pdungsap, L. 756002: *20.1.*
Pearson, T.D.L. 83E052: *21.1.*
Pekkarinen, L. 60A002: *29.24*; 60E006: *29.24.*
Perathoner, S. 86E832: *7.1, 7.3, 24.4, 24.17.*
Peterson, J.R. 85A161: *16.2.*
Peterson, S.H. 776220: *19.30, 19.60.*
Phillips, G.O. 86B098: *19.26, 19.49.*
Pileni, M.P. 80N143: *29.24*; 84N212: *29.17.*
Pilling, M.J. 80A308: *19.1, 19.15, 19.17, 19.58, 20.1*; 81A031: *19.15, 19.17, 19.58, 20.1*; 85E617: *19.23, 19.32, 19.45, 22.1.*
Pinto Coelho, F. 766020: *28.1.*
Porter, G. 79F712: *29.23, 29.24*; 81A188: *11.8, 11.9*; 81F164: *29.17*; 81N178: *20.1*; 83A133: *15.6, 25.1, 25.2, 29.17, 29.19*; 83F182: *1.2, 2.2, 4.19, 5.6, 11.11, 15.8, 19.70*; 84E316: *29.24.*
Porter, G.B. 80E566: *20.1*; 80F228: *20.2.*
Potter, W. 79A220: *11.11, 29.23, 29.24.*
Poulos, A.T. 80A287: *3.1.*
Prasad, D.R. 82C018: *19.67*; 83E262: *19.66, 19.67*; 85A191: *22.1*; 86A120: *19.24.*
Previtali, C.M. 84E192: *21.1*; 86A165: *21.1.*
Privalova, T.A. 79E868: *24.4.*
Puaux, J.P. 80E074: *18.5, 18.9*; 84E097: *4.9, 4.10.*
Pyke, S.C. 83F230: *4.14, 4.18.*
Rabani, J. 78A219: *20.1, 21.1*; 80A133: *19.30*; 80A291: *20.1, 28.1*; 82A353: *28.1*; 82N118: *21.1*; 85A387: *19.29*; 85B030: *19.30, 21.1, 22.1*; 85F140: *9.2*; 85F141: *29.18, 29.19*; 86A057: *9.2.*
Rader, R.A. 85E063: *5.3.*
Raines, D.E. 85N199: *19.17, 19.18, 19.19, 19.58, 19.60.*
Ramasami, T. 83F230: *4.14, 4.18.*

Ramaswamy, B.S. 82F217: *18.16.*
Raney, K.W. 84N050: *14.5, 14.10, 14.12, 14.15, 14.16, 14.18.*
Ratz, R. 83A402: *21.2, 21.3.*
Rau, H. 82N184: *20.1*; 83A402: *21.2, 21.3*; 83E621: *20.1*; 86A140: *22.1.*
Reed, J.L. 84E097: *4.9, 4.10.*
Renge, I.V. 82A389: *29.4, 29.24.*
Riccieri, P. 84E097: *4.9, 4.10.*
Richardson, F.S. 776186: *24.20*; 80E072: *24.10.*
Richoux, M.-C. 80E669: *29.27, 29.28*; 81A188: *11.8, 11.9*; 81F164: *29.17*; 82A161: *29.7, 29.17, 29.29.*
Rieger, P.T. 85N199: *19.17, 19.18, 19.19, 19.58, 19.63.*
Rillema, D.P. 81C001: *19.71.*
Rodgers, M.A.J. 80N138: *21.1, 22.1.*
Rodman, G.S. 84E074: *16.2.*
Romanovskaya, G.I. 81F325: *28.1.*
Rosenfeld-Gruenwald, T. 80A291: *20.1, 28.1*; 82A353: *28.1.*
Rossi, R. 78E300: *28.1.*
Rougee, M. 82A306: *29.19.*
Roy, J.K. 72E284: *29.4*; 747293: *11.3, 29.4, 29.9.*
Rumfeldt, R.C. 82E073: *18.2, 18.4.*
Rybak, W. 81A250: *14.1, 20.1.*
Rygalov, L.N. 727386: *28.1.*
Sabbatini, N. 84F176: *7.3*; 86E195: *19.13, 19.15, 19.19, 19.36, 19.38, 19.39, 19.42, 19.44, 19.47, 19.48, 19.50, 20.1*; 86E832: *7.1, 7.3, 24.4, 24.17.*
Saito, K. 82A068: *20.1.*
Saji, T. 80E224: *14.1, 14.4, 14.10, 19.14, 20.1.*
Sakamoto, T. 85F007: *21.1.*
Sakurai, H. 81F381: *21.1*; 84F069: *21.1.*
Salama, S. 80E072: *24.10.*
Salmon, D.J. 777106: *21.1.*
Salokhiddinov, K.I. 81E738: *2.1, 5.5, 15.2, 29.6.*
Sandrini, D. 776252: *4.16*; 80F128: *19.58, 20.1*; 81E237: *19.60*; 83E586: *4.14*; 84A255: *14.10, 19.14, 19.17, 19.58, 20.1*; 84E372: *19.30*; 84E462: *19.41, 19.42, 19.50, 19.51*; 84F249: *4.14*; 85A248: *19.2, 19.42, 19.51, 21.1.*
Santus, R. 86A063: *29.24.*
Sapunov, V.V. 74E520: *5.4, 11.6, 15.1, 15.5*; 76E693: *11.6, 15.1, 15.3, 29.13, 29.24*; 85F493: *15.1.*
Sargeson, A.M. 85F222: *19.14, 20.1, 21.1, 22.1.*
Sasaki, Y. 82A068: *20.1.*
Sasse, W.H.F. 80S001: *19.35, 21.1, 22.1*; 82S257: *21.1, 22.1*; 83A008: *21.1*; 83N214: *19.53, 19.54, 19.72*; 85F222: *19.14, 20.1, 21.1, 22.1*; 85N094: *21.1*; 86F456: *21.1.*
Sassoon, R.E. 80A133: *19.30*; 82N118: *21.1*; 85A387: *19.29*; 85B030: *19.30, 21.1, 22.1.*
Sauvage, J.P. 79F206: *20.1*; 84S117: *5.3.*
Scandola, F. 767517: *4.14*; 78E518: *4.14, 9.1, 21.1*; 83S001: *20.1*; 84B055: *18.13*; 86A133: *20.1*; 86E555: *9.4, 16.3.*
Scandola, M.A.R. 83S001: *20.1.*
Schettler, P.D.,Jr. 86F346: *22.1.*
Schindler, J.W. 82E553: *16.1.*
Schmehl, R.H. 79E349: *15.8*; 81N147: *15.7*; 85E552: *15.7.*
Schuetz, R. 85A136: *29.23, 29.24*; 86A508: *29.25, 29.26.*
Schwarz, H.A. 78A090: *14.2, 14.4, 19.1, 19.11, 19.14, 19.15, 19.17, 19.18, 19.19, 19.22, 19.58, 20.1*; 82A278: *19.1, 19.11, 19.14, 19.15, 19.16, 19.18, 19.19, 19.58, 19.62, 21.1*; 83C017: *19.11, 19.14, 19.15, 19.17, 19.18, 19.19, 19.58, 21.1.*
Searle, N. 79F712: *29.23, 29.24.*
Seddon, K.R. 85E617: *19.23, 19.32, 19.45, 22.1.*
Seki, H. 85A013: *8.2, 8.5*; 86A325: *18.15, 18.17.*
Sergeeva, G.I. 767278: *28.1.*
Serpone, N. 78F263: *4.14, 14.4*; 79E270: *4.3, 4.4, 4.5, 4.6, 4.11, 4.12, 4.14, 4.18*; 81E458: *4.1, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.11, 4.12, 4.13, 4.14, 4.18*; 83A192: *4.18*; 83E110: *4.14*; 83E317: *4.14, 4.18.*
Sexton, D. 84A141: *18.5, 18.6.*
Seymour, P. 85E218: *19.24, 20.1.*
Shablya, A.V. 75E542: *13.1.*
Shaffer, D.I. 86F346: *22.1.*
Shagisultanova, G.A. 83A403: *4.14, 14.4, 20.1*; 83E719: *4.14, 14.4, 20.1*; 85A469: *4.14, 9.2, 14.4, 20.1, 28.1.*
Shah, J. 80E664: *24.4.*
Shakhverdov, P.A. 65A001: *11.5, 11.6*; 67A003: *29.23, 29.24.*
Shakhverdov, T.A. 72E317: *24.4, 24.19*; 73E367: *24.4*; 73E368: *7.1, 24.4.*
Shand, M.A. 86A101: *28.1*; 86F357: *28.1.*
Shepherd, T.M. 756252: *24.15*; 766073: *24.15.*
Shimidzu, T. 85E075: *19.31, 19.32.*
Shizuka, H. 85A013: *8.2, 8.5*; 86A325: *18.15, 18.17.*
Shuto, Y. 78A269: *19.58, 21.1.*
Skuridin, E.Yu. 84E308: *11.7.*
Slama-Schwok, A. 85F140: *9.2*; 86A057: *9.2.*
Smalley, J.F. 83A102: *11.4.*
Snyder, S.W. 85N199: *19.17, 19.18, 19.19, 19.58, 19.63.*
Solovev, K.N. 74E520: *5.4, 11.6, 15.1, 15.5*; 76E693: *11.6, 15.1, 15.3, 29.13, 29.24.*
Sostero, S. 79F334: *28.1.*
Sparks, R.H. 80F228: *20.2.*
Spaulding, L. 83E604: *24.2.*
Spikes, J.D. 86F214: *29.28.*
Spreer, L.O. 86F171: *20.1.*
Sprintschnik, H.W. 776441: *19.3, 19.4, 19.5, 19.6, 19.8, 19.9, 19.33, 19.34, 22.1*; 77F920: *19.3, 19.4, 19.5, 19.6, 19.8, 19.9, 19.33, 19.34, 21.1, 22.1.*
Sriram, R. 81E458: *4.1, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.11, 4.12, 4.13, 4.14, 4.18.*
Staryi, V.P. 80F472: *29.14*; 81F368: *8.4*; 82E636: *1.3, 11.7, 11.11.*
Stepanov, A.V. 84E828: *28.1.*
Stiegman, A.E. 85E779: *9.6, 16.2.*
Strekas, T.C. 82F048: *19.12, 20.1, 21.1*; 84E347: *19.65.*

Stryer, L. 81E787: *24.7*, *24.18*.
Sullivan, B.P. 79C010: *21.1*, *22.1*; 82S130: *14.6*; 85E347: *14.3*, *14.6*, *14.7*, *14.8*, *14.9*, *14.10*, *14.11*, *14.15*, *14.16*, *14.17*, *14.18*, *14.19*; 86S121: *14.6*.
Sultana, Q. 756295: *28.1*.
Summers, L.A. 82S257: *21.1*, *22.1*; 86F456: *21.1*.
Sutcliffe, C.R. 79E349: *15.8*.
Sutin, N. 747635: *20.1*; 766014: *14.4*, *20.1*; 766046: *20.1*; 766404: *19.1*, *19.11*, *19.14*, *19.15*, *19.16*, *19.17*, *19.18*, *19.19*, *19.22*, *19.58*, *20.1*; 78A090: *14.2*, *14.4*, *19.1*, *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.22*, *19.58*, *20.1*; 78F366: *4.1*, *4.3*, *4.4*, *4.6*, *4.7*, *4.14*, *4.18*; 79A183: *19.11*, *19.15*, *19.17*, *19.58*, *20.1*; 79F045: *20.1*, *21.1*; 80E040: *10.1*, *10.2*, *14.1*, *19.11*, *19.17*, *20.1*; 81A250: *14.1*, *20.1*; 81N003: *19.11*, *19.14*, *19.17*, *19.58*, *20.1*, *21.1*; 82A145: *19.11*, *19.15*, *19.16*, *19.17*, *19.18*, *19.19*, *19.58*, *20.1*, *21.1*, *22.1*; 82A278: *19.1*, *19.11*, *19.14*, *19.15*, *19.16*, *19.18*, *19.19*, *19.58*, *19.62*, *21.1*; 83C017: *19.11*, *19.14*, *19.15*, *19.17*, *19.18*, *19.19*, *19.58*, *21.1*; 84A238: *19.1*, *19.11*, *19.14*, *19.15*, *19.16*, *19.17*, *19.18*, *19.19*, *19.58*, *20.1*; 85A362: *4.18*, *20.1*; 85S022: *14.1*, *14.2*, *14.10*, *19.11*, *19.14*, *19.17*, *19.18*, *19.58*, *20.1*; 86A077: *14.18*, *19.17*, *20.1*.
Tachin, V.S. 706153: *6.1*, *7.1*, *7.5*, *7.6*, *7.7*, *7.8*, *7.9*, *24.4*, *24.15*; 73F674: *24.4*; 75E531: *24.4*.
Takagi, K. 82F153: *21.1*.
Takakubo, M. 85A430: *29.15*.
Takayanagi, T. 80N169: *19.37*.
Takeyama, N. 86N075: *29.16*, *29.17*.
Takuma, K. 78A269: *19.58*, *21.1*; 80N125: *19.37*.
Tamilarasan, R. 83F230: *4.14*, *4.18*; 86E096: *19.30*, *20.1*.
Tanaka, K. 86F247: *8.3*; 86N075: *29.16*, *29.17*.
Tanaka, T. 83C021: *18.11*; 83F105: *18.11*; 84F351: *21.1*.
Tanno, T. 83E088: *1.1*; 84A272: *11.6*, *29.11*; 86S089: *11.10*.
Taylor, D.G. 78F683: *20.1*.
Tazuke, S. 82A189: *21.1*; 83E209: *19.25*, *19.57*; 83F371: *19.24*, *19.25*, *19.26*, *19.57*, *22.1*.
Terenin, A.N. 65A001: *11.5*, *11.6*.
Thomas, J.K. 85N164: *20.1*, *21.1*, *22.1*.
Tikare, R.K. 86A380: *21.1*.
Tokousbalides, P. 74E518: *24.3*; 766551: *24.3*, *24.4*.
Toma, H.E. 776405: *20.1*, *21.1*.
Totten, M.D. 84E074: *16.2*.
Tracy, H.J. 84E074: *16.2*.
Tran-Thi, T.H. 86A174: *29.15*.
Traverso, O. 78E300: *28.1*; 79F334: *28.1*.
Tsutsui, Y. 80N125: *19.37*.
Tsvirko, M.P. 74E520: *5.4*, *11.6*, *15.1*, *15.5*; 76E693: *11.6*, *15.1*, *15.3*, *29.13*, *29.24*.
Turp, J.E. 85E617: *19.23*, *19.32*, *19.45*, *22.1*.
Turro, N.J. 85R098: *19.21*, *19.58*, *20.1*.
Ueno, F.B. 82A068: *20.1*.
Van Damme, H. 85S227: *20.1*.
Varani, G. 736183: *4.15*; 767517: *4.14*; 78E518: *4.14*, *9.1*, *21.1*; 86E555: *9.4*, *16.3*.
Vasil'ev, V.V. 83A403: *4.14*, *14.4*, *20.1*.
Vinogradov, S.A. 83E719: *4.14*, *14.4*, *20.1*; 85A469: *4.14*, *9.2*, *14.4*, *20.1*, *28.1*.
Vlcek, A.,Jr. 83E170: *21.1*.
von Zelewsky, A. 81E512: *19.42*; 82S159: *19.2*, *19.10*, *19.44*, *19.51*; 84E462: *19.41*, *19.42*, *19.50*, *19.51*; 85A248: *19.2*, *19.42*, *19.51*, *21.1*.
Walters, P. 81N178: *20.1*; 83A133: *15.6*, *25.1*, *25.2*, *29.17*, *29.19*.
Wampler, D.L. 86F346: *22.1*.
Wasgestian, H.F. 736183: *4.15*; 83E203: *4.2*.
Watanabe, S. 84B008: *26.1*.
Watkins, P.A. 82S130: *14.6*; 86S121: *14.6*.
Watts, R.J. 79F173: *9.2*, *9.3*.
Weiner, M.A. 82F048: *19.12*, *20.1*, *21.1*.
Wells, D. 82S257: *21.1*, *22.1*.
White, H.S. 84F121: *20.1*.
Whitten, D.G. 68A001: *11.2*, *29.3*; 707320: *11.1*, *11.2*, *11.3*, *29.1*, *29.2*, *29.3*, *29.4*, *29.5*; 72E284: *29.4*; 747159: *20.1*, *21.1*; 747293: *11.3*, *29.4*, *29.9*; 757168: *21.1*; 767009: *7.5*, *15.4*, *19.30*, *19.58*, *19.68*, *20.1*, *22.1*; 767528: *21.1*; 776441: *19.3*, *19.4*, *19.5*, *19.6*, *19.8*, *19.9*, *19.33*, *19.34*, *22.1*; 77F920: *19.3*, *19.4*, *19.5*, *19.6*, *19.8*, *19.9*, *19.33*, *19.34*, *21.1*, *22.1*; 78A101: *15.4*, *15.8*, *16.4*; 79C010: *21.1*, *22.1*; 79E349: *15.8*; 80C004: *20.1*; 81N147: *15.7*; 85F328: *25.3*; 86F005: *19.7*.
Wildes, P.D. 68A001: *11.2*, *29.3*; 707320: *11.1*, *11.2*, *11.3*, *29.1*, *29.2*, *29.3*, *29.4*, *29.5*.
Willner, I. 82N119: *19.30*, *21.1*; 85M244: *20.1*; 85N254: *29.20*; 86N119: *21.1*, *29.20*.
Wilowska, A. 83F182: *1.2*, *2.2*, *4.19*, *5.6*, *11.11*, *15.8*, *19.70*; 84E316: *29.24*.
Winkler, J.R. 82A280: *20.1*.
Winterle, J.S. 767179: *20.1*.
Woehrle, D. 85F520: *29.22*; 86S089: *11.10*.
Wolfgang, S. 84E347: *19.65*.
Wrighton, M.S. 736244: *21.1*; 746021: *17.1*; 756002: *20.1*; 78E397: *17.2*, *17.6*; 79E269: *17.7*; 80F316: *17.3*, *17.4*.
Yamada, A. 83E088: *1.1*; 84A272: *11.6*, *29.11*; 85A101: *29.10*; 85F030: *29.10*; 86S089: *11.10*.
Yamashita, M. 85F089: *20.1*.
Yamazaki, H. 86F060: *21.1*.
Yanuck, M.D. 85E552: *15.7*.
Yasuda, M. 81F381: *21.1*; 84F069: *21.1*.
Yasufuku, K. 86A325: *18.15*, *18.17*; 86F060: *21.1*; 86F247: *8.3*.
Yeh, S.M. 81E787: *24.7*, *24.18*.
Yocom, K.M. 82A280: *20.1*.
Yokota, H. 81F401: *20.1*.
Yokoyama, Y. 74F655: *28.1*; 766201: *28.1*; 77E693: *28.1*; 77E694: *28.1*.
Young, R.C. 767009: *7.5*, *15.4*, *19.30*, *19.58*, *19.68*, *20.1*, *22.1*; 777106: *21.1*; 81E203: *21.1*.

Zahir, K. 85F161: *19.11, 19.17, 19.19, 19.58, 20.1.*
Zanella, A.W. 84A238: *19.1, 19.11, 19.14, 19.15, 19.16, 19.17, 19.18, 19.19, 19.58, 20.1.*
Zengerle, K. 83N178: *19.24*; 85A431: *19.24, 19.25, 19.57, 22.1.*
Zidler, B. 80A247: *21.1, 22.1*; 82C019: *21.1, 22.1.*
Ziessel, R. 86F230: *17.5, 20.1, 21.1.*
Zimnyakov, A.M. 85A469: *4.14, 9.2, 14.4, 20.1, 28.1.*
Zinato, E. 84E097: *4.9, 4.10.*
Zinina, E.M. 75E542: *13.1.*
Zipp, A.P. 82A145: *19.11, 19.15, 19.16, 19.17, 19.18, 19.19, 19.58, 20.1, 21.1, 22.1.*

11.2. Index of Excited States

A locator *t.m* following a substrate name refers to table number *t* and excited state number *m*.

Al(phthalocyanine)Cl *1.1.*
Al(5,10,15,20-tetraphenylporphyrin)$^{+}$ *1.2.*
Al(5,10,15,20-tetraphenylporphyrin)(OH) *1.3.*
Cd(mesoporphyrin IX dimethyl ester) *2.1.*
Cd(5,10,15,20-tetraphenylporphyrin) *2.2.*
Ce^{3+} *3.1.*
Cr(5-Brphen)$_3^{3+}$ *4.1.*
$Cr(CN)_6^{3-}$ *4.2.*
Cr(5-Clphen)$_3^{3+}$ *4.3.*
Cr(4,4′-Me_2bpy)$_3^{3+}$ *4.4.*
Cr(3,4,7,8-Me_4phen)$_3^{3+}$ *4.5.*
Cr(4,7-Me_2phen)$_3^{3+}$ *4.6.*
Cr(5-Mephen)$_3^{3+}$ *4.7.*
Cr(5,6-Me_2phen)$_3^{3+}$ *4.8.*
$Cr(NH_3)_5(CN)^{2+}$ *4.9.*
trans-$Cr(NH_3)_4(CN)_2^{+}$ *4.10.*
Cr(4,4′-Ph_2bpy)$_3^{3+}$ *4.11.*
Cr(4,7-Ph_2phen)$_3^{3+}$ *4.12.*
Cr(5-Phphen)$_3^{3+}$ *4.13.*
Cr(bpy)$_3^{3+}$ *4.14.*
Cr(en)$_3^{3+}$ *4.15.*
trans-Cr(en)$_2$(NCS)$_2^{+}$ *4.16.*
trans-Cr(en)$_2$(NH_3)F^{2+} *4.17.*
Cr(phen)$_3^{3+}$ *4.18.*
Cr(5,10,15,20-tetraphenylporphyrin)$^{+}$ *4.19.*
Cu($MePh_2P$)$_3$Cl *5.1.*
Cu(2,9-Me_2phen)$_2^{+}$ *5.2.*
Cu(2,9-Ph_2phen)$_2^{+}$ *5.3.*
Cu(etioporphyrin I) *5.4.*
Cu(mesoporphyrin IX dimethyl ester) *5.5.*
Cu(5,10,15,20-tetraphenylporphyrin) *5.6.*
Dy^{3+} *6.1.*
Dy(anthranilato)$^{2+}$ *6.2.*
Dy(salicylato)$^{2+}$ *6.3.*
Dy(5-sulfosalicylato)$^{2+}$ *6.4.*
Eu^{3+} *7.1.*
Eu(acetylacetonato)$_3$ *7.2.*
Eu(crypt)$^{3+}$ *7.3.*
Eu(1,3-diphenyl-1,3-propanedionato)$_4^{-}$ *7.4.*
Eu(phen)$_3^{3+}$ *7.5.*
Eu(phen)(1-thienyl-4,4,4-trifluoro-1,3-butanedionato)$_3$ *7.6.*
Eu(1-phenyl-1,3-butanedionato)$_4^{-}$ *7.7.*
Eu(1-phenyl-4,4,4-trifluoro-1,3-butanedionato)$_4^{-}$ *7.8.*
Eu(1-thienyl-4,4,4-trifluoro-1,3-butanedionato)$_4^{-}$ *7.9.*
Fe(bpy)$_3^{2+}$ *10.1.*
Fe(terpy)$_2^{2+}$ *10.2.*
In(phthalocyanine)Cl *8.1.*
In(5,10,15,20-tetraphenylporphyrin)$^{+}$ *8.2.*
In(5,10,15,20-tetraphenylporphyrin)(C_2H_5) *8.3.*
In(5,10,15,20-tetraphenylporphyrin)(OH) *8.4.*
In(5,10,15,20-tetraphenylporphyrin)(TEOA)$_2^{+}$ *8.5.*
cis-Ir(5,6-Me_2phen)$_2Cl_2^{+}$ *9.1.*
Ir(bpy)$_2$(C^3,N'-Hbpy)$^{3+}$ *9.2.*
Ir(bpy)$_2$(C^3,N'-bpy)$^{2+}$ *9.3.*
Ir(8-hydroxyquinolinato)$_3$ *9.4.*
Ir(phen)$_3^{3+}$ *9.5.*
Ir_2(μ-pyrazolyl)$_2$(1,5-cyclooctadiene)$_2$ *9.6.*
Mg(etioporphyrin I)(pyridine) *11.1.*
Mg(etioporphyrin I) [singlet] *11.2.*
Mg(etioporphyrin I) [triplet] *11.3.*
Mg(2,3,7,8,12,13,17,18-octaethylporphyrin) *11.4.*
Mg(phthalocyanine) [singlet] *11.5.*
Mg(phthalocyanine) [triplet] *11.6.*
Mg[tetrakis(4-*tert*-butyl)phthalocyanine] *11.7.*
Mg[tetrakis(*N*-methylaza)phthalocyanine]$^{4+}$ [singlet] *11.8.*
Mg[tetrakis(*N*-methylaza)phthalocyanine]$^{4+}$ [triplet] *11.9.*
Mg(tetramethoxyphthalocyanine) *11.10.*
Mg(5,10,15,20-tetraphenylporphyrin) *11.11.*
Mg(5,10,15,20-tetraphenylporphyrin)(pyridine) *11.12.*
$Mo_6Cl_{14}^{2-}$ *12.1.*
Nd^{3+} *13.1.*
Os(5-Clphen)$_3^{2+}$ *14.1.*
Os(5,6-Me_2phen)$_3^{2+}$ *14.2.*
Os(3,4,7,8-Me_4phen)$_2$[*cis*-1,2-bis(diphenylphosphino)ethene]$^{2+}$ *14.3.*
Os(bpy)$_3^{2+}$ *14.4.*
cis-Os(bpy)$_2$(CH_3CN)$_2^{2+}$ *14.5.*
Os(bpy)[1,2-bis(dimethylarsino)benzene]$_2^{2+}$ *14.6.*
Os(bpy)[*cis*-1,2-bis(diphenylphosphino)ethene]$_2^{2+}$ *14.7.*
Os(bpy)$_2$[bis(diphenylphosphino)methane]$^{2+}$ *14.8.*
cis-Os(bpy)$_2$(dimethylsulfoxide)$_2^{2+}$ *14.9.*
Os(phen)$_3^{2+}$ *14.10.*
cis-Os(phen)$_2$(CH_3CN)$_2^{2+}$ *14.11.*
cis-Os(phen)$_2$(CO)Cl^{+} *14.12.*
Os(phen)$_2$[4,7-($PhSO_3$)$_2$phen] *14.13.*
Os(phen)$_2$(4,7-Ph_2phen)$^{2+}$ *14.14.*
Os(phen)$_2$[*cis*-1,2-bis(diphenylphosphino)ethene]$^{2+}$ *14.15.*
Os(phen)$_2$[bis(diphenylphosphino)methane]$^{2+}$ *14.16.*
cis-Os(phen)$_2$(dimethylphenylphosphine)$_2^{2+}$ *14.17.*
Os(terpy)$_2^{2+}$ *14.18.*
Os(terpy)[*cis*-1,2-bis(diphenylphosphino)ethene]Cl^{+} *14.19.*
Pd(etioporphyrin I) *15.1.*
Pd(mesoporphyrin IX dimethyl ester) *15.2.*

Pd(octaethylchlorin) *15.3.*
Pd(2,3,7,8,12,13,17,18-octaethylporphyrin) *15.4.*
Pd(tetrabenzoporphyrin) *15.5.*
Pd[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ *15.6.*
Pd[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$ *15.7.*
Pd(5,10,15,20-tetraphenylporphyrin) *15.8.*
$Pt(CN)_4^{2-}$ *16.1.*
$Pt_2[\mu$-diphosphito(2-)-*P,P'*$]_4^{4-}$ *16.2.*
Pt(8-hydroxyquinolinato)$_2$ *16.3.*
Pt(5,10,15,20-tetraphenylporphyrin) *16.4.*
fac-Re(CO)$_3$(5-Clphen)Cl *17.1.*
fac-Re(CO)$_3$(4,7-Ph$_2$phen)Cl *17.2.*
fac-Re(CO)$_3$(4-acetylpyridine)$_2$I *17.3.*
fac-Re(CO)$_3$(4-benzoylpyridine)$_2$Cl *17.4.*
fac-Re(CO)$_3$(bpy)Br *17.5.*
fac-Re(CO)$_3$(phen)Cl *17.6.*
fac-Re(CO)$_3$(4-phenylpyridine)$_2$Cl *17.7.*
$Re_2Cl_8^{2-}$ *17.8.*
$Rh(ND_3)_6^{3+}$ *18.1.*
$Rh(ND_3)_5Cl^{2+}$ *18.2.*
$Rh(NH_3)_6^{3+}$ *18.3.*
$Rh(NH_3)_5Br^{2+}$ *18.4.*
$Rh(NH_3)_5Cl^{2+}$ *18.5.*
$Rh(NH_3)_5I^{2+}$ *18.6.*
Rh(4,7-Ph$_2$phen)$_3^{3+}$ *18.7.*
cis-Rh(4,7-Ph$_2$phen)$_2$Cl$_2^+$ *18.8.*
cis-Rh(bpy)$_2$Cl$_2^+$ *18.9.*
trans-Rh(cyclam)(CN)$_2^+$ *18.10.*
Rh$_2$(1,3-diisocyanopropane)$_4^{2+}$ [singlet] *18.11.*
Rh$_2$(1,3-diisocyanopropane)$_4^{2+}$ [triplet] *18.12.*
Rh(phen)$_3^{3+}$ *18.13.*
cis-Rh(phen)$_2$Cl$_2^+$ *18.14.*
Rh(5,10,15,20-tetraphenylporphyrin)Cl *18.15.*
Rh(5,10,15,20-tetraphenylporphyrin)[OC(O)CH$_3$] *18.16.*
Rh(5,10,15,20-tetraphenylporphyrin)(pyridine)Cl *18.17.*
Ru(5-Brphen)$_3^{2+}$ *19.1.*
Ru(4,4'-Bu$_2$bpy)$_3^{2+}$ *19.2.*
Ru[4,4'-(COObz)$_2$bpy]$_3^{2+}$ *19.3.*
Ru[4,4'-(COOchl)$_2$bpy]$_3^{2+}$ *19.4.*
Ru[4,4'-(COOcyc)$_2$bpy]$_3^{2+}$ *19.5.*
Ru[4,4'-(COOdec)$_2$bpy]$_3^{2+}$ *19.6.*
Ru[4,4'-(COOet)$_2$bpy]$_3^{2+}$ *19.7.*
Ru[4,4'-(COOnap)$_2$bpy]$_3^{2+}$ *19.8.*
Ru[4,4'-(COOpr)$_2$bpy]$_3^{2+}$ *19.9.*
Ru(4,4'-Cl$_2$bpy)$_3^{2+}$ *19.10.*
Ru(5-Clphen)$_3^{2+}$ *19.11.*
Ru[4-(Et$_3$P)bpy]$_3^{5+}$ *19.12.*
Ru(3,3'-Me$_2$bpy)$_3^{2+}$ *19.13.*
Ru(4,4'-Me$_2$bpy)$_3^{2+}$ *19.14.*
Ru(3,4,7,8-Me$_4$phen)$_3^{2+}$ *19.15.*
Ru(3,5,6,8-Me$_4$phen)$_3^{2+}$ *19.16.*
Ru(4,7-Me$_2$phen)$_3^{2+}$ *19.17.*
Ru(5-Mephen)$_3^{2+}$ *19.18.*
Ru(5,6-Me$_2$phen)$_3^{2+}$ *19.19.*
Ru[4,7-(PhSO$_3$)$_2$phen]$_3^{4-}$ *19.20.*
Ru(4,7-Ph$_2$phen)$_3^{2+}$ *19.21.*
Ru(5-Phphen)$_3^{2+}$ *19.22.*
Ru[4,4'-(SO$_3$)$_2$bpy]$_3^{4-}$ *19.23.*
Ru(2,2'-bipyrazine)$_3^{2+}$ *19.24.*
Ru(3,3'-bipyridazine)$_3^{2+}$ *19.25.*
Ru(2,2'-bipyrimidine)$_3^{2+}$ *19.26.*
Ru^{II}[1,2-bis(phenylthio)ethane]$_2$Cl(μ-vio)Ru^{II}(bpy)$_2$Cl^{2+} *19.27.*
Ru^{II}[1,2-bis(phenylthio)ethane]$_2$Cl(μ-vio)Ru^{III}(bpy)$_2$Cl^{3+} *19.28.*
Ru(bpy)$_3^{2+}$ *20.1, 21.1, 22.1.*
$(+)_D$-Ru(bpy)$_3^{2+}$ *21.2.*
$(-)_D$-Ru(bpy)$_3^{2+}$ *20.2, 21.3.*
Ru(bpy)$_2$[(BUG)$_2$bpy]$^{n+}$ *19.29.*
cis-Ru(bpy)$_2$(CN)$_2$ *19.30.*
Ru(bpy)$_2$[4,4'-(COOH)$_2$bpy]$^{2+}$ *19.31.*
Ru(bpy)$_2$[4,4'-(COO)$_2$bpy] *19.32.*
Ru(bpy)[4,4'-(COOchl)$_2$bpy]$_2^{2+}$ *19.33.*
Ru(bpy)$_2$[4,4'-(COOchl)$_2$bpy]$^{2+}$ *19.34.*
Ru(bpy)$_2$[4,4'-(COOet)$_2$bpy]$^{2+}$ *19.35.*
Ru(bpy)$_2$(4,4'-Cl$_2$bpy)$^{2+}$ *19.36.*
Ru(bpy)$_2$(Do$_2$Ca$_2$bpy)$^{2+}$ *19.37.*
Ru(bpy)(3,3'-Me$_2$bpy)$_2^{2+}$ *19.38.*
Ru(bpy)$_2$(3,3'-Me$_2$bpy)$^{2+}$ *19.39.*
Ru(bpy)$_2$(4,4'-Me$_2$bpy)$^{2+}$ *19.40.*
Ru(bpy)(Me$_2$dibenzoH$_2$phen)$_2^{2+}$ *19.41.*
Ru(bpy)$_2$(Me$_2$dibenzoH$_2$phen)$^{2+}$ *19.42.*
Ru(bpy)$_2$[5-(NH$_2$)phen]$^{2+}$ *19.43.*
Ru(bpy)$_2$[4-(NO$_2$)bpy]$^{2+}$ *19.44.*
Ru(bpy)[4,4'-(SO$_3$)$_2$bpy]$_2^{2-}$ *19.45.*
Ru(bpy)$_2$(acetylacetonato)$^+$ *19.46.*
Ru(bpy)$_2$(3,3'-biisoquinoline)$^{2+}$ *19.47.*
Ru(bpy)(3,3'-biisoquinoline)$_2^{2+}$ *19.48.*
Ru(bpy)$_2$(2,2'-bipyrimidine)$^{2+}$ *19.49.*
Ru(bpy)(2,2'-biquinoline)$_2^{2+}$ *19.50.*
Ru(bpy)$_2$(2,2'-biquinoline)$^{2+}$ *19.51.*
Ru(bpy)$_2$(en)$^{2+}$ *19.52.*
Ru(bpy)[2-(thiazol-2-yl)pyridine]$_2^{2+}$ *19.53.*
Ru(bpy)$_2$[2-(thiazol-2-yl)pyridine]$^{2+}$ *19.54.*
cis-Ru(bpy)$_2$(vio)Cl$^+$ *19.55.*
Ru(2,7-dimethyl-1,4,5,8-tetraazaphenanthrene)$_3^{2+}$ *19.56.*
Ru[4-methyl-2-(2-pyridyl)pyrimidine]$_3^{2+}$ *19.57.*
Ru(phen)$_3^{2+}$ *19.58.*
Ru(phen)$_2$(5-Brphen)$^{2+}$ *19.59.*
cis-Ru(phen)$_2$(CN)$_2$ *19.60.*
Ru(phen)$_2$(5-Clphen)$^{2+}$ *19.61.*
Ru(phen)$_2$[4,7-(PhSO$_3$)$_2$phen] *19.62.*
Ru(phen)$_2$(4,7-Ph$_2$phen)$^{2+}$ *19.63.*
Ru(phen)$_2$(5-Phphen)$^{2+}$ *19.64.*
Ru[2-(phenylazo)pyridine]$_3^{2+}$ *19.65.*
Ru(phthalocyanine)(DMF)$_2$ *19.66.*
Ru(phthalocyanine)(pyridine)$_2$ *19.67.*
Ru(terpy)(bpy)(NH$_3$)$^{2+}$ *19.68.*
Ru(1,4,5,8-tetraazaphenanthrene)$_3^{2+}$ *19.69.*
Ru(5,10,15,20-tetraphenylporphyrin) *19.70.*
Ru(5,10,15,20-tetraphenylporphyrin)(CO) *19.71.*
Ru[2-(thiazol-2-yl)pyridine]$_3^{2+}$ *19.72.*
Sm^{3+} *23.1.*

$Sm(salicylato)^{2+}$ *23.2.*
$Sm(5\text{-sulfosalicylato})^{2+}$ *23.3.*
Sn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]Cl_2^{4+} *25.1.*
Sn[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]Cl_2^{4-} *25.2.*
Sn(5,10,15,20-tetraphenylporphyrin)$(OH)_2$ *25.3.*
Tb^{III}-Aspartic acid *24.1.*
Tb^{III}-Citric acid *24.2.*
Tb^{3+} $[^5D_3]$ *24.3.*
Tb^{3+} $[^5D_4]$ *24.4.*
Tb^{III}-Dipicolinic acid *24.5.*
$Tb^{III}(\text{Dipicolinic acid})_3$ *24.6.*
$Tb(EDTA)^-$ *24.7.*
Tb^{III}-Hemimellitic acid *24.8.*
Tb^{III}-Malic acid *24.9.*
Tb^{III}-L-Malic acid *24.10.*
Tb^{III}-Phthalic acid *24.11.*
Tb^{III}-Picolinic acid *24.12.*
Tb^{III}-Pyromellitic acid *24.13.*
Tb^{III}-Trimellitic acid *24.14.*
$Tb(\text{acetylacetonato})_3$ *24.15.*
$Tb(\text{anthranilato})^{2+}$ *24.16.*
$Tb(\text{crypt})^{3+}$ *24.17.*
Tb[*N*-(2-hydroxyethyl)EDTA] *24.18.*
$Tb(\text{salicylato})_3$ *24.19.*
$Tb(2,2,6,6\text{-tetramethyl-3,5-heptanedionato})_3$ *24.20.*
Ti(oxo)(5,10,15,20-tetraphenylporphyrin) *26.1.*
UO_2^{2+} *28.1.*
$W(CO)_5$(4-cyanopyridine) *27.1.*
Zn(etioporphyrin I)(pyridine) [singlet] *29.1.*
Zn(etioporphyrin I)(pyridine) [triplet] *29.2.*
Zn(etioporphyrin I) [singlet] *29.3.*
Zn(etioporphyrin I) [triplet] *29.4.*
Zn(mesoporphyrin IX dimethyl ester) [singlet] *29.5.*
Zn(mesoporphyrin IX dimethyl ester) [triplet] *29.6.*
Zn[5-(1-methylpyridinium-4-yl)-10,15,20-tris(4-tolyl)porphyrin]$^+$ *29.7.*
Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [singlet] *29.8.*
Zn(2,3,7,8,12,13,17,18-octaethylporphyrin) [triplet] *29.9.*
Zn[5-phenyl-10,15,20-tris(4-sulfonatophenyl)porphyrin]$^{3-}$ *29.10.*
Zn(phthalocyanine) *29.11.*
Zn(protoporphyrin) *29.12.*
Zn(tetrabenzoporphyrin) *29.13.*
Zn[tetrakis(4-*tert*-butyl)phthalocyanine] *29.14.*
Zn[5,10,15,20-tetrakis(1-methylpyridinium-3-yl)porphyrin]$^{4+}$ *29.15.*
Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [singlet] *29.16.*
Zn[5,10,15,20-tetrakis(1-methylpyridinium-4-yl)porphyrin]$^{4+}$ [triplet] *29.17.*
Zn[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$ [singlet] *29.18.*
Zn[5,10,15,20-tetrakis(4-sulfonatophenyl)porphyrin]$^{4-}$ [triplet] *29.19.*
Zn{5,10,15,20-tetrakis[1-(3-sulfonato-1-propyl)pyridinium-4-yl]porphyrin} *29.20.*
Zn{5,10,15,20-tetrakis[4-(trimethylammonio)phenyl]porphyrin}$^{4+}$ *29.21.*
Zn(*N*,*N'*,*N''*,*N'''*-tetramethyltetra-2,3-pyridinoporphyrazine)$^{4+}$ *29.22.*
Zn(5,10,15,20-tetraphenylporphyrin) [singlet] *29.23.*
Zn(5,10,15,20-tetraphenylporphyrin) [triplet] *29.24.*
Zn[4,4',4'',4'''-tetra(sulfomorpholide)phthalocyanine] [singlet] *29.25.*
Zn[4,4',4'',4'''-tetra(sulfomorpholide)phthalocyanine] [triplet] *29.26.*
Zn(4,4',4'',4'''-tetrasulfophthalocyanine)$^{4-}$ [singlet] *29.27.*
Zn(4,4',4'',4'''-tetrasulfophthalocyanine)$^{4-}$ [triplet] *29.28.*
Zn[5,10,15-tris(4-tolyl)-20-(4-carboxylatophenyl)porphyrin]$^-$ *29.29.*
Zn(uroporphyrin I) *29.30.*

11.3. Index of Inorganic Quenchers

A locator *t.m.n* following a quencher name refers to table number *t*, excited state number *m*, and quencher number *n*.

Ag^+ *19.58.1, 20.1.1, 28.1.1.*
$Ag(bpy)_2^+$ *20.1.2.*
Ag(TPP) *11.6.1, 15.1.1, 29.24.1.*
Ba^{2+} *28.1.2.*
Br^- *9.2.1, 28.1.3.*
Br_2^- *29.19.1.*
CO_3^{2-} *18.5.1.*
Cd^+ *29.19.2.*
Ce^{IV} *28.1.4.*
Ce^{3+} *28.1.5.*
Ce^{4+} *19.65.1, 24.4.1.*
Cl^- *19.24.1, 28.1.6.*
ClO_4^- *19.58.2, 20.1.3.*
Co^{2+} *9.2.2, 9.3.1, 19.30.1, 19.58.3, 19.60.1, 20.1.4, 28.1.7, 29.24.2.*
$Co(acac)_2$ *19.30.2, 19.58.4, 19.60.2, 20.1.5.*
$Co(acac)_3$ *4.14.1, 4.18.1, 5.2.1, 16.3.1, 19.30.3, 19.58.5, 19.60.3, 20.1.6, 20.2.1.*
$Co(AMcapten)^{3+}$ *19.14.1, 20.1.7.*
$Co(AMMEsar)^{3+}$ *19.14.2, 20.1.8.*
$Co(AMMEsarH)^{4+}$ *19.11.1, 19.17.1, 19.58.6.*
$Co(AZAcapten)^{3+}$ *19.14.3, 20.1.9.*
$Co(AZAMEsar)^{3+}$ *19.1.1, 19.14.4, 19.17.2, 19.58.7, 20.1.10.*
$Co(bpy)^{2+}$ *19.11.2, 19.17.3, 19.58.8, 20.1.11.*
$Co(bpy)_3^+$ *19.17.4, 20.1.12.*
$Co(bpy)_3^{2+}$ *1.1.1, 11.6.2, 14.1.1, 14.2.1, 14.10.1, 19.11.3, 19.14.5, 19.17.5, 19.18.1, 19.58.9, 20.1.13, 29.11.1.*
$Co(bpy)_3^{3+}$ *1.1.2, 8.1.1, 11.6.3, 19.12.1, 20.1.14, 29.11.2.*
$Co^{III}(bpy)_2(\mu\text{-}O_2,NH_2)Co^{III}(bpy)_2^{4+}$ *20.1.15.*
cis-$Co(bzac)_3$ *20.1.16.*
trans-$Co(bzac)_3$ *20.1.17.*

$Co(5\text{-}Brphen)^{2+}$ *19.17.6.*
$Co(C_5H_5)_2^{+}$ *20.1.18.*
$Co(C_5H_4COOH)_2^{+}$ *16.2.1, 20.1.19.*
$CoCl^{+}$ *4.15.1.*
$CoCl_2$ *4.15.2.*
$CoCl_3^{-}$ *4.15.3.*
$Co(CLHOsar)^{3+}$ *19.14.6, 20.1.20.*
$Co(CLNOsar)^{3+}$ *19.14.7, 20.1.21.*
$Co(5\text{-}Clphen)^{2+}$ *19.11.4, 19.17.7, 19.58.10, 20.1.22.*
$Co(5\text{-}Clphen)_3^{2+}$ *19.11.5, 19.17.8, 19.58.11, 20.1.23.*
$Co(CLsar)^{3+}$ *19.14.8, 20.1.24.*
$Co(CMMEabsar)^{3+}$ *19.14.9, 20.1.25.*
$Co(CN)_6^{3-}$ *4.14.2, 4.16.1, 4.18.2, 7.1.1, 7.3.1, 14.4.1, 19.30.4, 19.58.12, 19.60.4, 20.1.26, 24.4.2, 24.17.1, 29.30.1.*
$Co^{III}(CN)_5(\mu\text{-}O_2)Co^{III}(CN)_5^{5-}$ *20.1.27.*
$Co(CN)_5(pyrazinecarboxylato)^{3-}$ *20.1.28.*
$Co(C_2O_4)_3^{2-}$ *20.1.29.*
$Co(C_2O_4)_3^{3-}$ *19.30.5, 19.58.13, 19.60.5, 20.1.30.*
trans-$Co(cyclam)Cl_2^{+}$ *4.14.3, 4.18.3.*
trans-$Co(cyclam)(H_2O)_2^{3+}$ *4.14.4, 4.18.4.*
trans-$Co(cyclam)(H_2O)Br^{2+}$ *4.18.5.*
trans-$Co(cyclam)(H_2O)Cl^{2+}$ *4.18.6.*
trans-$Co(cyclam)(H_2O)(N_3)^{2+}$ *4.14.5, 4.18.7.*
trans-$Co(cyclam)(N_3)_2^{+}$ *4.18.8.*
trans-$Co(cyclam)(NCS)_2^{+}$ *4.18.9.*
trans-$Co(cyclam)(NCS)Cl^{+}$ *4.18.10.*
trans-$Co(cyclam)(NCS)(N_3)^{+}$ *4.18.11.*
trans-$Co(cyclam)(N_3)Cl^{+}$ *4.18.12.*
trans-$Co(cyclam)(NO_2)_2^{+}$ *4.18.13.*
lel$_3$-$Co(diAMchar)^{3+}$ *19.14.10, 20.1.31.*
$Co(diAMsar)^{3+}$ *19.1.2, 19.11.6, 19.14.11, 19.17.9, 19.58.14, 20.1.32.*
$Co(diAMsarH_2)^{5+}$ *19.1.3, 19.17.10, 19.58.15.*
lel$_3$-$Co(diAZAchar)^{3+}$ *19.14.12, 20.1.33.*
$Co(diCLsar)^{3+}$ *19.14.13, 20.1.34.*
$Co(diNOsar)^{3+}$ *19.14.14, 20.1.35.*
$Co(DMG)_2(C_2H_5)(H_2O)$ *4.14.6, 4.18.14, 16.3.2, 19.58.16, 20.1.36, 28.1.8.*
$Co(EDTA)^{-}$ *20.1.37, 24.7.1, 24.18.1, 29.15.1.*
$(-)_D$-$Co(EDTA)^{-}$ *20.2.2.*
$(+)_D$-$Co(EDTA)^{-}$ *20.2.3.*
rac-$Co(EDTA)^{-}$ *20.2.4.*
$Co(EDTA)^{2-}$ *29.15.2.*
$Co(EFMEoxosar\text{-}H)^{2+}$ *19.14.15, 20.1.38.*
$Co(en)_3^{3+}$ *4.14.7, 14.10.2, 16.1.1, 19.11.7, 19.17.11, 19.19.1, 19.58.17, 20.1.39.*
cis-$Co(en)_2Cl_2^{+}$ *4.14.8, 14.10.3, 20.1.40.*
trans-$Co(en)_2Cl_2^{+}$ *4.14.9, 14.10.4, 20.1.41.*
$Co(en)_2(gly)^{2+}$ *20.1.42.*
cis-$Co(en)_2(H_2O)Cl^{2+}$ *4.14.10, 14.10.5, 20.1.43.*
cis-$Co(en)_2(NCS)_2^{+}$ *4.14.11, 14.10.6, 20.1.44.*
trans-$Co(en)_2(NCS)_2^{+}$ *4.14.12, 14.10.7, 20.1.45.*
cis-$Co(en)_2(NCS)Cl^{+}$ *4.14.13, 14.10.8, 20.1.46.*
trans-$Co(en)_2(NCS)Cl^{+}$ *4.14.14, 14.10.9, 20.1.47.*
cis-$Co(en)_2(NH_3)Cl^{2+}$ *4.14.15, 14.10.10, 20.1.48.*
$Co^{III}(en)_2(\mu\text{-}O_2,NH_2)Co^{III}(en)_2^{4+}$ *20.1.49.*
$Co(HEDTA)Br^{-}$ *20.1.50.*
$Co(HEDTA)Cl^{-}$ *20.1.51.*
$Co(HEDTA)(NO_2)^{-}$ *20.1.52.*
$Co(H_2O)_6^{2+}$ *4.15.4.*
$Co(HYMEoxosar\text{-}H)^{2+}$ *20.1.53.*
$Co(4,4'\text{-}Me_2bpy)^{2+}$ *19.17.12.*
$Co(4,4'\text{-}Me_2bpy)_3^{+}$ *20.1.54.*
$Co(4,4'\text{-}Me_2bpy)_3^{2+}$ *20.1.55.*
trans-$Co(Me_6cycladiene)(H_2O)_2^{3+}$ *20.1.56.*
$Co(MENOsar)^{3+}$ *19.14.16, 20.1.57.*
$Co(2,9\text{-}Me_2phen)^{2+}$ *19.17.13.*
$Co(4,7\text{-}Me_2phen)^{2+}$ *19.11.8, 19.17.14, 19.58.18, 20.1.58.*
$Co(4,7\text{-}Me_2phen)_3^{2+}$ *19.11.9, 19.17.15, 19.58.19, 20.1.59.*
$Co(5\text{-}Mephen)^{2+}$ *19.17.16.*
$Co(5,6\text{-}Me_2phen)^{2+}$ *19.17.17.*
$Co(NH_3)_6^{3+}$ *4.14.16, 4.18.15, 14.10.11, 19.11.10, 19.14.17, 19.17.18, 19.19.2, 19.24.2, 19.30.6, 19.58.20, 19.60.6, 19.66.1, 19.67.1, 20.1.60.*
$Co(NH_3)_5(benzoato)^{2+}$ *20.1.61.*
$Co(NH_3)_5[1,2\text{-bis}(4\text{-pyridyl})ethane]^{3+}$ *20.1.62.*
$Co(NH_3)_5[trans\text{-}1,2\text{-bis}(4\text{-pyridyl})ethene]^{3+}$ *20.1.63.*
$Co(NH_3)_5Br^{2+}$ *4.18.16, 14.4.2, 20.1.64.*
$Co(NH_3)_5(CN)^{2+}$ *4.14.17.*
$Co(NH_3)_5(CO_3)^{+}$ *14.4.3.*
$Co(NH_3)_5Cl^{2+}$ *4.14.18, 4.16.2, 4.18.17, 14.4.4, 14.10.12, 14.18.1, 15.6.1, 19.24.3, 19.30.7, 19.58.21, 19.60.7, 19.66.2, 19.67.2, 20.1.65, 29.17.1, 29.21.1.*
$Co(NH_3)_5F^{2+}$ *4.14.19, 4.18.18, 9.2.3, 14.10.13, 20.1.66.*
$Co(NH_3)_5(H_2O)^{3+}$ *4.14.20, 4.18.19, 14.4.5, 14.10.14, 19.66.3, 19.67.3, 20.1.67.*
$Co(NH_3)_5(N\text{-}Mevio)^{4+}$ *20.1.68.*
$Co(NH_3)_5(N_3)^{2+}$ *4.14.21, 4.18.20, 14.4.6.*
$Co(NH_3)_5(NCS)^{2+}$ *4.14.22, 4.18.21, 14.10.15, 20.1.69.*
$Co(NH_3)_5(NO_2)^{2+}$ *4.14.23, 4.18.22, 20.1.70.*
$Co(NH_3)_5[2\text{-}(NO_2)benz]^{2+}$ *20.1.71.*
$Co(NH_3)_5[4\text{-}(NO_2)benz]^{2+}$ *20.1.72.*
$Co(NH_3)_5[OC(O)CH_3]^{2+}$ *20.1.73.*
$Co(NH_3)_5[OC(O)H]^{2+}$ *4.14.24, 14.10.16, 20.1.74.*
$Co^{III}(NH_3)_5(\mu\text{-}O_2)Co^{III}(NH_3)_5^{5+}$ *20.1.75.*
$Co^{III}(NH_3)_4(\mu\text{-}O_2,NH_2)Co^{III}(NH_3)_4^{4+}$ *20.1.76.*
$Co(NH_3)_5(py)^{3+}$ *20.1.77.*
$Co(NH_3)_5(SO_4)^{+}$ *14.4.7.*
$Co(NH_3)_5(vio)^{3+}$ *20.1.78.*
$Co(NO_2)_6^{3-}$ *20.1.79.*
$Co[4\text{-}(NO_2)bpy]_3^{3+}$ *19.12.2, 20.1.80.*
$Co(phen)^{2+}$ *19.11.11, 19.17.19, 19.58.22, 20.1.81.*
$Co(phen)_3^{2+}$ *1.1.3, 11.6.4, 19.11.12, 19.17.20, 19.58.23, 20.1.82, 29.11.3.*
$Co(phen)_3^{3+}$ *1.1.4, 8.1.2, 11.6.5, 14.4.8, 20.1.83, 20.2.5, 29.11.4.*
$Co^{III}(phen)_2(\mu\text{-}O_2,NH_2)Co^{III}(phen)_2^{4+}$ *20.1.84.*
$Co(sar)^{3+}$ *19.14.18, 20.1.85.*
$Co(sep)^{3+}$ *19.1.4, 19.11.13, 19.14.19, 19.15.1, 19.16.1, 19.17.21, 19.18.2, 19.19.3, 19.58.24, 20.1.86, 29.21.2.*
$CoSiW_{11}O_{39}H_2O^{6-}$ *20.1.87.*

$Co(terpy)_2^+$ *20.1.88.*
$Co(terpy)_2^{2+}$ *1.1.5, 11.6.6, 20.1.89, 29.11.5.*
$Co(terpy)_2^{3+}$ *1.1.6, 8.1.3, 11.6.7, 29.11.6.*
cis-$Co(tfac)_3$ *20.1.90.*
trans-$Co(tfac)_3$ *20.1.91.*
Cr^{3+} *3.1.1, 19.1.5, 19.11.14, 19.14.20, 19.17.22, 19.18.3, 19.19.4, 19.30.8, 19.58.25, 20.1.92, 28.1.9.*
$Cr(acac)_3$ *5.2.2, 5.3.1, 19.30.9, 19.58.26, 19.60.8, 20.1.93.*
$Cr(bpy)_3^{3+}$ *4.14.25, 20.1.94.*
cis-$Cr(bzac)_3$ *5.3.2, 20.1.95.*
trans-$Cr(bzac)_3$ *5.3.3, 20.1.96.*
$Cr(5\text{-Brphen})_3^{3+}$ *4.1.1.*
$Cr(CN)_6^{3-}$ *4.9.1, 4.14.26, 4.16.3, 4.17.1, 7.1.2, 7.3.2, 9.3.2, 9.4.1, 14.4.9, 16.3.3, 18.10.1, 19.30.10, 19.58.27, 19.60.9, 20.1.97, 24.4.3, 24.17.2, 29.30.2.*
$Cr(CO)_6$ *28.1.10.*
$Cr(C_2O_4)_3^{3-}$ *19.30.11, 19.58.28, 19.60.10, 20.1.98.*
trans-$Cr(cyclam)(CN)_2^+$ *19.30.12, 20.1.99.*
$Cr(5\text{-Clphen})_3^{3+}$ *4.3.1.*
$Cr(dbm)_3$ *5.3.4.*
trans-$Cr(diethylenetriamine)_2^{3+}$ *19.30.13.*
$Cr(en)_3^{3+}$ *19.30.14, 20.1.100.*
trans-$Cr(en)_2Br_2^+$ *19.30.15.*
cis-$Cr(en)_2Cl_2^+$ *19.30.16, 20.1.101.*
trans-$Cr(en)_2Cl_2^+$ *19.30.17, 19.60.11, 20.1.102.*
trans-$Cr(en)_2F_2^+$ *19.30.18, 19.60.12.*
cis-$Cr(en)_2(NCS)_2^+$ *19.30.19.*
trans-$Cr(en)_2(NCS)_2^+$ *19.30.20, 19.60.13.*
cis-$Cr(en)_2(NCS)Cl^+$ *19.30.21.*
trans-$Cr(en)_2(NCS)Cl^+$ *19.30.22, 19.60.14.*
trans-$Cr(en)_2(ONO)Cl^+$ *19.30.23, 19.60.15.*
$Cr(hfac)_3$ *5.3.5.*
$Cr(hfac)(tfbzac)_2$ *5.3.6.*
$Cr(4,4'\text{-Me}_2bpy)_3^{3+}$ *4.4.1.*
$Cr(3,4,7,8\text{-Me}_4phen)_3^{3+}$ *4.5.1.*
$Cr(4,7\text{-Me}_2phen)_3^{3+}$ *4.6.1.*
$Cr(5\text{-Mephen})_3^{3+}$ *4.7.1.*
$Cr(5,6\text{-Me}_2phen)_3^{3+}$ *4.8.1.*
$Cr(NH_3)_6^{3+}$ *19.30.24, 20.1.103.*
$Cr(NH_3)_5Br^{2+}$ *19.30.25, 20.1.104.*
$Cr(NH_3)_5(CN)^{2+}$ *19.30.26, 20.1.105.*
$Cr(NH_3)_5Cl^{2+}$ *19.30.27, 20.1.106.*
$Cr(NH_3)_5(H_2O)^{3+}$ *19.30.28, 20.1.107.*
$Cr(NH_3)_5(N_3)^{2+}$ *19.30.29, 20.1.108.*
trans-$Cr(NH_3)_2(NCS)_4^-$ *19.30.30, 19.60.16.*
$Cr(NH_3)_5(NCS)^{2+}$ *19.30.31, 20.1.109.*
$Cr_2O_7^{2-}$ *28.1.11.*
$Cr(pdo)_3$ *5.3.7.*
$Cr(4,4'\text{-Ph}_2bpy)_3^{3+}$ *4.11.1.*
$Cr(phen)_3^{3+}$ *4.18.23.*
$Cr(4,7\text{-Ph}_2phen)_3^{3+}$ *4.12.1.*
$Cr(5\text{-Phphen})_3^{3+}$ *4.13.1.*
$Cr[trans\text{-(R)-cyclohexanediamine}]_3^{3+}$ *19.30.32.*
$Cr(tfac)_3$ *5.3.8.*
cis-$Cr(tfac)_3$ *20.1.110.*
trans-$Cr(tfac)_3$ *20.1.111.*
$Cr(tfbzac)_3$ *5.3.9.*
$Cr(tta)_3$ *5.3.10.*
Cu^{2+} *3.1.2, 14.2.2, 14.4.10, 19.1.6, 19.11.15, 19.14.21, 19.15.2, 19.17.23, 19.18.4, 19.19.5, 19.22.1, 19.23.1, 19.24.4, 19.30.33, 19.31.1, 19.32.1, 19.58.29, 19.60.17, 19.63.1, 20.1.112, 28.1.12, 29.15.3, 29.24.3.*
$Cu(acac)_2$ *19.30.34, 19.58.30, 19.60.18, 20.1.113.*
Cu^{II}-Acetic acid *20.1.114.*
Cu^{II}-azurin *4.18.24, 20.1.115.*
Cu^{I}-azurin *20.1.116.*
$CuCl^+$ *19.15.3, 19.17.24, 19.58.31, 20.1.117.*
$CuCl_2$ *19.15.4, 19.17.25, 19.58.32, 20.1.118.*
$Cu(EDTA)^{2-}$ *24.7.2.*
Cu^{II}-EDTA *16.1.2.*
Cu^{II}-Formic acid *20.1.119.*
$Cu(H_2O)_n^{2+}$ *19.15.5, 19.17.26, 19.58.33, 20.1.120.*
Cu^{II}-plastocyanin *4.18.25, 20.1.121.*
Cu^{I}-plastocyanin *20.1.122.*
Cu^{II}-stellacyanin *4.18.26, 20.1.123.*
Cu^{I}-stellacyanin *20.1.124.*
$Dy(acac)_3$ *24.15.1.*
Er^{3+} *24.4.4, 28.1.13.*
$Er(acac)_3$ *24.15.2.*
Eu^{2+} *9.2.4, 14.1.2, 19.11.16, 19.14.22, 19.17.27, 19.58.34, 20.1.125.*
Eu^{3+} *3.1.3, 11.11.1, 16.1.3, 19.1.7, 19.11.17, 19.14.23, 19.17.28, 19.18.5, 19.19.6, 19.58.35, 20.1.126, 24.4.5, 28.1.14, 29.23.1, 29.24.4.*
$Eu(acac)_3$ *24.15.3.*
Eu^{III}-Aspartic acid *24.1.1.*
$Eu(benzo\text{-}15\text{-crown-}5)^{3+}$ *29.24.5.*
Eu^{III}-Citric acid *24.2.1.*
$Eu(crypt)^{2+}$ *19.13.1, 19.42.1, 19.44.1, 19.47.1, 19.48.1, 19.50.1, 20.1.127.*
$Eu(crypt)^{3+}$ *19.13.2, 19.15.6, 19.19.7, 19.36.1, 19.38.1, 19.39.1, 19.44.2, 20.1.128.*
$Eu^{III}(Dipicolinic\ acid)_3$ *24.6.1.*
Eu^{III}-Dipicolinic acid *24.5.1.*
Eu^{III}-Hemimellitic acid *24.8.1.*
Eu^{III}-Malic acid *24.9.1.*
Eu^{III}-L-Malic acid *24.10.1.*
Eu^{III}-Phthalic acid *24.11.1.*
Eu^{III}-Picolinic acid *24.12.1.*
Eu^{III}-Pyromellitic acid *24.13.1.*
$Eu(thd)_3$ *24.20.1.*
Eu^{III}-Trimellitic acid *24.14.1.*
Fe^{2+} *4.3.2, 4.4.2, 4.5.2, 4.6.2, 4.7.2, 4.11.2, 4.12.2, 4.14.27, 4.18.27, 18.13.1, 19.24.5, 19.65.2, 20.1.129, 28.1.15.*
Fe^{3+} *3.1.4, 9.2.5, 10.1.1, 10.2.1, 14.1.3, 14.4.11, 14.10.17, 15.6.2, 19.1.8, 19.11.18, 19.12.3, 19.14.24, 19.15.7, 19.16.2, 19.17.29, 19.18.6, 19.19.8, 19.22.2, 19.24.6, 19.58.36, 19.66.4, 19.67.4, 19.68.1, 20.1.130, 20.2.6, 25.1.1, 28.1.16, 29.15.4, 29.17.2.*
$Fe(bpy)_3^{2+}$ *14.1.4, 20.1.131.*
$Fe(bpy)(CN)_4^-$ *1.1.7.*
$Fe(bpy)(CN)_4^{2-}$ *1.1.8.*

cis-$Fe(bpy)_2(CN)_2^+$ *1.1.9.*
$Fe(C_5H_5)_2$ *1.1.10, 4.14.28, 8.3.1, 20.1.132, 28.1.17.*
$Fe(C_5H_5)_2^+$ *29.11.7.*
$Fe(C_5H_5)[C_5H_4C(O)CH_3]$ *20.1.133, 28.1.18.*
$Fe(C_5H_5)[C_5H_4C(O)C_6H_5]$ *20.1.134, 28.1.19.*
$Fe(C_5H_5)(C_5H_4COOH)$ *4.14.29.*
$Fe[C_5H_4C(O)CH_3]_2$ *28.1.20.*
$Fe(CN)_6^{3-}$ *1.1.11, 4.14.30, 14.4.12, 16.1.4, 19.24.7, 19.30.35, 19.58.37, 19.60.19, 19.66.5, 19.67.5, 20.1.135, 28.1.21, 29.11.8, 29.30.3.*
$Fe(CN)_6^{4-}$ *4.14.31, 7.1.3, 7.3.3, 14.1.5, 14.4.13, 19.21.1, 19.24.8, 19.30.36, 19.58.38, 19.60.20, 19.65.3, 20.1.136, 20.2.7, 24.4.6, 24.17.3, 28.1.22, 29.30.4.*
$Fe(CN)_5(CO)^{3-}$ *20.1.137.*
$Fe(CN)_5(DMSO)^{3-}$ *20.1.138.*
$Fe(CN)_5(imidazole)^{3-}$ *20.1.139.*
$Fe(CN)_5$(*N*-methylpyrazinium)$^{2-}$ *20.1.140.*
$Fe(CN)_5(NO)^{2-}$ *20.1.141.*
$Fe(CN)_5(py)^{3-}$ *20.1.142.*
$Fe(CN)_5$(pyrazinecarboxylato)$^{4-}$ *20.1.143.*
$Fe(CO)_5$ *28.1.23.*
$Fe(C_2O_4)_2^-$ *20.1.144.*
Fe^{III}(cytochrome c) *14.4.14, 14.10.18, 19.58.39, 20.1.145.*
Fe^{III}(cytochrome c)-(histidine-33)$Ru^{III}(NH_3)_5$ *20.1.146.*
Fe^{III}-EDTA *16.1.5.*
Fe(NTA) *20.1.147.*
$Fe(OH)^{2+}$ *9.3.3.*
$Fe(phen)_3^{2+}$ *14.1.6, 20.1.148.*
cis-$Fe(phen)_2(CN)_2^+$ *1.1.12.*
Ga^{3+} *28.1.24.*
Gd^{3+} *24.4.7, 28.1.25.*
$Ge(CH_3)_4$ *28.1.26.*
$Ge(C_2H_5)_4$ *28.1.27.*
H *29.19.3.*
H_2O *4.14.32, 13.1.1, 19.35.1.*
Hg^{2+} *4.18.28, 19.11.19, 19.14.25, 19.17.30, 19.18.7, 19.19.9, 19.58.40, 20.1.149, 28.1.28.*
Hg_2^{2+} *28.1.29.*
$HgCl_2$ *14.5.1, 14.10.19, 14.12.1, 14.15.1, 14.16.1, 14.18.2, 19.1.9, 19.11.20, 19.14.26, 19.15.8, 19.17.31, 19.18.8, 19.19.10, 19.21.2, 19.58.41, 20.1.150.*
$HgCl_3^-$ *19.1.10, 19.11.21, 19.14.27, 19.15.9, 19.17.32, 19.18.9, 19.19.11, 19.58.42, 20.1.151.*
$HgCl_4^{2-}$ *19.1.11, 19.11.22, 19.14.28, 19.17.33, 19.18.10, 19.19.12, 19.58.43, 20.1.152.*
Ho^{3+} *24.4.8, 28.1.30.*
$Ho(acac)_3$ *24.15.4.*
I^- *4.3.3, 4.4.3, 4.5.3, 4.6.3, 4.11.3, 4.12.3, 4.14.33, 4.16.4, 4.18.29, 19.24.9, 19.30.37, 19.58.44, 19.60.21, 20.1.153, 28.1.31.*
ICN *4.2.1.*
IO_3^- *16.1.6.*
In^{3+} *20.1.154, 28.1.32.*
$IrCl_6^{3-}$ *20.1.155.*
La^{3+} *24.4.9.*
Mg(OEP) *11.4.1.*
Mn^{2+} *28.1.33.*
$Mn(CN)_6^{3-}$ *29.30.5.*
$Mn_2(CO)_{10}$ *28.1.34.*
MnO_4^- *28.1.35.*
$Mn(TMePyP)^{5+}$ *20.1.156.*
Mo^{VI} *28.1.36.*
$Mo(CN)_8^{4-}$ *4.14.34, 14.4.15, 20.1.157.*
$Mo(CO)_6$ *28.1.37.*
N_2H_4 *28.1.38.*
NO_2^- *16.1.7.*
NO_3^- *19.58.45, 20.1.158.*
Nd^{3+} *6.1.1, 7.1.4, 23.1.1, 24.4.10, 28.1.39.*
$Nd(acac)_3$ *24.15.5.*
$Nd(H_2O)_n^{3+}$ *6.2.1, 6.3.1, 6.4.1, 23.2.1, 23.3.1, 24.16.1.*
Ni^{2+} *9.2.6, 9.3.4, 19.30.38, 19.58.46, 19.60.22, 20.1.159, 28.1.40, 29.24.6.*
$Ni(acac)_2$ *19.30.39, 19.58.47, 19.60.23, 20.1.160.*
$Ni(13\text{-}At)^+$ *4.14.35.*
$Ni(CN)_4^{2-}$ *4.14.36, 14.4.16, 16.1.8, 20.1.161.*
$Ni(CO)_4$ *28.1.41.*
$NiCl_4^{2-}$ *19.30.40, 19.60.24.*
Ni(etioporphyrin I) *11.6.8, 15.1.2, 15.5.1.*
$Ni(gly)_2$ *4.16.5.*
$Ni(Me_6cyclam)^{2+}$ *4.14.37.*
$Ni[S_2C_2(C_6H_5)_2]_2$ *20.1.162.*
$Ni[S_2C_2(C_6H_5)_2]_2^-$ *20.1.163.*
$Ni[S_2C_2(CN)_2]_2^{2-}$ *20.1.164.*
Ni(TPP) *15.1.3.*
O_2 *2.1.1, 4.1.2, 4.2.2, 4.3.4, 4.4.4, 4.5.4, 4.6.4, 4.7.3, 4.11.4, 4.12.4, 4.14.38, 4.18.30, 5.5.1, 9.2.7, 9.5.1, 14.4.17, 14.6.1, 14.10.20, 14.13.1, 14.14.1, 15.2.1, 16.1.9, 16.2.2, 19.1.12, 19.11.23, 19.14.29, 19.15.10, 19.16.3, 19.17.34, 19.18.11, 19.19.13, 19.20.1, 19.21.3, 19.22.3, 19.26.1, 19.30.41, 19.49.1, 19.58.48, 19.59.1, 19.60.25, 19.61.1, 19.62.1, 19.63.2, 19.64.1, 20.1.165, 29.6.1, 29.12.1, 29.15.5, 29.21.3, 29.24.7, 29.28.1.*
O_3 *6.1.2, 24.4.11.*
OD^- *18.1.1.*
OH *29.19.4.*
OH^- *4.9.2, 4.10.1, 4.14.39, 4.16.6, 18.2.1, 18.3.1, 18.4.1, 18.5.2, 18.6.1, 18.9.1, 18.10.2.*
$Os(bpy)_3^{2+}$ *4.14.40, 4.18.31, 19.11.24, 19.17.35, 20.1.166.*
$Os(bpy)_3^{3+}$ *4.14.41, 20.1.167.*
$Os(C_5H_5)_2$ *28.1.42.*
$Os(C_5H_5)[C_5H_4C(O)CH_3]$ *20.1.168.*
$Os(CN)_6^{4-}$ *7.3.4, 20.1.169.*
trans-$Os(en)_2Cl_2^+$ *20.1.170.*
cis-$Os(en)_2H_2^{2+}$ *20.1.171.*
trans-$Os(en)_2O_2^{2+}$ *20.1.172.*
$Os(NH_3)_6^{3+}$ *19.11.25, 19.15.11, 19.17.36, 19.19.14, 20.1.173.*
$Os(NH_3)_5Cl^{2+}$ *19.11.26, 19.15.12, 19.17.37, 20.1.174.*
$Os(NH_3)_5(H_2O)^{3+}$ *19.11.27, 19.15.13, 19.16.4, 19.17.38, 19.19.15, 20.1.175.*
$Os(NH_3)_5I^{2+}$ *19.11.28, 19.15.14, 19.16.5, 19.19.16,*

20.1.176.
$Os(NH_3)_5(N_2)^{2+}$ *19.11.29, 19.17.39, 20.1.177.*
$PW_{12}O_{40}^{3-}$ *12.1.1.*
Pb^{2+} *28.1.43.*
$Pb(CH_3)_4$ *28.1.44.*
$Pb(C_2H_5)_4$ *28.1.45.*
$Pb(CH_3)(C_2H_5)_3$ *28.1.46.*
$Pb(CH_3)_2(C_2H_5)_2$ *28.1.47.*
$Pb(CH_3)_3(C_2H_5)$ *28.1.48.*
$Pd(CN)_4^{2-}$ *20.1.178.*
Pd(etioporphyrin I) *11.6.9.*
Pr^{3+} *7.1.5, 24.4.12, 28.1.49.*
$Pr(acac)_3$ *24.15.6.*
$PtBr_4^{2-}$ *4.14.42, 14.4.18, 20.1.179.*
$PtBr_6^{2-}$ *4.14.43, 14.4.19, 20.1.180.*
$Pt(CN)_4^{2-}$ *4.14.44, 9.2.8, 20.1.181, 24.4.13, 28.1.50.*
$Pt(C_2O_4)_2^{2-}$ *4.14.45, 9.2.9, 14.4.20, 20.1.182, 28.1.51.*
$PtCl_4^{2-}$ *4.14.46, 14.4.21, 19.30.42, 19.58.49, 19.60.26, 20.1.183, 24.4.14.*
$PtCl_6^{2-}$ *4.14.47, 14.4.22, 19.58.50, 20.1.184.*
$Pt(en)_2^{2+}$ *4.14.48, 9.2.10, 28.1.52.*
PtF_6^{2-} *4.14.49, 14.4.23, 20.1.185.*
$Pt(NH_3)_4^{2+}$ *4.14.50, 9.2.11, 24.4.15, 28.1.53.*
$Pt(NH_3)_4Br_2^{2+}$ *9.2.12, 14.4.24, 20.1.186.*
$Pt(NH_3)_5Br^{3+}$ *9.2.13, 14.4.25, 20.1.187.*
$Pt(NH_3)Cl_3^-$ *24.4.16.*
cis-$Pt(NH_3)_2Cl_2$ *24.4.17.*
trans-$Pt(NH_3)_2Cl_2$ *24.4.18.*
$Pt(NH_3)_3Cl^+$ *24.4.19.*
$Pt(NH_3)_4Cl_2^{2+}$ *9.2.14, 14.4.26, 20.1.188.*
$Pt(NH_3)_5Cl^{3+}$ *9.2.15, 14.4.27, 20.1.189.*
$Pt(NO_2)_4^{2-}$ *4.14.51, 9.2.16, 28.1.54.*
$Pt[S_2C_2(C_6H_5)_2]_2$ *20.1.190.*
$Pt[S_2C_2(CN)_2]_2^{2-}$ *20.1.191.*
$Pt(SCN)_4^{2-}$ *4.14.52, 14.4.28, 20.1.192.*
$Pt(SCN)_6^{2-}$ *4.14.53, 14.4.29, 20.1.193.*
$Rh(bpy)_3^{3+}$ *16.2.3, 19.11.30, 19.14.30, 19.17.40, 19.18.12, 19.58.51, 20.1.194.*
cis-$Rh(bpy)_2(H_2O)_2^{3+}$ *19.11.31, 19.14.31, 19.17.41, 19.58.52, 20.1.195.*
cis-$Rh(bpy)_2(H_2O)Cl^{2+}$ *20.1.196.*
cis-$Rh(bpy)_2(H_2O)(OH)^{2+}$ *20.1.197.*
cis-$Rh(bpy)_2(OH)_2^+$ *19.11.32, 19.14.32, 19.17.42, 19.58.53, 20.1.198.*
cis-$Rh(bpy)_2(OH)Cl^+$ *20.1.199.*
$Rh(5\text{-Brphen})_3^{3+}$ *20.1.200.*
$Rh(5\text{-Clphen})_3^{3+}$ *20.1.201.*
$Rh(4,4'\text{-Me}_2bpy)_3^{3+}$ *19.11.33, 19.17.43, 19.18.13, 19.58.54, 20.1.202.*
$Rh(4,7\text{-Me}_2phen)_3^{3+}$ *20.1.203.*
$Rh(5\text{-Mephen})_3^{3+}$ *19.11.34, 19.17.44, 19.18.14, 19.58.55, 20.1.204.*
$Rh(5,6\text{-Me}_2phen)_3^{3+}$ *19.17.45, 19.18.15, 19.58.56, 20.1.205.*
$Rh(NH_3)_5Cl^{2+}$ *4.18.32.*
$Rh(phen)_3^{3+}$ *19.11.35, 19.14.33, 19.17.46, 19.58.57, 20.1.206.*
$Rh(5\text{-Phphen})_3^{3+}$ *20.1.207.*
$Ru(acac)_3$ *20.1.208.*
$Ru(2,2'\text{-biquinoline})_3^{2+}$ *19.50.2, 19.51.1.*
$Ru(bpy)_3^{2+}$ *4.14.54, 4.18.33, 16.2.4, 20.1.209, 28.1.55.*
$Ru(bpy)_3^{3+}$ *4.14.55, 20.1.210.*
$Ru(C_5H_5)_2$ *20.1.211, 28.1.56.*
$Ru(C_5H_5)[C_5H_4CH(OH)C_6H_5]$ *28.1.57.*
$Ru(C_5H_5)[C_5H_4C(O)C_6H_5]$ *28.1.58.*
$Ru[C_5H_4C(O)CH_3]_2$ *20.1.212.*
$Ru[C_5H_4C(O)C_6H_5]_2$ *28.1.59.*
$Ru(CN)_6^{4-}$ *4.14.56, 7.1.6, 7.3.5, 14.4.30, 24.4.20, 24.17.4.*
$Ru(C_2O_4)_2(H_2O)_2^-$ *20.1.213.*
$Ru(5\text{-Clphen})_3^{2+}$ *4.14.57, 4.18.34.*
$Ru(EDTA)^-$ *20.1.214.*
$Ru(H_2O)Cl_5^{2-}$ *20.1.215.*
$Ru(4,4'\text{-Me}_2bpy)_3^{2+}$ *4.14.58.*
$Ru(Me_2dibenzoH_2phen)_3^{2+}$ *19.41.1, 19.42.2.*
$Ru(3,4,7,8\text{-Me}_4phen)_3^{2+}$ *4.14.59.*
$Ru(4,7\text{-Me}_2phen)_3^{2+}$ *4.14.60, 4.18.35.*
$Ru(4,7\text{-Me}_2phen)_3^{3+}$ *19.17.47.*
$Ru(5\text{-Mephen})_3^{2+}$ *4.14.61.*
$Ru(NH_3)_6^{2+}$ *14.1.7, 20.1.216.*
$Ru(NH_3)_6^{3+}$ *4.14.62, 4.18.36, 14.4.31, 19.66.6, 19.67.6, 20.1.217.*
$Ru(NH_3)_5Cl^{2+}$ *20.1.218.*
$Ru(NH_3)_5(histidine)^{3+}$ *20.1.219.*
$Ru[5\text{-}(NO_2)phen]_3^{2+}$ *4.14.63, 4.18.37, 20.1.220.*
$Ru(phen)_3^{2+}$ *4.14.64.*
$Ru(terpy)_2^{2+}$ *14.1.8, 20.1.221.*
$Ru(TPTZ)_2^{2+}$ *14.1.9, 20.1.222.*
SCN^- *28.1.60.*
SO_2 *24.4.21.*
SO_3^{2-} *20.1.223.*
$S_2O_4^{2-}$ *20.1.224.*
$S_2O_8^{2-}$ *9.2.17, 15.6.3, 16.1.10, 16.2.5, 19.58.58, 20.1.225, 25.1.2, 25.2.1, 29.17.3, 29.19.5.*
$Si(CH_3)_4$ *28.1.61.*
$Si(C_2H_5)_4$ *28.1.62.*
$Si(CH_3)_3[C(CH_3)_3]$ *28.1.63.*
$Si(CH_3)_3(C_2H_5)$ *28.1.64.*
$SiW_{12}O_{40}^{4-}$ *12.1.2.*
Sm^{3+} *20.1.226, 23.1.2, 24.3.1, 24.4.22, 28.1.65.*
$Sm(acac)_3$ *24.15.7.*
Sn^{IV} *28.1.66.*
Sn^{2+} *28.1.67.*
$Sn(CH_3)_4$ *28.1.68.*
$Sn(C_2H_5)_4$ *28.1.69.*
$Sn[CH(CH_3)_2]_4$ *28.1.70.*
$Sn(CH_3)_3(C_2H_5)$ *28.1.71.*
$Sn(CH_2CH_2CH_3)_4$ *28.1.72.*
$Sn[CH(CH_3)CH_2CH_3]_4$ *28.1.73.*
$Sn(CH_2CH_2CH_2CH_3)_4$ *28.1.74.*
$Sn(CH_3)_3(CH_2CH_2CH_2CH_3)$ *28.1.75.*
Sr^{2+} *28.1.76.*
Tb^{3+} *24.3.2.*
Th^{IV} *28.1.77.*
Ti^{3+} *19.11.36, 19.15.15, 19.17.48, 19.58.59, 20.1.227.*
Tl^+ *20.1.228, 28.1.78.*

Tl^{3+} *3.1.5, 9.2.18, 20.1.229, 28.1.79.*
$Tl(OH)^{2+}$ *9.3.5.*
UO_2^{+} *28.1.80.*
UO_2^{2+} *20.1.230, 28.1.81.*
V^{V} *28.1.82.*
$V(CO)_6$ *28.1.83.*
W^{VI} *28.1.84.*
$W(CO)_6$ *28.1.85.*
Yb^{3+} *28.1.86.*
Yb(etioporphyrin I)$^{+}$ *15.1.4, 15.3.1, 29.13.1.*
Zn(OEP) *29.9.1.*
Zn(protoporphyrin) *29.12.2.*
Zn(TPP) *29.24.8.*
Zn(uroporphyrin I) *29.30.6.*

11.4. Index of Organic Quenchers

A locator *t.m.n* following a quencher name refers to table number *t*, excited state number *m*, and quencher number *n*.

The following abbreviations are used to designate *parts* of organic quenchers:

bpy^{2+} 2,2′-Bipyridinium dication (in *N,N′*-disubstituted derivatives)
H-3-pyl Pyridinium-3-yl cation radical
H-4-pyl Pyridinium-4-yl cation radical
Me-2-pyl *N*-Methylpyridinium-2-yl cation radical
Me-3-pyl *N*-Methylpyridinium-3-yl cation radical
Me-4-pyl *N*-Methylpyridinium-4-yl cation radical
phen^{2+} 1,10-Phenanthrolinium dication (in *N,N′*-disubstituted derivatives)
poly-2,4-ionene Poly[(dimethylimino)-1,4-butanediyl(dimethylimino)-1,2-ethanediyl dication], Fig. 9
py^{+} Pyridinium cation (in *N*-substituted derivatives)
sydnone 1,2,3-Oxadiazol-5-one, Fig. 18 (in mono- and disubstituted derivatives)
vio^{+} 4-(4-Pyridyl)pyridinium cation (in *N*-monosubstituted derivatives)
vio^{2+} 4,4′-Bipyridinium dication (in *N,N′*-disubstituted derivatives)
vioH^{2+} 4-(4-Pyridyl)pyridinium cation, protonated (in *N*-monosubstituted derivatives)

Acetate ion *21.1.1.*
2-Acetonaphthone *see* 2-Acetylnaphthalene
cis-α-Acetoxystilbene *21.1.2.*
1-Acetylanthracene *7.1.7, 7.7.1.*
2-Acetylanthracene *24.4.23.*
2-Acetylnaphthalene *6.1.3, 24.4.24, 24.15.8.*
4-Acetylphenol *21.1.3.*
cis-α-Acetylstilbene *21.1.4.*
2-Acetylthiophene *28.1.87.*
3-Acetylthiophene *28.1.88.*
Acid Fuchsin *24.4.25, 24.19.1.*
Acridine *7.1.8, 24.4.26.*
Acridine Orange *24.19.2.*
Acridine Yellow *24.19.3.*
Acrylamide *29.8.1.*
Allylacetic acid *see* Pent-4-enoic acid
2-Amino-2-methylpropane *see tert*-Butylamine
1-Aminonaphthalene *4.14.65, 7.1.9, 7.2.1, 7.4.1, 21.1.5, 24.4.27, 29.8.2.*
2-Aminonaphthalene *4.14.66, 21.1.6, 28.1.89.*
2-Aminophenol *29.8.3.*
4-Aminophenol *21.1.7.*
N-(4-Aminophenyl)aniline *4.14.67, 19.2.1, 19.42.3, 19.51.2, 21.1.8.*
Aniline *4.14.68, 7.1.10, 9.1.1, 17.2.1, 17.6.1, 19.24.10, 28.1.90.*
Aniline Bright Red B *24.4.28.*
p-Anisidine *see* 4-Methoxyaniline
Anthracene *7.1.11, 7.2.2, 7.4.2, 7.5.1, 7.6.1, 7.7.2, 7.8.1, 7.9.1, 16.2.6, 17.1.1, 18.12.1, 21.1.9, 24.4.29, 27.1.1.*
Anthracene-9-carboxylate ion *5.3.11, 21.1.10.*
9,10-Anthraquinone *29.8.4.*
9,10-Anthraquinone-2,6-disulfonate ion *19.30.43, 21.1.11, 29.20.1.*
9,10-Anthraquinone-2-sulfonate ion *21.1.12.*
9,10-Anthraquinone-2-sulfonate ion, β-CD complex *29.20.2.*
Ascorbate ion *19.1.13, 19.11.37, 19.14.34, 19.15.16, 19.16.6, 19.18.16, 19.19.17, 19.58.60, 19.62.2, 21.1.13.*
Ascorbic acid *28.1.91.*
D-Asparagine *28.1.92.*
Auramine *24.19.4.*
Aurin *24.19.5.*
Azulene *16.2.7, 18.12.2, 29.4.1.*
Benzaldehyde *29.8.5.*
Benzene *28.1.93.*
Benzenediazonium cation *21.1.14, 29.23.2, 29.24.9.*
1,4-Benzenedicarboxylic acid, dinitrile *see* 1,4-Dicyanobenzene
Benzenethiolate ion *21.1.15.*
Benzidine *see* 4,4′-Diaminobiphenyl
Benzoate ion *21.1.16.*
Benzoic acid *29.8.6.*
Benzophenone *4.2.3, 18.11.1.*
Benzophenone-2-diazonium cation *19.9.1.*
1,4-Benzoquinone *1.1.13, 1.2.1, 1.3.1, 2.2.1, 4.19.1, 5.6.1, 8.4.1, 11.5.1, 11.6.10, 11.11.2, 15.8.1, 16.3.4, 18.11.2, 19.46.1, 19.52.1, 19.70.1, 21.1.17, 29.3.1, 29.8.7, 29.9.2, 29.11.9, 29.12.3, 29.23.3, 29.24.10.*
2,1,3-Benzothiadiazole-4,7-dicarbonitrile (Fig. 4) *see* OrgQue6
N-Benzyl-3-carbamyl-py^{+} *9.6.1, 14.3.1, 14.10.21, 14.11.1, 29.30.7.*
1-Benzyl-1,4-dihydronicotinamide *21.1.18.*
Benzyldimethylamine *see* *N,N*-Dimethylbenzylamine
Biacetyl *9.2.19, 9.3.6.*
Biphenyl *16.2.8.*
2,2′-Bipyridine, diprotonated *see* $bpyH_2^{2+}$

4,4′-Bipyridine, diprotonated *see* $vioH_2^{2+}$
2,2′-Bipyridine, monoprotonated *see* $bpyH^+$
4,4′-Bipyridine, monoprotonated *see* $vioH^+$
2,2′-Bipyridine *see* bpy
2,6-Bis(*tert*-butyl)-1,4-benzoquinone *21.1.19.*
3,5-Bis(*tert*-butyl)-1,2-benzoquinone *21.1.20.*
N,N′-Bis(2-carboxylatoethyl)-(vio^{2+}) zwitterion *21.1.21.*
2,2-Bis(4-chlorophenyl)-1,1,1-trichloroethane *see* DDT
1,4-Bis(*N,N*-dimethylamino)benzene *1.1.14, 4.12.5, 4.14.69, 14.8.1, 14.10.22, 14.11.2, 14.17.1, 14.18.3, 14.19.1, 16.2.9, 17.2.2, 17.6.2, 17.8.1, 18.12.3, 19.2.2, 19.42.4, 19.51.3, 21.1.22.*
4,4′-Bis(*N,N*-dimethylamino)biphenyl *1.1.15, 4.12.6, 4.14.70, 9.1.2, 14.6.2, 14.8.2, 14.10.23, 14.11.3, 14.15.2, 14.16.2, 14.17.2, 14.18.4, 14.19.2, 16.2.10, 17.8.2, 19.71.1, 21.1.23.*
1,2-Bis(H-3-pyl)ethane dication *21.1.24.*
1,2-Bis(H-4-pyl)ethane dication *21.1.25.*
N,N′-Bis(2-hydroxyethyl)-vio^{2+} *19.58.61, 19.66.7, 19.67.7, 21.1.26.*
trans-1,2-Bis(Me-2-pyl)ethene dication *21.1.28.*
trans-1,2-Bis(Me-3-pyl)ethene dication *21.1.29.*
trans-1,2-Bis(Me-4-pyl)ethene dication *21.1.27.*
N,N-Bis(4-methoxyphenyl)amine *17.8.3.*
Bis(2-naphthyl)amine *24.4.30.*
1,4-Bis(*N*-phenylamino)benzene *4.14.71, 9.1.3, 17.6.3, 19.2.3, 19.24.11, 19.42.5, 19.51.4, 21.1.31.*
1,1′-Bis(phenylmethyl)-3,3′-dicarboxamide-1,1′,4,4′-tetrahydro-4,4′-bipyridine (Fig. 5) *see* OrgQue7
N,N′-Bis(poly-2,4-ionene)-(vio^{2+}) polycation *19.30.44, 21.1.32.*
N,N′-Bis(2-propyl)-vio^{2+} *21.1.33.*
1,2-Bis(4-pyridyl)ethane *21.1.34.*
trans-1,2-Bis(4-pyridyl)ethene *21.1.35.*
N,N′-Bis(4-sulfonatobenzyl)-(vio^{2+}) zwitterion *21.1.36.*
N,N′-Bis(2-sulfonatoethyl)-(vio^{2+}) zwitterion *12.1.3, 16.2.11.*
N,N′-Bis(3-sulfonato-1-propyl)-(bpy^{2+}) zwitterion *21.1.37.*
N,N′-Bis(3-sulfonato-1-propyl)-3,3′-dimethyl-(bpy^{2+}) zwitterion *21.1.38.*
N,N′-Bis(3-sulfonato-1-propyl)-2,2′-dimethyl-(vio^{2+}) zwitterion *21.1.39.*
N,N′-Bis(3-sulfonato-1-propyl)-2,2′,6,6′-tetramethyl-(vio^{2+}) zwitterion *21.1.40.*
N,N′-Bis(1-sulfonato-2-propyl)-(vio^{2+}) zwitterion *16.2.12.*
N,N′-Bis(3-sulfonato-1-propyl)-(vio^{2+}) zwitterion *12.1.4, 21.1.41, 29.10.1, 29.16.1, 29.17.4.*
bpy *19.12.4, 21.1.42.*
$bpyH^+$ *19.14.35, 19.15.17, 19.17.49, 19.18.17, 19.19.18, 19.58.62.*
$bpyH_2^{2+}$ *19.11.38, 19.14.36, 19.18.18, 19.19.19, 19.58.63, 21.1.43.*
4-Bromoaniline *17.6.4.*
4-Bromobenzenediazonium cation *21.1.44, 29.23.4, 29.24.11.*
4-Bromo-*N,N*-dimethylaniline *14.6.3, 14.8.3, 14.9.1, 14.15.3, 14.16.3.*
Bromoform *28.1.94.*
1-Bromo-2-nitrobenzene *11.12.1.*
1-Bromo-4-nitrobenzene *16.3.5.*
α-Bromo-4-nitrotoluene *19.46.2, 19.52.2, 29.4.2.*
4-Bromophenol *21.1.45.*
3-Bromopropanoic acid *see* 3-Bromopropionic acid
3-Bromopropionic acid *28.1.95.*
2,3-Butanedione *see* Biacetyl
Butanethiol *28.1.96.*
tert-Butyl alcohol *28.1.97.*
tert-Butylamine *4.14.72, 9.1.4.*
1-Butyl bromide *28.1.98.*
2-Butyl bromide *28.1.99.*
1-*tert*-Butyl-4-hydroxybenzene *see* 4-(*tert*-Butyl)phenol
Butyl iodide *18.11.3.*
1-Butyl iodide *28.1.100.*
4-(*tert*-Butyl)phenol *21.1.46.*
N-Butylphenothiazine *19.37.1.*
Carbon tetrachloride *16.2.13, 29.4.3.*
CDTA *28.1.101.*
$C_8H_{17}C_6H_4(OCH_2CH_2)_xOH$ (x = 9 or 10) *see* Triton X-100
p-Chloranil *see* Tetrachloro-1,4-benzoquinone
3-Chloroaniline *7.1.12.*
4-Chlorobenzenediazonium cation *29.23.5, 29.24.12.*
2-Chlorobenzoic acid, nitrile *see* 2-Chlorobenzonitrile
2-Chlorobenzonitrile *5.2.3.*
4-Chloro-*N,N*-dimethylaniline *21.1.47.*
Chloroform *16.2.14.*
1-Chloronaphthalene *24.4.31.*
1-Chloro-2-nitrobenzene *11.12.2.*
1-Chloro-4-nitrobenzene *4.2.4, 5.3.12, 9.4.2, 16.3.6, 17.6.5, 18.11.4, 21.1.48, 29.4.4, 29.9.3.*
4-Chlorophenol *21.1.49.*
2-Chlorophenothiazine *14.8.4, 14.11.4, 14.18.5, 14.19.3.*
Chrysoidin *24.19.6, 28.1.102.*
Coryphosphine *24.19.7.*
Coumarin *24.19.8.*
Cresol *see* Methylphenol
Cresyl Violet *21.1.50.*
3-Cyanophenol *21.1.51.*
4-Cyanophenol *21.1.52.*
trans-α-Cyanostilbene *21.1.53.*
2-Cyanothiophene *see* Thiophene-2-carbonitrile
Cyclobutanecarboxylic acid *28.1.103.*
Cyclohexanecarboxylic acid *28.1.104.*
Cyclohexanol *28.1.105.*
Cyclohexanol-d_{11} *28.1.106.*
Cyclohexene *28.1.107.*
Cyclopentanecarboxylic acid *28.1.108.*
Cyclopropanecarboxylic acid *28.1.109.*
Cysteine *19.69.1, 28.1.110, 29.19.6.*

L-Cystine *28.1.111.*
DDT *29.4.5, 29.9.4.*
2,3-Diacetoxynorbornadiene *9.3.7.*
2,3-Diacetoxyquadricyclane *9.3.8.*
1,2-Diaminobenzene *4.12.7, 4.14.73, 18.7.1.*
1,4-Diaminobenzene *4.12.8, 4.14.74, 18.7.2, 29.8.8.*
4,4′-Diaminobiphenyl *4.14.75, 9.1.5, 21.1.54, 24.19.9.*
trans-1,2-Diaminocyclohexane-*N,N,N′,N′*-tetraacetic acid *see* CDTA
4,4′-Diamino-3,3′-dimethylbiphenyl *see* 3,3′-Dimethyl-4,4′-diaminobiphenyl
1,4-Diazabicyclo[2.2.2]octane *18.12.4.*
4-Diazo-*N,N*-diethylaniline *see* 4-(*N,N*-Diethylamino)benzenediazonium cation
1,5-Dibenzoylnaphthalene *24.4.32.*
N,N′-Dibenzoyl-vio^{2+} *19.66.8, 19.67.8.*
Dibenzylamine *4.14.76, 9.1.6.*
N,N′-Dibenzyl-vio^{2+} *14.3.2, 14.6.4, 14.7.1, 14.8.5, 14.9.2, 14.15.4, 14.16.4, 14.17.3, 15.7.1, 17.2.3, 17.6.6, 19.11.39, 19.17.50, 19.35.2, 19.58.64,*
Dibutylamine *4.14.77, 9.1.7.*
Di-*tert*-butylbenzoquinone *see* Bis(*tert*-butyl)benzoquinone
N,N′-Dibutyl-bpy^{2+} *19.67.9.*
Di-*n*-butyl sulfide *28.1.112.*
N,N′-Dibutyl-vio^{2+} *19.21.4, 19.58.65.*
9,10-Dichloroanthracene *18.12.5.*
1,4-Dichlorobenzene *29.4.6.*
2,5-Dichloro-1,4-benzoquinone *1.1.16.*
2,6-Dichloro-1,4-benzoquinone *1.1.17.*
1,2-Dichloroethane *9.6.2.*
Dichloromethane *9.6.3.*
1,4-Dicyanobenzene *18.11.5.*
Dicyclohexylamine *4.14.78, 9.1.8.*
N,N′-Didodecyl-vio^{2+} *29.17.5.*
Diethylamine *4.14.79, 9.1.9.*
4-(*N,N*-Diethylamino)benzenediazonium cation *29.23.6, 29.24.13, 29.25.1, 29.26.1.*
N,N-Diethylaniline *4.14.80, 9.1.10, 17.8.4, 19.17.51, 19.19.20, 21.1.56, 29.8.9.*
N,N′-Diethyl-bpy^{2+} *19.66.9, 19.67.10.*
N,N′-Diethyl-4,4′-dimethyl-bpy^{2+} *19.66.10, 19.67.11.*
Diethyldithiocarbamate ion *21.1.57.*
O,O′-Diethyldithiophosphate ion *21.1.58.*
Diethylenedioxide *see* 1,4-Dioxane
Diethyl fumarate *18.11.6.*
1,1′-Diethylisocyanine cation *24.4.33, 24.19.10.*
3,3′-Diethyl-9-methylthiacarbocyanine cation *24.4.34, 24.19.11.*
N,N′-Diethyl-2-methyl-vio^{2+} *21.1.59.*
Diethylphenylamine *see N,N*-Diethylaniline
Diethyl sulfide *28.1.113.*
N,N′-Diethyl-vio^{2+} *19.21.5, 19.58.66.*
N,N′-Diheptyl-vio^{2+} *21.1.60, 29.15.6.*
N,N′-Dihexyl-vio^{2+} *19.58.67, 29.17.6.*
Dihydronicotinamide adenine dinucleotide *29.30.8.*
1,4-Dihydroxybenzene *19.56.1, 19.69.2, 21.1.61, 28.1.114, 29.8.10.*
1,4-Dihydroxy-2,3,5-trimethylbenzene *see* Trimethyl-1,4-dihydroxybenzene
1,2-Dimethoxybenzene *4.14.81, 9.1.11, 19.24.12.*
1,4-Dimethoxybenzene *4.14.82, 9.1.12, 17.2.4, 17.6.7, 18.7.3, 18.8.1, 18.13.2, 19.24.13.*
1-(*N,N*-Dimethylamino)naphthalene *see* 1-Naphthyldimethylamine
4-(*N,N*-Dimethylamino)phenol *21.1.62.*
4-Dimethylaminotoluene *see* 4,*N,N*-Trimethylaniline
N,N-Dimethylaniline *7.1.13, 7.6.2, 7.7.3, 9.1.13, 14.11.5, 14.17.4, 15.8.2, 16.2.15, 17.6.8, 17.8.5, 18.12.6, 19.2.4, 19.3.1, 19.4.1, 19.5.1, 19.6.1, 19.8.1, 19.9.2, 19.17.52, 19.24.14, 19.33.1, 19.34.1, 19.35.3, 19.42.6, 19.51.5, 21.1.63.*
3,3′-Dimethylbenzidine *see* 3,3′-Dimethyl-4,4′-diaminobiphenyl
N,N-Dimethylbenzylamine *4.14.83, 9.1.14, 17.6.9.*
N,N′-Dimethyl-3,3′-bipyridinium dication *21.1.64.*
N,N′-Dimethyl-4,4′-bipyridinium dication *see* MV^{2+}
N,N′-Dimethyl-bpy^{2+} *19.66.11, 19.67.12, 21.1.65, 29.10.2.*
4,4′-Dimethyl-bpyH$_2$$^{2+}$ *19.11.40, 19.14.37, 19.17.53, 19.58.68, 21.1.66.*
3,3′-Dimethyl-4,4′-diaminobiphenyl *1.1.18, 4.12.9, 4.14.84, 18.7.4.*
N,N′-Dimethyl-2,7-diazaphenanthrene dication *21.1.67.*
Dimethyldibenzothiafulvalene *21.1.68.*
Dimethyl disulfide *28.1.115.*
1,2-Dimethyl-4-hydroxybenzene *see* 3,4-Dimethylphenol
1,1′-Dimethyl-5,6-naphthopseudoisocyanine cation *24.19.12.*
N,N-Dimethyl-1-naphthylamine *see* 1-Naphthyldimethylamine
1,2-Dimethyl-3-nitrobenzene *19.46.3, 19.52.3.*
1,3-Dimethyl-2-nitrobenzene *19.52.4.*
N,N-Dimethyl-4-nitrosoaniline *see* 4-Nitroso-*N,N*-dimethylaniline
N,N′-Dimethyl-phen^{2+} *21.1.69.*
3,4-Dimethylphenol *29.8.11.*
N,4-Dimethyl-py^{+} *9.6.4.*
Dimethyl sulfide *28.1.116.*
Dimethylsulfoxide *see* DMSO
N,N′-Dimethyl-3,3′-thio-vio^{2+} *21.1.70.*
N,N-Dimethyl-*p*-toluidine *see* 4,*N,N*-Trimethylaniline
Di-2-naphthylamine *see* Bis(2-naphthyl)amine
2,4-Dinitroaniline *4.2.5.*
2,4-Dinitrobenzaldehyde *4.2.6.*
1,2-Dinitrobenzene *4.2.7, 11.12.3, 16.3.7, 19.3.2, 19.4.2, 19.5.2, 19.6.2, 19.8.2, 19.33.2, 19.34.2, 19.46.4, 19.52.5, 19.66.12, 19.67.13, 21.1.71.*
1,3-Dinitrobenzene *4.2.8, 5.2.4, 5.3.13, 11.5.2, 16.3.8, 18.11.7, 19.46.5, 19.52.6, 19.66.13, 19.67.14, 21.1.72.*
1,4-Dinitrobenzene *5.3.14, 11.12.4, 18.11.8, 19.3.3, 19.4.3, 19.5.3, 19.6.3, 19.8.3, 19.9.3, 19.33.3,*

19.34.3, *19.46.6*, *19.52.7*, *19.66.14*, *19.67.15*, *21.1.73*, *29.4.7*, *29.23.7*, *29.24.14*.
4,4′-Dinitrobiphenyl *5.3.15*, *17.6.10*, *21.1.74*.
cis-4,4′-Dinitrostilbene *21.1.75*, *29.4.8*, *29.5.1*.
trans-4,4′-Dinitrostilbene *29.4.9*.
N,N′-Dioctyl-vio^{2+} *21.1.76*.
N,N′-Dioctyl-vio^{2+}, β-CD complex *21.1.77*.
1,4-Dioxane *28.1.117*.
Diphenylamine *4.14.85*, *7.1.14*, *7.6.3*, *9.1.15*, *16.2.16*, *17.6.11*, *17.8.6*, *18.7.5*, *19.24.15*, *21.1.78*, *29.1.110*.
N,N-Diphenylaniline *see* Triphenylamine
9,10-Diphenylanthracene cation radical *7.1.15*, *24.4.35*.
Diphenylethene *see* Stilbene
Diphenyl ketone *see* Benzophenone
Diphenylmethanol *16.2.17*.
Diphenylmethylamine *7.1.16*.
Diphenylmorpholinoethane derivatives *see* OrgQue11 and OrgQue12, Fig. 7
N,N′-Diphenyl-1,4-phenylenediamine *see* 1,4-Bis(*N*-phenylamino)benzene
3,4-Diphenyl-sydnone *21.1.79*.
Dipropylamine *4.14.86*, *9.1.16*.
N,N′-Dipropyl-bpy^{2+} *19.66.15*, *19.67.16*.
Di-*n*-propyl sulfide *28.1.119*.
N,N′-Dipropyl-vio^{2+} *29.17.7*.
Diquat *see* DQ^{2+}
1,3-Dithiane *28.1.120*.
1,4-Dithiane *28.1.121*.
DMSO *21.1.80*.
DQ^{2+} *17.6.12*, *19.11.41*, *19.14.38*, *19.17.54*, *19.18.19*, *19.19.21*, *19.58.69*, *21.1.81*, *29.10.3*.
Duroquinone *see* Tetramethyl-1,4-benzoquinone
EDTA *19.24.16*, *28.1.122*, *29.15.7*, *29.17.8*, *29.22.1*.
Eosin *24.4.36*.
Erythrosin *24.4.37*.
Ethanol *28.1.123*.
Ethanol, protonated *26.1.1*.
4-Ethoxyphenol *21.1.82*.
Ethyl bromide *28.1.124*.
N-Ethyl-4-(*tert*-butyl)-py^{+} *9.6.5*.
N-Ethyl-3-carbamyl-py^{+} *14.3.3*, *14.8.6*, *14.10.24*, *14.15.5*.
N-Ethyl-4-carbamyl-py^{+} *9.6.6*, *14.8.7*, *14.10.25*, *14.11.6*, *14.15.6*, *14.16.5*, *14.17.5*.
N-Ethyl-4-carbomethoxy-py^{+} *14.3.4*, *14.6.5*, *14.7.2*, *14.9.3*, *14.10.26*, *14.16.6*, *14.17.6*.
N,N′-Ethylene-2,2′-bipyridinium dication *see* DQ^{2+}
Ethylenediaminetetraacetic acid *see* EDTA
N,N′-Ethylene-3,3′-dimethyl-bpy^{2+} *21.1.83*.
N,N′-Ethylene-4,4′-dimethyl-bpy^{2+} *19.11.42*, *19.17.55*, *19.66.16*, *19.67.17*, *21.1.84*.
N,N′-Ethylene-5,5′-dimethyl-bpy^{2+} *21.1.85*.
N,N′-Ethylene-6,6′-dimethyl-bpy^{2+} *21.1.86*.
N,N′-Ethylene-6-ethyl-bpy^{2+} *21.1.87*.
N,N′-Ethylene-6-methyl-bpy^{2+} *21.1.88*.
N,N′-Ethylene-phen^{2+} *21.1.89*.
Ethylene sulfide *28.1.125*.
1-Ethyl-4-hydroxybenzene *see* 4-Ethylphenol
Ethyl iodide *28.1.126*.
N-Ethylphenazinium cation *19.71.2*.
4-Ethylphenol *21.1.90*.
N-Ethyl-py^{+} *9.6.7*.
2-Ethylthiophene *28.1.127*.
Ethylxanthate ion *21.1.91*.
Fluorene *7.5.2*, *24.19.13*.
9-Fluorenone *6.1.4*, *24.4.38*.
1-Fluoro-4-nitrobenzene *16.3.9*, *21.1.92*.
3-Fluorophenol *21.1.93*.
4-Fluorophenol *21.1.94*.
Formic acid *28.1.128*.
Fuchsin *24.4.39*, *24.19.14*.
L-Glutamine *28.1.129*.
Heteropentalenes *see* OrgQue1 to OrgQue5, Fig. 3
Hexachlorobenzene *5.2.5*, *29.4.10*, *29.9.5*.
Hexachloroethane *29.4.11*, *29.9.6*.
N,N′,2,2′,6,6′-Hexamethyl-vio^{2+} *21.1.95*.
Histidine *28.1.130*.
1-(H-3-pyl)-2-(H-4-pyl)ethane dication *21.1.96*.
Hydroquinone *see* 1,4-Dihydroxybenzene
4-Hydroxyacetophenone *see* 4-Acetylphenol
Hydroxyaniline *see* Aminophenol
Hydroxyanisole *see* Methoxyphenol
4-Hydroxybenzoic acid *21.1.97*.
Hydroxybenzoic acid, nitrile *see* Cyanophenol
4-Hydroxybiphenyl *21.1.98*,
4-Hydroxy-*N,N*-dimethylaniline *see* 4-(*N,N*-Dimethylamino)phenol
Hydroxynaphthalene *see* Naphthol
2-Hydroxy-2-propyl radical *29.19.7*.
Hydroxytoluene *see* Methylphenol
2-Hydroxy-1,3,5-trimethylbenzene *see* 2,4,6-Trimethylphenol
Imidazole *21.1.99*.
Iodobutane *see* Butyl iodide
Iodomethane *see* Methyl iodide
1-Iodo-4-nitrobenzene *19.66.17*, *19.67.18*.
4-Iodophenol *21.1.100*.
Isoleucine *28.1.131*.
Lactic acid *28.1.132*.
DL-Leucine *28.1.133*.
Magdala Red *24.4.40*, *24.19.15*.
trans-1-(Me-2-pyl)-2-(Me-3-pyl)ethene dication *21.1.102*.
trans-1-(Me-3-pyl)-2-(Me-4-pyl)ethene dication *21.1.101*.
2-Mercaptobenzoic acid *21.1.103*.
2-Mercaptoethanol *29.10.4*.
4-Mercaptopyridine *21.1.104*.
Methanol *28.1.134*.
Methanol-d_1 *28.1.135*.
Methanol-d_3 *28.1.136*.
Methanol-d_4 *28.1.137*.
DL-Methionine *28.1.138*.
4-Methoxyaniline *21.1.105*.
4-Methoxybenzenediazonium cation *21.1.106*, *29.23.8*,

29.24.15, 29.25.2, 29.26.2.
4-Methoxy-*N*,*N*-dimethylaniline 14.10.27, 14.11.7, 14.17.7, 14.18.6, 14.19.4, 15.8.3, 21.1.107.
4-Methoxydithiobenzoate ion 21.1.108.
2-Methoxynaphthalene 24.4.41.
1-Methoxy-2-nitrobenzene 18.11.9.
1-Methoxy-4-nitrobenzene 5.2.6, 11.3.1, 19.46.7, 19.52.8, 29.3.2, 29.4.12, 29.9.7.
3-Methoxyphenol 21.1.109.
4-Methoxyphenol 21.1.110.
3-Methoxyphenothiazine 14.11.8, 14.18.7, 14.19.5.
N-Methyl-4-acetoxy-py$^+$ 9.6.8.
N-Methyl-4-acetyl-py$^+$ 21.1.111.
N-Methylaniline 4.14.87, 9.1.17, 21.1.112.
4-Methylbenzenediazonium cation 21.1.113, 29.23.9, 29.24.16, 29.25.3, 29.26.3.
Methyl-1,4-benzoquinone 1.3.2, 21.1.114.
N-Methyl-3-carbamyl-py$^+$ 9.6.9, 14.3.5, 14.10.28.
N-Methyl-4-carbamyl-py$^+$ 14.3.6, 14.15.7, 14.17.8, 19.27.1, 19.28.1, 19.55.1.
N-Methyl-4-carbomethoxy-py$^+$ 14.6.6, 14.7.3, 14.8.8, 14.9.4, 14.10.29, 14.11.9, 14.15.8, 14.17.9, 17.6.13, 18.12.7, 19.71.3, 21.1.115.
N-Methyl-4-carboxylato-(py$^+$) zwitterion 21.1.116.
N-Methyl-4-carboxy-py$^+$ 21.1.117.
N-Methyl-4-cyano-py$^+$ 9.6.10, 14.3.7, 14.6.7, 14.7.4, 14.8.9, 14.9.5, 14.10.30, 14.11.10, 14.15.9, 14.16.7, 14.17.10, 17.6.14, 19.71.4, 21.1.118.
N-Methyl-*N'*-hexadecyl-vio^{2+} 21.1.119.
2-Methyl-2-hydroxypropyl radical 29.19.8.
Methyl iodide 4.2.9, 28.1.139.
N-Methyl-2-methoxy-py$^+$ 9.6.11.
N-Methylnicotinamide 18.12.8.
Methyl 3-nitrobenzoate 19.66.18, 19.67.19, 21.1.120.
Methyl 4-nitrobenzoate 18.11.10, 19.66.19, 19.67.20, 21.1.121.
3-Methylphenol 21.1.122.
4-Methylphenol 21.1.123.
N-Methylphenothiazine 14.9.6, 14.15.10, 14.16.8, 14.17.11, 14.18.8, 14.19.6, 16.2.18, 17.6.15, 17.8.7, 21.1.124.
Methylphenylamine *see* *N*-Methylaniline
3-Methyl-4-phenyl-sydnone 21.1.125.
N-Methyl-*N'*-[(3*S*)-(−)-3-pinanylmethyl]-vio^{2+} 21.2.1, 21.3.1.
N-Methyl-*N'*-(poly-2,4-ionene)-(vio^{2+}) polycation 19.30.45, 21.1.126.
2-Methyl-2-propanol *see* *tert*-Butyl alcohol
N-Methylpyrazinium cation 21.1.127.
cis-α-Methylstilbene 15.4.1.
trans-α-Methylstilbene 15.4.2.
N-Methyl-*N'*-tetradecyl-vio^{2+} 21.1.128, 29.17.9.
Methylthioacetonitrile 28.1.140.
Methyl thiocyanate 28.1.141.
N-Methyl-vio$^+$ 21.1.129.
N-Methyl-vioH^{2+} 21.1.130.
Methylviologen *see* MV^{2+}
Metronidazole 29.24.17.
Misonidazole 29.24.18.
Morin 24.4.42.
MV^{2+} 1.1.19, 5.3.16, 8.2.1, 8.5.1, 9.2.20, 9.4.3, 9.6.12, 11.6.11, 11.8.1, 11.9.1, 11.10.1, 14.6.8, 14.7.5, 14.8.10, 14.9.7, 14.10.31, 14.11.11, 14.15.11, 14.16.9, 14.17.12, 15.4.3, 15.6.4, 15.7.2, 16.1.11, 16.2.19, 16.3.10, 17.2.5, 17.6.16, 18.12.9, 18.15.1, 18.16.1, 18.17.1, 19.2.5, 19.4.4, 19.5.4, 19.8.4, 19.9.4, 19.10.1, 19.11.43, 19.14.39, 19.17.56, 19.23.2, 19.24.17, 19.25.1, 19.29.1, 19.30.46, 19.31.2, 19.32.2, 19.33.4, 19.34.4, 19.35.4, 19.40.1, 19.42.7, 19.44.3, 19.45.1, 19.51.6, 19.53.1, 19.54.1, 19.57.1, 19.58.70, 19.66.20, 19.67.21, 19.71.5, 19.72.1, 22.1.1, 25.1.3, 25.2.2, 25.3.1, 29.7.1, 29.10.5, 29.11.10, 29.15.8, 29.17.10, 29.19.9, 29.21.4, 29.22.2, 29.24.19, 29.27.1, 29.28.2, 29.29.1.
Naphthacene 4.2.10, 15.1.5, 29.4.13.
Naphthacene cation radical 7.1.17, 24.4.43.
Naphthacene, protonated 7.1.18, 24.4.44.
Naphthalene 7.5.3, 16.2.20, 17.7.1, 24.4.45, 24.15.9, 29.8.12.
1-Naphthoic acid 24.4.46.
1-Naphthol 29.8.13.
2-Naphthol 28.1.142.
1,2-Naphthoquinone 21.1.131.
1,4-Naphthoquinone 1.3.3, 8.4.2, 11.7.1, 21.1.132, 29.8.14, 29.11.11.
Naphthoquinone sulfonate 29.12.4.
1-Naphthylacetic acid 24.4.47.
Naphthylamine *see* Aminonaphthalene
2-Naphthyl benzoate 24.4.48.
1-Naphthyldimethylamine 21.1.133.
2-Naphthyl diphenyl ketone 24.4.49.
1-Naphthylphenylamine 21.1.134.
2-Naphthylphenylamine 21.1.135, 24.4.50.
New Fuchsin 24.4.51, 24.19.16.
Nicotinamide 18.12.10.
Nicotinamide adenine dinucleotide anion 29.30.10.
Nicotinamide adenine dinucleotide phosphate trianion 29.30.9.
Nile Blue A 21.1.136.
Nitrilotriacetate ion 19.37.2.
2-Nitroaniline 11.12.5, 18.11.11.
3-Nitroaniline 11.12.6.
4-Nitroaniline 4.2.11, 5.2.7, 18.11.12, 29.3.3, 29.4.14, 29.9.8.
Nitroanisole *see* Methoxynitrobenzene
9-Nitroanthracene 29.4.15.
2-Nitrobenzaldehyde 4.2.12, 19.66.21, 19.67.22.
3-Nitrobenzaldehyde 16.3.11, 17.6.17, 18.11.13, 19.66.22, 19.67.23, 21.1.137.
4-Nitrobenzaldehyde 16.3.12, 17.6.18, 19.66.23, 19.67.24, 21.1.138, 29.4.16.
4-Nitrobenzamide 19.46.8, 19.52.9.
Nitrobenzene 4.2.13, 5.2.8, 5.3.17, 9.4.4, 11.2.1, 11.3.2, 11.5.3, 11.6.12, 16.3.13, 18.11.14, 21.1.139, 29.3.4, 29.4.17, 29.18.1, 29.19.10, 29.23.10, 29.24.20.
4-Nitrobenzoate ion 21.1.140.

4-Nitrobenzoic acid, amide *see* 4-Nitrobenzamide
Nitrobenzoic acid, nitrile *see* Nitrobenzonitrile
3-Nitrobenzonitrile *16.3.14.*
4-Nitrobenzonitrile *16.3.15.*
4-Nitro-bpy *19.12.5, 21.1.141.*
Nitromethane *29.23.11, 29.24.21.*
trans-4-Nitro-β-methylstilbene *29.4.18.*
1-Nitronaphthalene *11.12.7, 24.4.52.*
1-Nitro-4-nitrosobenzene *21.1.142.*
4-Nitroso-*N,N*-dimethylaniline *19.66.24, 19.67.25.*
cis-4-Nitrostilbene *11.1.1, 11.2.2, 11.3.3, 29.1.1, 29.2.1, 29.3.5, 29.4.19, 29.5.2.*
trans-4-Nitrostilbene *29.3.6, 29.4.20.*
2-Nitrotoluene *4.2.14.*
3-Nitrotoluene *19.46.9, 19.52.10.*
4-Nitrotoluene *5.2.9, 11.3.4, 16.3.16, 17.6.19, 19.46.10, 19.52.11, 21.1.143, 29.3.7, 29.4.21, 29.9.9.*
Norbornadiene *5.1.1, 9.3.9.*
OrgQue1 *21.1.144.*
OrgQue2 *21.1.145.*
OrgQue3 *21.1.146.*
OrgQue4 *21.1.147.*
OrgQue5 *21.1.148.*
OrgQue6 *21.1.149.*
OrgQue7 *21.1.150.*
OrgQue8 *21.1.151.*
OrgQue9 *19.9.5, 21.1.152.*
OrgQue10 *21.1.153.*
OrgQue11 *19.7.1.*
OrgQue12 *19.7.2.*
OrgQue13 *11.7.2.*
OrgQue14 *11.7.3.*
Oxalic acid *28.1.143.*
Oxazine 1 *21.1.154.*
Paraquat *see* MV^{2+}
Pentamethylene sulfide *28.1.144.*
Pent-4-enoic acid *28.1.145.*
Perylene *5.4.1, 15.1.6, 29.4.22.*
Perylene cation radical *7.1.19, 24.4.53.*
Phenanthrene *24.19.17.*
9,10-Phenanthrenequinone *1.3.4, 4.2.15, 16.3.17, 21.1.155.*
1,10-Phenanthroline, diprotonated *see* $phenH_2^{2+}$
1,10-Phenanthroline, monoprotonated *see* $phenH^+$
9,10-Phenanthroquinone *see* 9,10-Phenanthrenequinone
Phenazine *24.4.54.*
$phenH^+$ *19.11.44, 19.14.40, 19.18.20, 19.58.71, 21.1.156.*
$phenH_2^{2+}$ *19.11.45, 19.18.21, 19.58.72, 21.1.157.*
Phenol *21.1.158, 28.1.146, 29.8.15.*
Phenosafranine *24.4.55.*
Phenothiazine *1.1.20, 14.6.9, 14.8.11, 14.9.8, 14.10.32, 14.15.12, 14.16.10, 14.17.13, 14.19.7, 17.8.8, 19.2.6, 19.24.18, 19.42.8, 19.51.7, 21.1.159.*
Phenothiazine, polymeric *see* PolyPTZ, Fig. 10
Phenoxathiin *14.6.10, 14.9.9.*
L-Phenylalanine *28.1.147.*
N-Phenylaniline *see* Diphenylamine
Phenylenediamine *see* Diaminobenzene
cis-1-Phenyl-2-(Me-4-pyl)ethene cation *21.1.160.*
cis-1-Phenyl-2-(2-naphthyl)ethene *4.14.88.*
trans-1-Phenyl-2-(2-naphthyl)ethene *4.14.89.*
N-Phenylphenylenediamine *see* *N*-(4-Aminophenyl)aniline
trans-1-Phenyl-2-(2-pyridyl)ethene *21.1.161.*
trans-1-Phenyl-2-(4-pyridyl)ethene *21.1.162.*
3-Phenyl-sydnone *21.1.163.*
Polymeric phenothiazine *see* PolyPTZ, Fig. 10
Polymeric viologens *see* PolyVio1 to PolyVio14, Figs. 11 to 17
PolyPTZ *19.43.1.*
PolyVio1 *21.1.164.*
PolyVio2 *21.1.165.*
PolyVio3 *29.17.11.*
PolyVio4 *29.17.12.*
PolyVio5 *29.17.13.*
PolyVio6 *29.17.14.*
PolyVio7 *29.17.15.*
PolyVio8 *29.17.16.*
PolyVio9 *29.17.17.*
PolyVio10 *19.30.47, 21.1.166.*
PolyVio11 *19.30.48, 21.1.167.*
PolyVio12 *19.30.49, 21.1.168.*
PolyVio13 *19.30.50, 21.1.169.*
PolyVio14 *21.1.170.*
Propanethiol *28.1.148.*
2-Propanol *16.2.21, 28.1.149.*
2-Propanol-2-*d* *28.1.150.*
Propenoic acid amide *see* Acrylamide
1-Propyl bromide *28.1.151.*
2-Propyl bromide *28.1.152.*
1-Propyl iodide *28.1.153.*
2-Propyl iodide *28.1.154.*
2-Propylthiophene *28.1.155.*
py *5.2.10, 21.1.171.*
pyH^+ *21.1.172.*
Pyrazinecarboxylic acid *21.1.173.*
Pyridine, protonated *see* pyH^+
Pyridine *see* py
Quadricyclane *9.3.10.*
Quercetin *24.4.56.*
Quinone *see* 1,4-Benzoquinone
Rhodamine 101 *21.1.174.*
Rose Bengal *24.4.57.*
Rutin *24.4.58.*
Safranine T *24.4.59, 24.19.18.*
Serine *28.1.156.*
cis-Stilbene *15.4.4, 15.8.4, 16.4.1.*
Stilbenediazonium cation derivatives *see* OrgQue8 to OrgQue10, Fig. 6
trans-Stilbene *15.4.5, 15.8.5, 16.4.2, 17.1.2, 17.7.2, 18.12.11, 21.1.175.*
Tetrabutylammonium bromide *4.2.16.*
Tetrabutylammonium iodide *4.2.17.*
Tetracene *see* Naphthacene

1,2,4,5-Tetrachlorobenzene *29.4.23.*
Tetrachloro-1,2-benzoquinone *21.1.177.*
Tetrachloro-1,4-benzoquinone *1.1.21, 18.11.15, 21.1.176, 29.11.12, 29.14.1.*
Tetrachloromethane *see* Carbon tetrachloride
Tetracyanoethene *12.1.5, 16.3.18, 17.6.20, 19.3.4, 19.4.5, 19.5.5, 19.6.4, 19.8.5, 19.33.5, 19.34.5, 21.1.178.*
Tetracyanoethylene *see* Tetracyanoethene
N,N,N',N'-Tetramethylbenzidine *see* 4,4'-Bis(*N,N*-dimethylamino)biphenyl
Tetramethyl-1,4-benzoquinone *1.3.5, 21.1.179, 29.8.16, 29.18.2, 29.23.12, 29.24.22.*
N,N'-(Tetramethylene)-bpy^{2+} *19.11.46, 21.1.180, 29.10.6.*
N,N'-(Tetramethylene)-4,4'-dimethyl-bpy^{2+} *21.1.181.*
N,N'-(Tetramethylene)-phen^{2+} *21.1.182.*
Tetramethylene sulfide *28.1.157.*
2,2,6,6-Tetramethyl-4-oxopiperidine-1-oxyl radical (Fig. 8a) *see* OrgQue13
N,N,N',N'-Tetramethyl-1,4-phenylenediamine *see* 1,4-Bis(*N,N*-dimethylamino)benzene
2,2,6,6-Tetramethylpiperidine-1-oxyl radical (Fig. 8b) *see* OrgQue14
N,2,3,6-Tetramethyl-py^{+} *9.6.13.*
N,2,4,6-Tetramethyl-py^{+} *9.6.14.*
N,N',2,2'-Tetramethyl-vio^{2+} *21.1.183.*
N,N',3,3'-Tetramethyl-vio^{2+} *21.1.184.*
Tetrathiafulvalene *21.1.185, 29.19.11.*
Thiofuran *see* Thiophene
Thiolacetic acid *28.1.158.*
Thiophene *28.1.159.*
Thiophene-2-carbonitrile *28.1.160.*
Thiophenolate ion *see* Benzenethiolate ion
Thiosalycilic acid *see* 2-Mercaptobenzoic acid
Threonine *28.1.161.*
o-Tolidine *see* 3,3'-Dimethyl-4,4'-diaminobiphenyl
Toluene *16.2.22.*
Toluquinone *see* Methyl-1,4-benzoquinone
Tributylamine *4.14.90, 9.1.18.*
Trichloromethane *see* Chloroform
Triethanolamine *17.5.1, 19.24.19, 19.25.2, 19.26.2, 19.69.3, 21.1.186, 29.17.18.*
Triethylamine *4.14.91, 9.1.19, 16.2.23, 17.3.1, 17.4.1, 19.9.6.*
3,3',9-Triethyl-5,5'-dichlorothiacarbocyanine cation *24.4.60, 24.19.19.*
Triethylenediamine *see* 1,4-Diazabicyclo[2.2.2]octane
4-(Triethylphosphonio)-bpy cation *19.12.6, 21.1.187.*
Triethyl-2,2',2''-trihydroxyamine *see* Triethanolamine
2-(Trifluoromethyl)phenothiazine *14.8.12.*
1,2,3-Trimethoxybenzene *4.14.92, 9.1.20, 19.24.20.*
1,2,4-Trimethoxybenzene *4.14.93, 9.1.21, 18.8.2, 18.13.3, 18.14.1, 19.24.21.*
1,3,5-Trimethoxybenzene *4.14.94, 18.7.6, 18.8.3, 19.24.22.*
4,*N,N*-Trimethylaniline *14.17.14, 16.2.24, 17.2.6, 17.6.21, 17.8.9, 19.2.7, 19.17.57, 19.19.22, 19.24.23, 19.42.9, 19.51.8, 21.1.188.*
Trimethyl-1,4-benzoquinone *21.1.189.*
1,2,3-Trimethyl-5,6-dicyanonorbornadiene *21.1.190.*
Trimethyl-1,4-dihydroxybenzene *21.1.191.*
N,N'-(Trimethylene)-4,4'-bis(4-sulfonatophenethyl)-(bpy^{2+}) zwitterion *21.1.192.*
N,N'-(Trimethylene)-bpy^{2+} *19.58.73, 21.1.193, 29.10.7.*
N,N'-(Trimethylene)-4,4'-dimethyl-bpy^{2+} *21.1.194.*
N,N'-(Trimethylene)-4,7-dimethyl-phen^{2+} *21.1.195.*
N,N'-(Trimethylene)-4,4'-diphenethyl-bpy^{2+} *21.1.196.*
N,N'-(Trimethylene)-4,7-diphenyl-phen^{2+} *21.1.197.*
N,N'-(Trimethylene)-5-methoxy-bpy^{2+} *21.1.198.*
N,N'-(Trimethylene)-6-methyl-bpy^{2+} *21.1.199.*
N,N'-(Trimethylene)-phen^{2+} *17.6.22, 21.1.200.*
Trimethylene sulfide *28.1.162.*
N,N'-(Trimethylene)-4,4',5,5'-tetramethyl-bpy^{2+} *21.1.201.*
N,2,6-Trimethyl-4-methoxy-py^{+} *9.6.15.*
2,4,6-Trimethylphenol *21.1.202.*
N,2,6-Trimethyl-py^{+} *9.6.16.*
1,3,5-Trimethyl-2,4,6-trinitrobenzene *11.12.8.*
N,N',2-Trimethyl-vio^{2+} *21.1.203.*
Trinitrobenzene *11.5.4.*
2,4,7-Trinitro-9-fluorenone *8.3.2, 29.11.13.*
Trinitromesitylene *see* 1,3,5-Trimethyl-2,4,6-trinitrobenzene
Triphenylamine *4.12.10, 4.14.95, 7.1.20, 7.5.4, 9.1.22, 14.6.11, 14.9.10, 14.15.13, 14.16.11, 16.2.25, 17.6.23, 19.4.6, 19.5.6, 19.24.24, 19.42.10, 19.51.9, 21.1.204.*
Tris(4-bromophenyl)amine *14.6.12.*
Triton X-100 *28.1.163.*
Tryphaflavin *24.19.20.*
L-Tryptophan *28.1.164.*
Tyrosine *28.1.165.*
DL-Valine *28.1.166.*
vioH^{+} *21.1.205.*
vioH$_2$$^{2+}$ *21.1.206.*
Viologens, polymeric *see* PolyVio1 to PolyVio14, Figs. 11 to 17