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OSAC 2025-N-0017

Standard Terminology

Relating to Trace Materials

Analysis

Trace Materials Subcommittee
Chemistry: Trace Evidence Toxicology Scientific Area Committee (SAC)
Organization of Scientific Area Committees (OSAC) for Forensic Science



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OSAC Proposed Standard

DRAFT OSAC 2025-N-0017 Standard Terminology Relating to Trace Materials Analysis

Prepared by
Seized Drugs Subcommittee
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Disclaimer:

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60 **Standard Terminology Relating to Trace Materials Analysis**

61 **1. Scope**

62 1.1 This terminology standard is a compilation of terms and corresponding definitions
63 related to the analysis of Trace Materials, including but not limited to fibers, glass, hair,
64 paint, tape, and geological materials. Legal or scientific terms that are generally
65 understood or defined adequately in other readily available sources may not be
66 included.

67 1.2 The values stated in SI units are to be regarded as the standard. No other units of
68 measurement are included in this standard.

69 1.3 *This international standard was developed in accordance with internationally*
70 *recognized principles on standardization established in the Decision on Principles for the*
71 *Development of International Standards, Guides and Recommendations issued by the*
72 *World Trade Organization Technical Barriers to Trade (TBT) Committee.*
73

74 **2. Referenced Documents**

75 2.1 *ASTM Standards:*

76 **D123** Terminology Relating to Textiles

77 **E1732** Terminology Relating to Forensic Science

78 **E2224** Guide for Forensic Analysis of Fibers by Infrared Spectroscopy

79 **E2225** Guide for Forensic Examination of Fabrics and Cordage

80 **E2227** Guide for Forensic Examination of Dyes in Textile Fibers by Thin-Layer
81 Chromatography

82 **E2228** Guide for Microscopical Examination of Textile Fibers

83 **E3406** Guide for Microspectrophotometry in Forensic Fiber Analysis

84 **WK78747** Guide for the Forensic Examination of Fibers

85 **WK 78748** Practice for a Forensic Fiber Training Program
86

87 **3. Significance and Use**

88 3.1 These terms have particular application to the analysis of trace materials, including but
89 not limited to fibers, glass, hair, paint, tape, and geological materials. This standard is
90 intended to aid the user in the understanding of, and serves to bring consistency to, the
91 use of terminology across ASTM standards on trace materials.
92

93 **4. Terminology**

94 4.1 *Definitions:*

95
96 **aggregate(s) [clump(s)]**, *n*—a group of soil particles that cohere to each other more strongly than
97 to other surrounding particles (**12**).

98 DISCUSSION— (1) Soil aggregates can be natural (a ped) or formed by human activities (a
99 clod). Often the genesis of evidentiary soil aggregates is unknown, so aggregate is often
100 a preferred term in descriptions of soil evidence. (2) This use of the term aggregate is

101 distinct from this term's use in construction as the sand or crushed rock mixed with
102 cement to form mortar, grout, or concrete.

103
104 **alibi location(s)**, *n*—a known location suggested or linked to a subject (for example, a subject's
105 home) that is distinct from the crime scene.

106 DISCUSSION—The term alibi or alibi location can be perceived negatively, but comparisons of
107 geological materials from alibi locations can be exonerating. Alibi location is used to be succinct,
108 however use of this term in documentation of evidence, evidence examination reports, or
109 courtroom testimony is discouraged.

110
111 **anagen**, *n*—the active growth phase of a hair follicle in the hair growth cycle (4).
112 DISCUSSION - the root from a pulled anagen hair is elongated and is usually fully
113 pigmented.

114
115 **ancestral group**, *n*—a biogeographic designation of human populations (for example, Asian,
116 African, European) whose hair can share similar morphological and microscopic traits (5).

117 DISCUSSION—The racial terms Caucasoid, Mongoloid, and Negroid should not be used as
118 these terms are no longer acceptable in the field of anthropology (the field from which
119 these designations originated)

120
121 **anisotropic**, *adj*—a characteristic of an object in which the refractive index differs depending on
122 the direction of propagation or vibration of light through the object (8).

123
124 **arrest lines**, *n*—a sharp line on the fracture surface defining the crack front shape of an arrested
125 or momentarily-hesitated crack (10).

126
127 **attenuated total reflection (ATR)**, *n*—a method of spectrophotometric analysis based on the
128 reflection of energy at the interface of two media which have different refractive indices and are
129 in intimate contact with each other.

130
131 **background**, *n*—the signal produced by the entire analytical system apart from the material of
132 interest.

133
134 **background radiation**, *n*—X-rays resulting from scattered Bremsstrahlung and coherently and
135 incoherently scattered tube target peaks.

136
137 **backing**, *n*—a thin flexible material to which adhesive is applied.

138
139 **backscattered electron (BE) imaging**, *n*—a technique that uses high energy electrons that
140 originate from the primary electron beam of the SEM and are elastically reflected by the
141 specimen to create an image of the sample. The probability of backscattering is proportional to
142 atomic number.

143

144 **backsize, n**—a layer applied to the top side of the backing. Its purpose is to coat and fill a porous
145 surfaced backing with a material that is inert to the adhesive formulation to be used.

146

147 **biaxially oriented polypropylene (BOPP), n**—an oriented polypropylene film in which the
148 polymer has been stretched in both the machine direction and cross direction during the
149 manufacturing process. Tapes with such films cannot be torn by hand.

150

151 **binder, n**—a non-volatile portion of a paint which serves to bind or cement the pigment particles
152 together.

153

154 **Bragg equation or Bragg's law, n**—describes the physical phenomenon of X-ray scattering from
155 a crystallographic three-dimensional lattice plane as $n\lambda=2d\sin\theta$, in which n is any integer, λ is the
156 wavelength of the X-ray, d is the crystal plane separation, also known as d-spacing, and θ is the
157 angle between the crystal plane and the diffracted beam, also known as the Bragg Angle.

158

159 **braid, n**—a rope or textile structure formed by the intertwining of strands.

160

161 **buckling, n**—an abrupt change in the shape and orientation of a hair shaft with or without a slight
162 twist.

163

164 **calendering, v**—a method of producing adhesive tape by pressing an adhesive to a backing
165 material through a series of heated rollers. The surface appearance depends on the type of roller
166 used.

167

168 **calendering marks, n**—characteristic marks left on the backing material due to the
169 manufacturing process.

170

171 **cantilever curl (compression curl), n**—a curved lip formed on the compression side under
172 (perpendicular to) a bending stress.

173 DISCUSSION—When a crack is generated by a bending stress, it initially propagates
174 perpendicular to the surface which is in tension and upon which the fracture originated.

175 As the crack propagates toward the surface that was originally in compression, the plane
176 of tension rotates, causing a rotation in the developing crack surface. By the time the
177 crack intersects the opposite surface a ridge, or lip, has formed. [C1256]

178

179 **catagen, n**—the transitional phase of the hair follicle between the active growth phase (anagen)
180 and the resting phase (telogen) in the hair growth cycle.

181

182 **cathodoluminescence, n**—emission of photons in the ultraviolet (UV), visible (Vis), and infrared
183 (IR) regions of the electromagnetic spectrum as a result of electron beam interaction with certain
184 materials.

185

186 **cellophane, n**—a thin, transparent sheet made of regenerated cellulose that can be used as a
187 backing material in tape products.

- 188 **cellulose acetate**, *n*—a type of transparent film that is used for tape backings.
189 DISCUSSION—A matte surface is used for write-on tapes. Cellulose acetate is more
190 moisture-resistant than cellophane.
191
- 192 **cellulosic fiber**, *n*—fiber composed of polymers formed from glucose subunits (for example,
193 vegetable, rayon/ Lyocell).
194
- 195 **characteristic X-ray**, *n*—X-ray emission resulting from de-excitation of an atom following inner
196 shell ionization.
197 DISCUSSION—The energy of a characteristic X-ray is related to the atomic number of the
198 atom, providing the basis for energy dispersive X-ray spectroscopy.
199
- 200 **charge-coupled device (CCD)**, *n*—a silicon-based semiconductor chip consisting of a linear or
201 two-dimensional array of photo sensors or pixels that transfers an electrical charge and converts
202 it into a digital value.
203
- 204 **charging**, *n*—negative charge accumulation on either a nonconductive sample or a sample that
205 is not properly grounded.
206 DISCUSSION—This effect can interfere with image formation and X-ray analysis because
207 of beam deflection. It can usually be eliminated by the application of a conductive coating
208 or by the use of a low vacuum system.
209
- 210 **coating**, *n*—a generic term for paint, lacquer, enamel, or other liquid or liquefiable material which
211 is converted to a solid, protective, decorative, or combination thereof, film after application.
212
- 213 **comparison microscope**, *n*—a system of two microscopes positioned side-by-side and connected
214 via an optical bridge so that two specimens are examined simultaneously in either transmitted
215 or reflected light.
216
- 217 **concentric fractures**, *n*—fractures forming in an approximately circular pattern around the point
218 of impact. They are usually in straight segments that terminate at an existing radial crack (6).
219
- 220 **conchoidal fracture**, *n*—a type of fracture that produces smooth, curved, and usually striated
221 surfaces.
222
- 223 **cord**, *n*—a twisted or formed structure composed of one or more single or plied filaments,
224 strands, or yarns of organic polymer or inorganic materials.
225 DISCUSSION—Generally, cords have a diameter less than 3/16 in.
226
- 227 **cordage**, *n*—a collective term for twines, cords and ropes made from textile fibers and yarns (1).
228
- 229 **core**, *n*—a textile product (yarn, strand, small diameter rope, etc.) placed in the center of a rope
230 and serving as a support for the strands around it (1).
231 DISCUSSION—Core can be of any continuous construction including parallel strands,
232 twisted strands or braided strands.

233 **cortex, n**—the main structural component of hair consisting of elongated and fusiform (spindle-
234 shaped) cells located between the cuticle and the medulla.

235

236 **cortical fusi, n**—small air spaces that form between the cortical cells in the hair shaft and, under
237 transmitted light, appear as tiny, dark structures.

238

239 **cortical texture, n**—the relief or definition of the margins of the cortical cells when viewed using
240 transmitted light microscopy.

241

242 **course, n**—in knitted fabrics, a row of successive loops in the width direction of the fabric.

243

244 **creped paper, n**—paper that has small folds in it giving it high stretch and conformability. Used
245 in the backing of masking tape (saturated paper tape).

246

247 **crimp, n**—the curl, wave, or compression that is naturally occurring or otherwise imparted to a
248 fiber.

249

250 **crow, n**—the raised portion of a strand in twisted cordage.

251

252 **crystal, n**—homogeneous, solid body of a chemical element or compound, having a regularly
253 repeating atomic arrangement that can be outwardly expressed by plane faces (adapted from 9).

254

255 **crystal lattice, n**—the three-dimensional regularly repeating set of points that represent the
256 translational periodicity of a crystal structure.

257 DISCUSSION—Each lattice point has identical surroundings. Lattice is the abstract pattern
258 used to describe the internal geometric structure of crystals. Lattice and structure are not
259 synonymous, as structure refers to the real mineral material (adapted from 9).

260

261 **crystalline, adj**—having a crystal structure or a regular arrangement of atoms in a crystal lattice.

262

263 **curie point, n**—the temperature at which a ferromagnetic metal loses its ferromagnetic
264 properties.

265

266 **cuticle, n**—the outermost region of a hair composed of layers of overlapping scales.

267 DISCUSSION—The dimension of the cuticle as measured from its outer margin to the
268 cortex is often described in relative terms (for example, thin, medium, thick).

269

270 **cuticle, cracked, n**—a cuticle with linear breaks that are perpendicular to the length of the shaft.

271

272 **cuticle, looped, n**—a cuticle in which the distal edges of the cuticular scales are curved away from
273 or cupped toward the hair shaft.

274

275 **cuticle, serrated, n**—a cuticle in which the outer margin has a notched appearance like a saw
276 blade.

277 **d-spacing, *n***—in diffraction of X-rays by a crystal, the distance or separation between successive
278 and identical parallel planes in the crystal lattice; d-spacing is expressed as *d* in the Bragg
279 equation (adapted from 9).

280

281 **dead time, *n***—the time (expressed as a percentage of real time) during which the energy
282 dispersive X-ray spectrometer is not able to process X-rays.

283

284 **decompositional changes, *n***—alteration in the root or the proximal end of a hair that can include
285 discoloration, postmortem root banding, or a tapered or brush-like appearance as well as fungal
286 tunneling along the length of the shaft.

287

288 **delustrant, *n***—a pigment, usually titanium dioxide, used to dull the luster of a manufactured fiber
289 (7).

290

291 **dichroism, *n***—the property of exhibiting different colors, especially two different colors, when
292 viewed along different axes by plane polarized light.

293

294 **diffractometer, *n***—an instrument that records either powder or single-crystal X-ray diffraction
295 patterns.

296

297 **discriminating power, *n***—the ability of an analytical procedure to distinguish between two items
298 of different origin.

299

300 **dislocations, *n***—distinct features that occur in natural fibers (for example, flax, ramie, jute,
301 hemp) in the shape of X's, I's, and V's that are present along the fiber cell wall; these features are
302 often useful for identification.

303

304 **dispersion, *n***—the difference in refractive index of a given material for different wavelengths of
305 the spectrum.

306

307 **dye, *n***—soluble substances that add color to textiles (7).

308 DISCUSSION—Dyes are classified into groups that have similar chemical characteristics
309 (for example, aniline, acid, and azo). They are incorporated into the fiber by chemical
310 reaction, absorption, or dispersion.

311

312 **effect pigment, *n***—any paint pigment that is designed to produce a significant change in color
313 attribute(s) in a paint film when the film is viewed or illuminated from varied angles.

314

315 **elastomer, *n***—a material that can be deformed but when the forces are removed it returns to its
316 original form. Serves as the base material for pressure sensitive adhesives.

317

318 **energy dispersive X-ray spectroscopy (EDS, EDXA, EDX), *n***—X-ray spectroscopy based on the
319 simultaneous measurement of the energies of X-rays emitted by a sample.

320

321 **escape peak, *n***—a spectral artifact resulting from incomplete deposition of the energy of an X-
322 ray entering the energy dispersive X-ray spectrometer detector.

323 DISCUSSION—An escape peak is produced when an incoming X-ray excites a silicon atom
324 within the detector crystal, and the resulting Si K α fluorescence X-ray exits the detector
325 crystal. It occurs at the energy for the original X-ray minus the energy of the Si K α
326 fluorescence X-ray (1.74 keV). The escape peak intensity is about 1-2 % of the parent peak.

327

328 **excitation filter, *n***—a filter used in fluorescence microscopy that transmits specific bands or
329 wavelengths of energy capable of inducing visible fluorescence in various substrates.

330

331 **extinction, *n***—the condition in which a birefringent particle appears dark when viewed between
332 crossed polarizers (2).

333 DISCUSSION—Most fibers exhibit extinction when their long axis is oriented parallel to
334 the privileged direction of one of the polarizing filters.

335

336 **extraneous material (contaminant, foreign material), *n***—material originating from a source
337 other than the specimen.

338

339 **filament, *n***—in textiles, a continuous fiber of extremely long length.

340

341 **flatback paper, *n***—smooth paper backing masking tape (saturated paper tape).

342

343 **float glass, *n***—sheet glass made by floating molten glass on a bed of molten tin.

344

345 **fluorescence microscope, *n***—a microscope equipped with a high energy light source (usually a
346 xenon or mercury vapor lamp) and a set of excitation and barrier filters, used to induce and
347 observe fluorescence in fibers and other particles or materials.

348

349 **follicular tag, *n***—tissue from a hair follicle that is still attached to the root end of a hair which has
350 been forcibly removed.

351

352 **fractography, *n***—the means and methods for characterizing fractured specimens or compounds
353 (10).

354

355 **fracture mirror, *n***—a smooth portion of the fracture surface surrounding the origin, the single
356 unique location at which every fracture system begins to form.

357

358 **frosting, *n***—a finely grained, slightly roughened surface texture.

359 **fungal tunneling**, *n*—air pockets in a hair shaft caused by fungal growth.

360

361 **generic class**, *n*—as used with textile fibers, a grouping having similar chemical compositions or
362 specific chemical characteristics.

363 DISCUSSION—A generic name applies to all members of a group and is not protected by
364 trademark registration. Generic names for manufactured fibers include, for example,
365 rayon, nylon, and polyester. Generic names used in the United States for manufactured
366 fibers were established as part of the Textile Fiber Products Identification Act enacted by
367 Congress in 1954 (13).

368

369 **glass**, *n*—an inorganic product of fusion that has been cooled to a rigid condition without
370 crystallization.

371

372 **grating**, *n*—parallel set of linear, regularly repeating grooves that, when illuminated, produces
373 dispersion of light into its requisite wavelengths with maxima and minima of light intensity as a
374 consequence of interference.

375 DISCUSSION—These maxima and minima vary in position with wavelength. This allows
376 radiation of any given wavelength to be isolated from a mixture of wavelengths (for
377 example, white light) and allows the grating to be used as part of a monochromator. The
378 dispersion or ability to resolve separate wavelengths is expressed as the number of lines
379 (or steps) in the grating per millimeter.

380

381 **hackle marks**, *n*—lines parallel to the direction of crack propagation separating portions of the
382 crack surface that are parallel but not coplanar.

383

384 **hair**, *n*—a slender outgrowth from the skin of mammals.

385

386 **hair follicle**, *n*—an invagination of the epidermis which contains the root of the hair.

387

388 **Hartmann net**, *n*—a graph of refractive index versus wavelength that uses a series of parallel
389 lines to represent the relationship between wavelength versus refractive index at a fixed
390 temperature for an immersion oil.

391

392 **Hertzian cone (percussion cone)**, *n*—a funnel-shaped area of damage caused by a high-velocity
393 impact from a small, hard body against the center (3).

394

395 **imbricate**, *n*—a term that describes a scale pattern in which the scales overlap and the edges
396 have an irregular wavy pattern; this pattern is typical of human hair.

397

398 **incoherent (Compton) scatter peaks**, *n*—spectral artifacts that result from inelastic scattering of
399 the tube target characteristic X-rays by the sample.

400 DISCUSSION—Because energy is lost in inelastic scattering, incoherent scatter peaks
401 occur at a lower energy than the tube target characteristic X-rays.

402

403 **inner cuticle margin**, *n*—the border between the cortex and the visible cuticle.

404 **inorganic fiber**, *n*—a class of fibers of natural mineral origin (for example, chrysotile asbestos)
405 and man-made mineral origin (for example, fiberglass).

406

407 **interface temperature**, *n*—the temperature of the heated zone between the pyrolysis unit and
408 the GC.

409

410 **interference fringes**, *n*—the pattern that results from constructive and destructive interference
411 of light waves.

412

413 **isotropic**, *adj*—a characteristic of an object in which the refractive index remains constant
414 irrespective of the direction of propagation or vibration of the light through the object (8).

415

416 **keratin**, *n*—a class of sulfur-containing fibrous proteins that forms the foundation of outgrowth
417 tissue from the epidermis, such as hair, nails, feathers, and horns.

418

419 **KLM reference lines**, *n*—the energies associated with the transitions of the K, L, and M shell
420 electrons.

421 DISCUSSION—Each element has characteristic energies of transitions of electrons
422 between shells.

423

424 **knitted fabric**, *n*—a structure produced by interlooping one or more ends of yarn or comparable
425 material.

426

427 **live time**, *n*—the time during which an energy dispersive X-ray spectrometer is available to accept
428 and process incoming X-rays.

429 DISCUSSION—Live time is often expressed as a percentage of real time, in seconds.

430

431 **lumen**, *n*—the cavity or central canal present in many natural fibers (for example, cotton, flax,
432 ramie, jute, hemp); its presence and structure are often useful aids in identification.

433

434 **macroscopic**, *n*—a term that describes characteristics large enough to be perceived without
435 magnification.

436

437 **manufactured fiber**, *n*—a class name for various genera of fibers (including filaments) produced
438 from fiber forming substances which can be (1) polymers synthesized from chemical compounds
439 [synthetic fibers], (2) modified or transformed natural polymers [regenerated fibers], and (3)
440 minerals, for example, glasses (7).

441

442 **match point, in refractive index measurements**, *n*—any combination of temperature and
443 wavelength at which two media have indistinguishable refractive indices. At the match point, the
444 glass will exhibit minimum contrast and visibility.

445

446 **matrix color**, *n*—dominant or background color component of a soil sample, soil aggregate, ped,
447 clod or horizon (adapted from 11).

448

449 **medulla**, *n*—the core of the hair shaft that is composed of vacuoles and cells that can be air- or
450 fluid-filled.

451 DISCUSSION—The medulla (if present) occurs in a continuous, discontinuous, or
452 fragmented pattern along the length of a hair and appears translucent or opaque.

453

454 **Michel-Lévy chart**, *n*—a chart relating thickness, birefringence, and retardation so that any one
455 of these variables can be determined when the other two are known (8).

456

457 **microscopical**, *adj*—concerning a microscope or the use of a microscope.

458

459 **microspectrophotometer (MSP)**, *n*—a specialized spectrophotometer designed to measure the
460 absorbance, reflectance, and emission spectra of microscopic areas on samples.

461

462 **microtomy**, *n*—a sample preparation method that sequentially passes a blade at a shallow depth
463 through a specimen, resulting in sections of selected thickness.

464

465 **mid-infrared**, *n*—pertaining to the IR region of the electromagnetic spectrum with wavelength
466 range from approximately 2.5 to 25 μm (wavenumber range approximately 4000 to 400 cm^{-1}).

467

468 **mineral**, *n*—a naturally occurring inorganic element or compound having an orderly internal
469 structure and characteristic chemical composition, crystal form(s), and physical properties, or an
470 element or chemical compound that is crystalline and that has formed as a result of geological or
471 pedogenic (soil-formed) processes (adapted from 9).

472 DISCUSSION—Artificial and biogenic crystalline materials are not minerals but can occur
473 in geological materials (for example, cement powder, lime, lye, biogenic calcite, biogenic
474 hydroxyapatite, bricks) and can be detected by XRD.

475

476 **modification ratio**, *n*—a geometrical parameter used in the characterization of noncircular fiber
477 cross-sections.

478 DISCUSSION—The modification ratio is the ratio in size between the outside diameter of
479 the fiber and the diameter of the core; it may also be called “aspect ratio.”

480

481 **monilethrix**, *n*—a hair disorder that results in periodic nodes or beading along the length of the
482 hair with intervening, tapering constrictions that are not medullated.

483

484 **monoaxially oriented polypropylene (MOPP)**, *n*—an oriented polypropylene film in which the
485 polymer has been stretched in only one direction during the manufacturing process. Tapes with
486 such films can be torn by hand.

487

488 **monochromator**, *n*—device designed to isolate narrow wavelength ranges of light from complex,
489 broad-spectrum radiation.

490

491 **Munsell color code**, *n*—Munsell color is recorded as alpha-numeric Hue Value/Chroma, H V/C
492 (e.g., 7.5YR 5/4 or 5R 6/4); neutral colors, lacking a hue tone, (chroma = 0) are designated with a
493 “hue” of N and omit chroma or list it as zero (N 3/ or N 3/0).

494

495 **natural fibers**, *n*—a class name for various genera of fibers (including filaments) of: (1) animal
496 (that is, silk and wool); (2) mineral (that is, asbestos); or (3) vegetable origin (that is, cotton, flax,
497 jute, and ramie) (7).

498

499 **nonwoven fabric**, *n*—a textile structure produced by bonding or interlocking of fibers, or both,
500 accomplished by mechanical, chemical, thermal, or solvent means and combinations thereof.

501

502 **ovoid bodies**, *n*—oval-shaped, heavily-pigmented inclusions usually found in the hair cortex.

503

504 **phase**, *n*—a part of a chemical system that is homogeneous, physically distinct and at least
505 hypothetically separable, and which has single or continuously variable chemical and mechanical
506 properties (adapted from 9).

507

508 **phase contrast microscope**, *n*—a microscope that translates differences in phase of the light
509 transmitted through the object into differences of intensity in the image — also called phase
510 microscope.

511

512 **photomultiplier tube (PMT)**, *n*—photosensitive vacuum tube device that quantitatively converts
513 photons of light into electrical energy.

514

515 **pigment aggregation**, *n*—clusters of pigment granules.

516

517 **pigment density**, *n*—in hair, the relative abundance of pigment granules in the hair cortex as
518 described along a continuum (for example, sparse, medium, heavy).

519

520 **pigment distribution**, *n*—in hair, the pattern or arrangement of the pigment granules in the hair
521 shaft, such as uniform, peripheral, one-sided, variable, or central.

522

523 **pili annulati**, *n*—a hair disorder causing hairs to appear ringed or banded due to the alternating
524 light and dark bands in the hair shaft; the dark bands are a manifestation of abnormal air spaces
525 in the cortex.

526

527 **pili torti**, *n*—a hair disorder characterized by the hair shaft being flattened and twisted 180
528 degrees numerous times along its axis; it is usually found at irregular intervals along the shaft.

529 **pixel binning, v** —the process of combining counts from adjacent pixels in a CCD detector during
530 readout.

531
532 **plane polarized light, n** —emitted or observed light in which the electric field vibrates in one
533 direction in a single plane.

534
535 **plasticizer, n** —material added to plastics to impart flexibility by creating spaces between the
536 polymer chains and lowering the inter- and intra-chain attractive forces, allowing freer
537 movement of the chains.

538 DISCUSSION—Plasticizers are used in pressure sensitive backings (particularly PVC) and
539 some adhesives to lower the glass-transition temperature and allow use at sub-ambient
540 temperatures.

541
542 **polarized light, n** —a bundle of light rays with a single propagation direction and a single
543 perpendicular vibration direction (8).

544
545 **polish lines, n** —striation marks produced on the glass surface by polishing.

546
547 **postmortem root banding, n** —the appearance of an opaque band near the root/ proximal end
548 of a hair potentially observed in anagen or catagen hairs that have been removed from a
549 decomposing body; the possibility of other conditions causing the same or similar characteristics
550 cannot be eliminated.

551
552 **prime coat, n** —a coating of adhesive-like material found between the tape adhesive and backing
553 that serves as a bonding agent.

554
555 **privileged direction (of a polarizer), n** —the direction of vibration to which light emerging from a
556 polarizer has been restricted.

557 DISCUSSION—In modern microscopes, the polarizer's privileged direction is oriented in
558 the east-west direction and the analyzer's privileged direction is oriented in the north-
559 south direction.

560
561 **provenance, n** —a place of origin; specifically, the area from which the constituent materials of a
562 sedimentary rock or facies are derived (adapted from 9).

563 DISCUSSION—In the context of forensic provenance analysis, geological material is
564 analyzed and interpreted to estimate or limit the geographic or environmental conditions
565 of the source of this material to provide an investigative lead. For example, soil on a shovel
566 can be examined to aid in the search for a clandestine grave, typically by comparison of
567 observations to reference data. Geographic attribution is an alternative term for
568 provenance.

569
570 **pulse processor time, n** —operator-selected value for the time designated to record a response
571 by the detector.

572 DISCUSSION—A higher value (longer time) results in a more accurate determination of
573 the detector amplifier pulse height (better spectral resolution). A lower value results in a
574 higher count rate but with reduced spectral resolution.

575

576 **pyrogram, *n***—a chromatogram obtained from the pyrolysis products of a material.

577

578 **pyrolysis, *n***—the thermal fragmentation of a substance in an inert atmosphere.

579

580 **pyrolysis temperature, *n***—the temperature (set or ramped) at which the pyrolysis of the sample
581 is performed.

582

583 **pyrolyzate, *n***—the product of the pyrolysis process.

584

585 **radial fractures, *n***—fracture features extending outward from the point of impact.

586

587 **raster, *n***—the pattern scanned by the electron beam on a sample; the raster dimensions change
588 inversely with magnification.

589

590 **ream, *n***—linear distortions as a result of non-homogeneous layers of flat glass.

591

592 **refraction, *n***—the deflection from a straight path undergone by a light ray in passing obliquely
593 from one medium (as air) into another (as glass) in which its velocity is different.

594

595 **refractive index, *n***—the ratio of the velocity of light in a vacuum to the velocity of light in some
596 medium (8).

597

598 **reinforcement, *n***—fabric (scrim), glass filaments, or plastic filaments added to tape to impart
599 stability and strength.

600

601 **release coat, *n***—an inert material with a low surface energy, applied to a backing film on the side
602 opposite the adhesive, that provides ease of unwind and prevents delamination or tearing.

603

604 **Rietveld refinement, *n***—a procedure for carrying out a crystal-structure refinement using X-ray
605 or neutron powder diffraction data, in which an entire powder pattern is simulated for a trial
606 structure(s) and matched against the observed powder pattern; atomic parameters and other
607 variables are modified to achieve an acceptable fit between the calculated and observed powder
608 patterns (adapted from 9).

609

610 **root, *n***—the structure that anchors a hair to a follicle and from which cells divide and produce
611 the hair shaft.

612 DISCUSSION—The portion of follicular tissue surrounding a root structure is the sheath.

613 **rope, n**—a compact and flexible, torsionally balanced structure produced from strands which are
614 laid, plaited, or braided together to produce a product which serves to transmit a tensile force
615 between two points (adapted from 1).

616 DISCUSSION—Generally greater than 3/16 in. diameter; a rope is made up of three or
617 more strands.

618

619 **rouge pits, n**—defects on the glass surface containing residual polishing material.

620

621 **scales, n**—overlapping, plate-like structures composed of keratin that form the cuticle.

622

623 **scanning electron microscopy (SEM), n**—a type of electron microscope in which a focused
624 electron beam is scanned in a raster on a solid sample surface; the term can also include the
625 analytical technique of energy dispersive X-ray spectroscopy.

626

627 **scarp, n**—subtle curved line on a fracture surface caused by interaction of a propagating crack
628 and a liquid or a reactive environment (10).

629

630 **scrim count, n**—the number of warp yarns per inch versus the number of fill yarns per inch.

631

632 **scrim, n**—a loosely-woven gauze-type fabric added to duct tape for reinforcement and to impart
633 strength.

634

635 **secondary electron (SE) imaging, n**—imaging using low-energy electrons produced from the
636 interaction of beam electrons and conduction band electrons of atoms within the interaction
637 volume, with only those near the surface having sufficient energy to escape.

638

639 **selvage, n**—the woven edge portion of a fabric parallel to the warp.

640

641 **shaft, n**—the portion of the hair emerging from the hair follicle.

642

643 **shaft form, n**—the shape of the hair both longitudinally (for example, curly, straight) and cross-
644 sectionally (for example, round, flattened).

645

646 **shaft thickness, n**—the diameter of the hair.

647 DISCUSSION—This is expressed either numerically or in relative terms, such as fine,
648 medium, or coarse.

649

650 **shouldering, n**—a variation of the hair form along the shaft, resulting in an irregular and often
651 asymmetrical change of cross-sectional shape.

652

653 **soil, n**—sediments or other unconsolidated accumulations of solid particles (for example,
654 minerals and organic matter) that are produced by the physical, chemical, and biological
655 disintegration of parent material, or which has the ability to support rooted plants.

656 DISCUSSION—“soil” includes native soil, as well as unconsolidated material emplaced by
657 human activities (adapted from 12).

658

659 **soil core sampler [soil corer; soil probe], n**—a device used to collect virtually undisturbed sub-
660 surface soil samples for documenting a soil profile.

661

662 **soil horizon, n**—a layer of soil or soil material approximately parallel to the land surface and
663 differing from adjacent genetically related layers in physical, chemical, and biological properties
664 or characteristics such as color, structure, texture, consistency, kinds and numbers of organisms
665 present, degree of acidity or alkalinity, etc (12).

666

667 **soil profile, n**—a vertical section of soil exposed from the ground surface to a depth of interest.
668 A soil profile can be observed in a freshly dug pit, along a road bank, or in many other places
669 (adapted from 9).

670

671 **somatic region, n**—an area of the body, such as head, pubic, or leg; synonymous with “body
672 area”.

673

674 **spectral artifacts, n**—spectral peaks other than characteristic peaks from the sample, produced
675 during the energy dispersive detection process. Examples include escape peaks, sum peaks, tube
676 target coherent and incoherent scatter peaks, system peaks, and diffraction peaks.

677

678 **spherulites, n**—spheres composed of needles or rods all oriented perpendicular to the outer
679 surface, or a plane section through such a sphere; a common form of polymer crystallization from
680 melts or concentrated solutions (2).

681

682 **staple, n**—natural fibers or cut lengths from filaments.

683

684 **stereomicroscope, n**—a microscope containing two separate optical paths, one for each eye,
685 giving a three-dimensional view of a specimen.

686

687 **strand, n**—(1) a single fiber, filament, or monofilament; (2) an ordered assemblage of textile
688 fibers having a high ratio of length to diameter and normally used as a unit; includes slivers,
689 roving, single yarns, plied yarns, cords, braids, ropes, etc (7).

690 DISCUSSION—A strand is often multiple plies joined together. The terms “ply” and “strand” are
691 not synonymous; cordage can have a single-ply strand, but not a stranded ply.

692

693 **sub-generic class, n**—a group of fibers within a generic class that share the same base.

694

695 **sum peak, *n***—a spectral artifact that results from the simultaneous detection of two X-rays,
696 manifested as a peak at the combined energy of the detected X-rays.

697

698 **surface dye, *n***—a colorant bound to the surface of a fiber.

699

700 **synthetic fibers, *n***—a class of manufactured polymeric fibers, which are synthesized from
701 chemical compounds (for example, nylon, polyester).

702

703 **system peaks, *n***—spectral artifacts that result from the production of characteristic X-rays from
704 structural components of the XRF instrument.

705

706 **tack, *n***—property of an adhesive that allows it to form a bond immediately with a surface with
707 the application of only slight pressure.

708

709 **tackifier, *n***—solid resins added to the adhesive base polymer to impart the necessary tack and
710 adhesion.

711

712 **target fibers, *n***—questioned fibers that an examiner selects for further examination based on
713 their resemblance to the known sample.

714

715 **technical fiber, *n***—a bundle of natural fibers composed of individual elongated cells that can be
716 physically or chemically separated and examined microscopically for identifying characteristics
717 (for example, hemp, jute, sisal).

718

719 **telogen, *n***—the resting phase of the hair follicle in the hair growth cycle (4).

720 DISCUSSION—During this phase, the hair has stopped growing and the root becomes
721 keratinized and bulbous (club-like) in shape.

722

723 **tempering, chemical (toughening), *n***—the process of strengthening glass by ion exchange in
724 which the glass is immersed in a molten salt bath having alkali ions larger than those in the host
725 glass.

726

727 **tempering, thermal (toughening), *n***—the process of strengthening glass by controlled thermal
728 treatments to create a buildup of surface compressive stresses.

729 DISCUSSION—Tempering is normally accomplished by rapidly cooling the glass as it
730 emerges from the furnace.

731

732 **thermal history, *n***—the last set of conditions under which a glass has been cooled from its
733 softened state.

734 DISCUSSION—Refractive index and density are functions of thermal history.

735

- 736 **thermoplastic**, *n*—a synthetic material that softens or melts at high temperatures.
737
- 738 **thread**, *n*—a slender strong strand or cord made by plying or twisting yarns, typically used for
739 stitching.
740
- 741 **tip**, *n*—*in hair*, the most distal end of a hair shaft.
742
- 743 **tracer**, *n*—A means of distinguishing one rope from another or one manufacturer from another
744 by the use of yarns, tapes or other markers in a rope, either externally, internally or both. Also
745 referred to as a marker (1).
746 DISCUSSION—This marker can be different in color, size, or composition, or combination
747 thereof, from that of the basic cordage. It can be found in the core or alongside a ply or
748 strand.
749
- 750 **trichonodosis**, *n*—a condition characterized by apparent or actual knotting of the hair.
751
- 752 **trichoptilosis**, *n*—a condition characterized by longitudinal splitting or fraying of the hair shaft.
753
- 754 **trichorrhaxis invaginata**, *n*—a genetic disease characterized by a segment of bulbous, dilated
755 hair enfolded into a concave hair terminal, recalling the appearance of a bamboo node; if the hair
756 breaks at the bulbous end, the hair has a “golf-tee” shaped end.
757
- 758 **trichorrhaxis nodosa**, *n*—a condition characterized by the formation of nodes; the hair is weaker
759 at the node and subject to breakage.
760
- 761 **trichoschisis**, *n*—a condition in which the hair readily breaks or splits along transverse cracks.
762
- 763 **twist**, *n*—the number of turns about the axis applied to a fiber, yarn, strand or rope over a given
764 length to combine the individual elements into a larger and stronger structure (1).
765 DISCUSSION—The direction of twist in yarns is indicated by the capital letters S and Z. A
766 yarn has an S-twist if, when it is held vertically, the spirals around its central axis slope in
767 the same direction as the middle portion of the letter S, and Z-twist if they slope in the
768 same direction as the middle portion of the letter Z.
769
- 770 **ultimates**, *n*—individual fibers from a technical fiber.
771
- 772 **unit cell**, *n*—the smallest group of atoms of a crystal lattice that has the overall symmetry of a
773 crystal of that substance, and from which the entire lattice can be built up by repetition in three
774 dimensions.
775
- 776 **wale**, *n*—in knitted fabrics, a column of successive loops in the length direction of the fabric; in
777 woven fabrics, one of a series of raised portions or ribs lying warp-wise in the fabric.

778 **Wallner line, *n***—a rib shaped mark with a wavelike contour (also known as “rib marks” or
779 “ripples”).

780

781 **woven fabric, *n***—a structure produced when at least two sets of strands are interlaced, usually
782 at right angles to each other, according to a predetermined pattern of interlacing, and such that
783 at least one set is parallel to the axis along the lengthwise direction of the fabric.

784

785 **Keywords**

786 1. analysis; trace evidence; terminology

787

788

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