PHASE BEHAVIOR AND STRUCTURE OF MICROEMULSIONS

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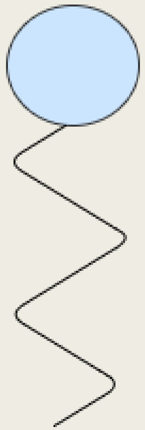
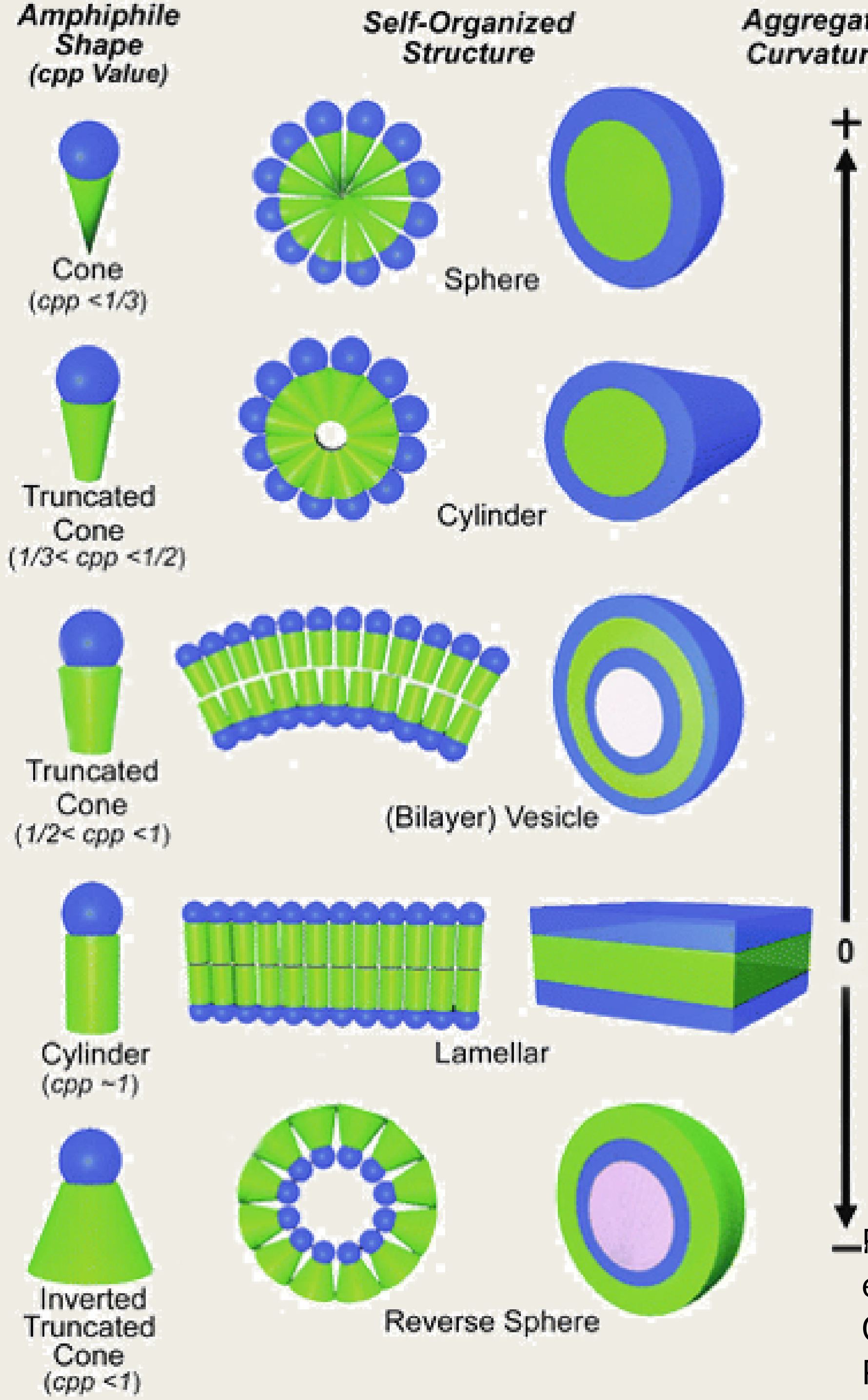
What are Surfactants?

Surfactant

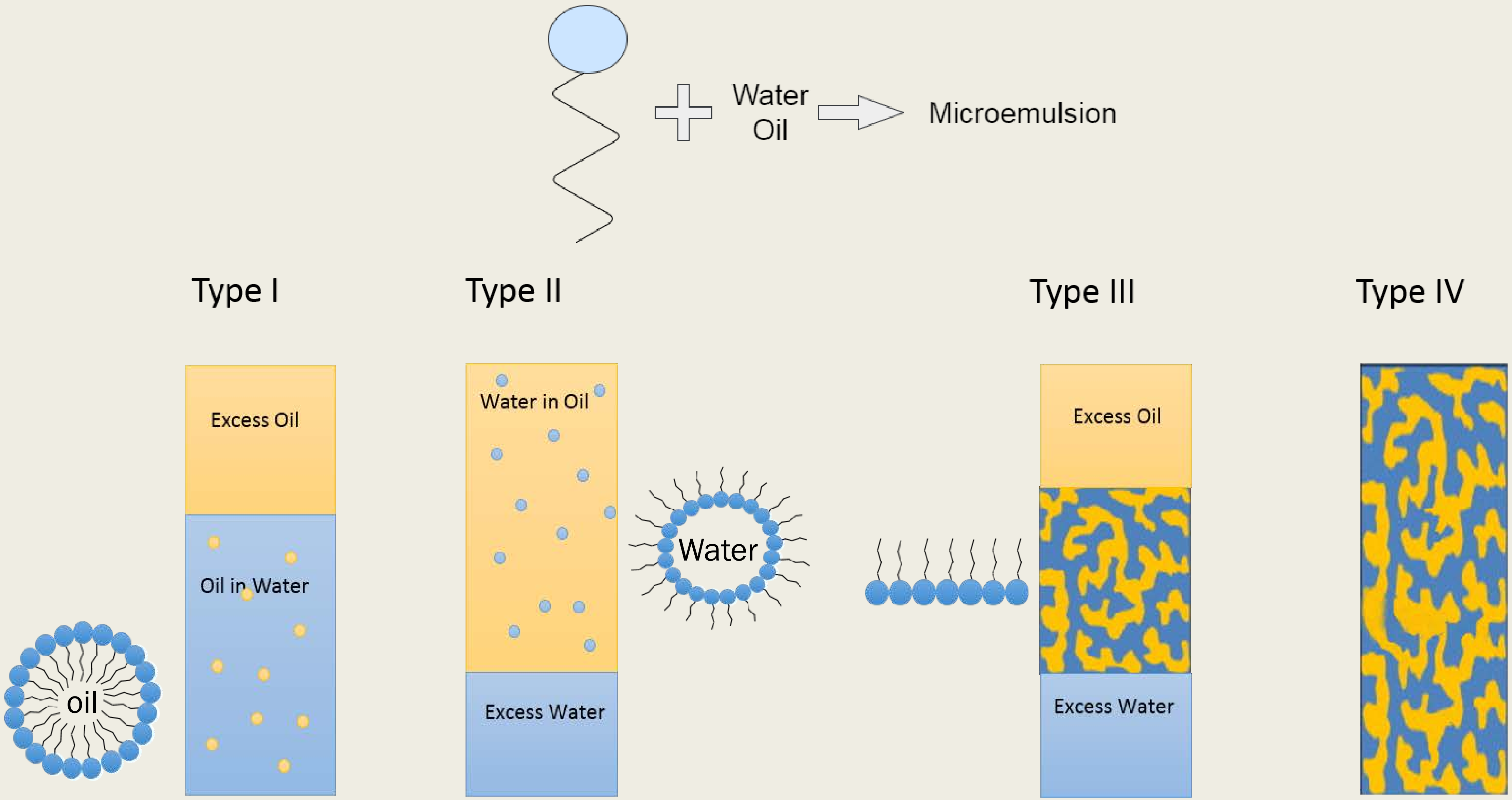


Water or Oil ⇨ Self-Assembled Structure



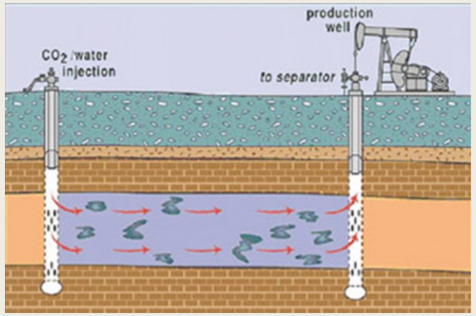
Ramanathan et al. Phys. Chem. Chem. Phys. 2013

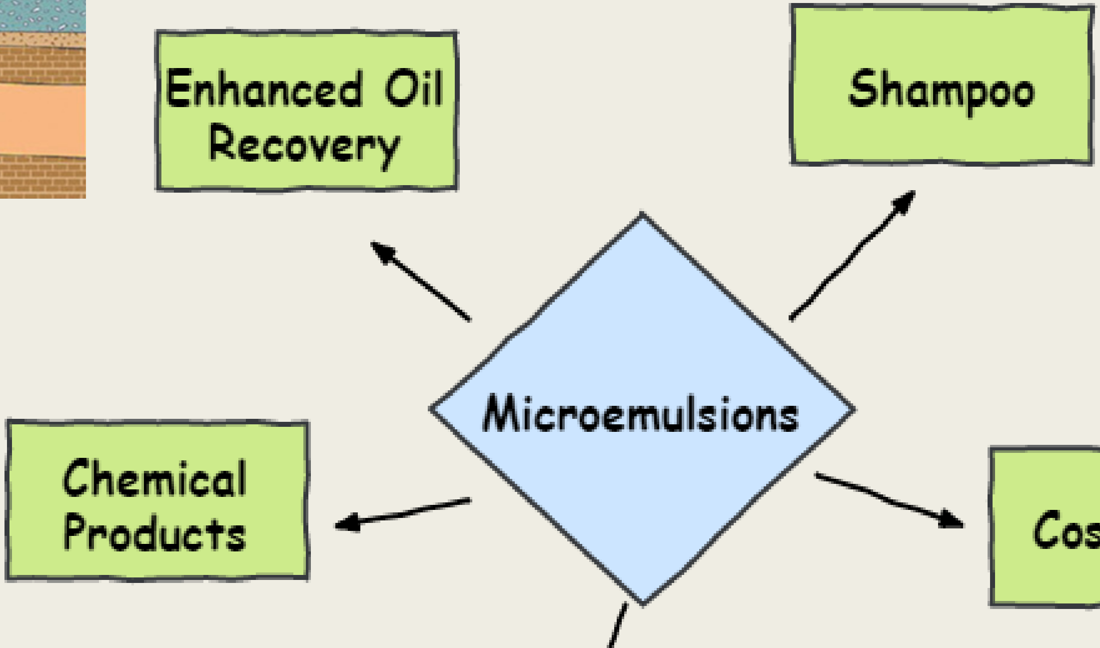
What are Microemulsions?

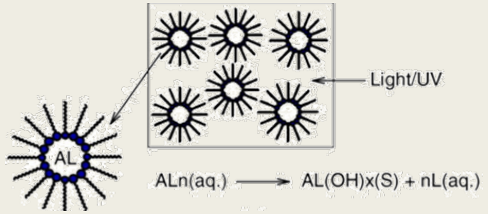


Serra et al. Elsevier 2014

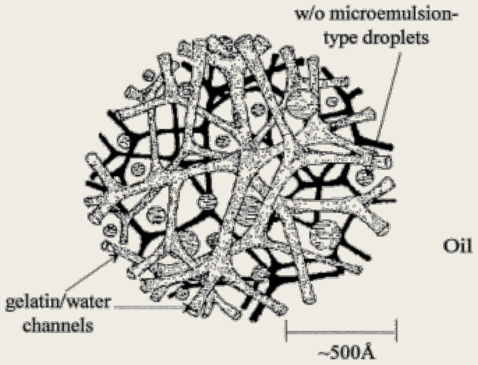
Applications







Malik et al. Arabic Journal of Chemistry 2012



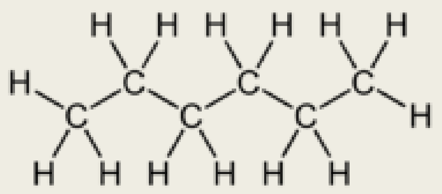
Lawrence et al. Elsevier 2012

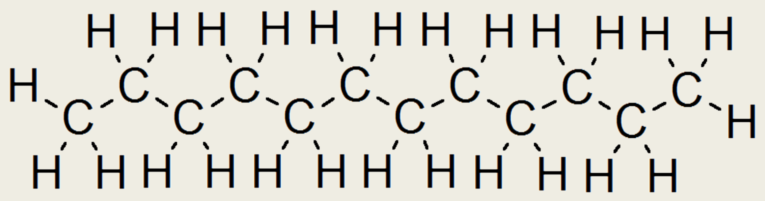
Objective & Motivation

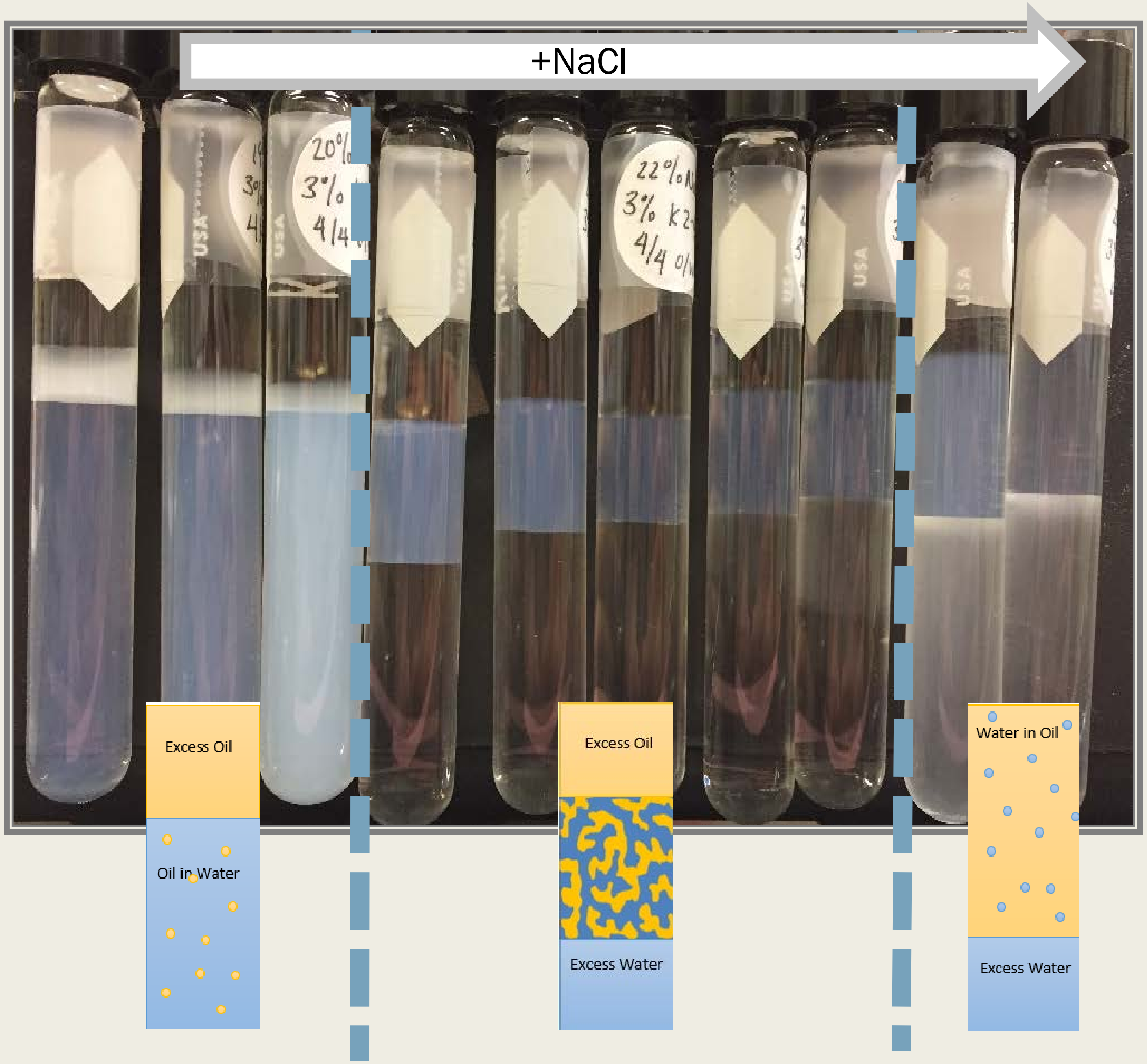
- Previously, an interesting gel was found with Isopar L
  - *Impure solvent*
  - *Mixture of various alkanes*
- To reproduce the gel but with pure alkane and a similar anionic surfactant system
- To investigate the shear-induced gelation phenomenon

Sample Preparation

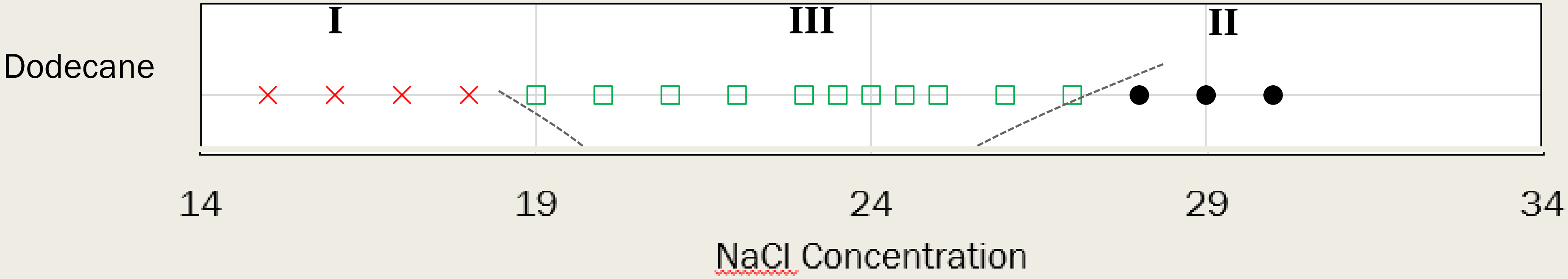
- Surfactant: Alforterra® K2-41S
- Sodium Chloride (NaCl)
- Oils: hexane, heptane, octane, decane, and dodecane

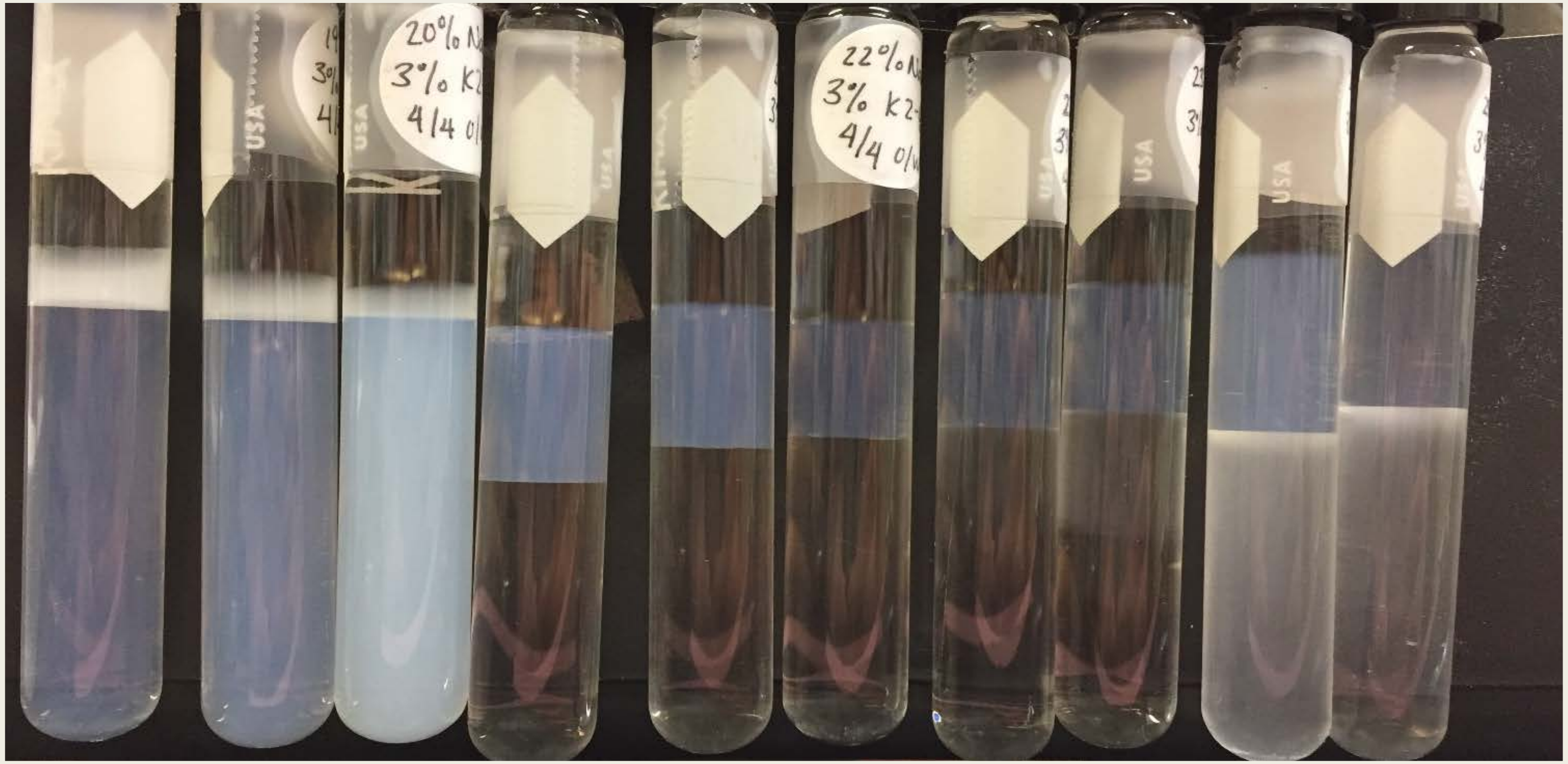




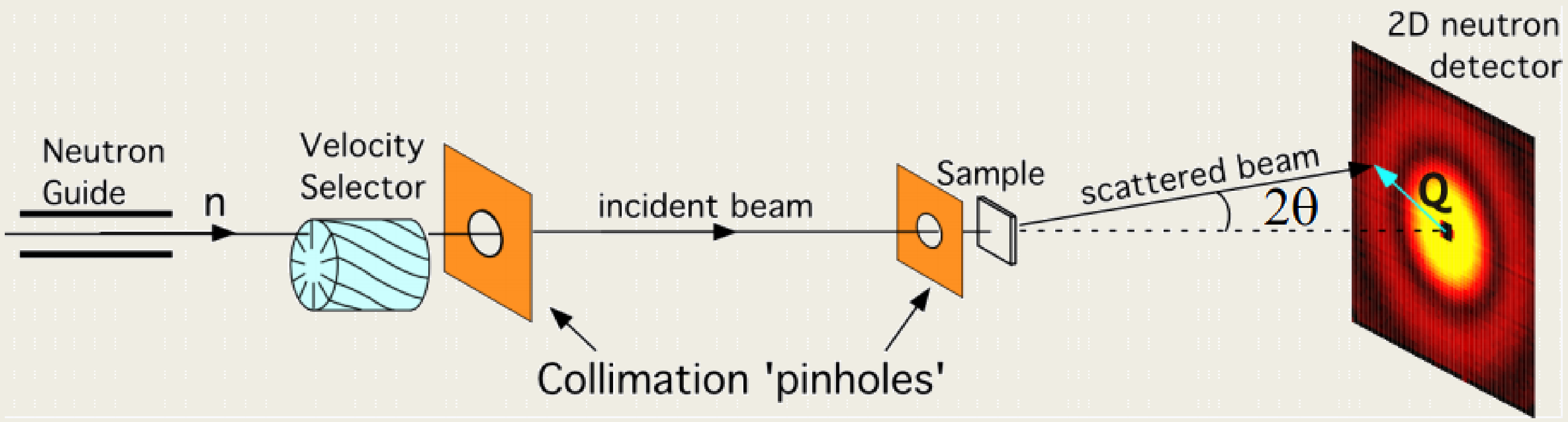


Phase Behavior

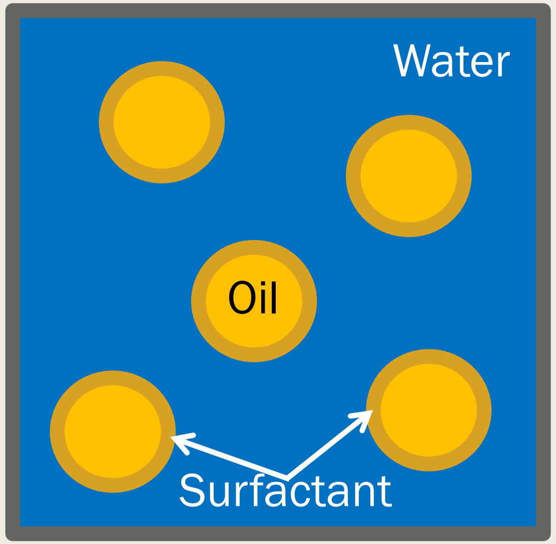




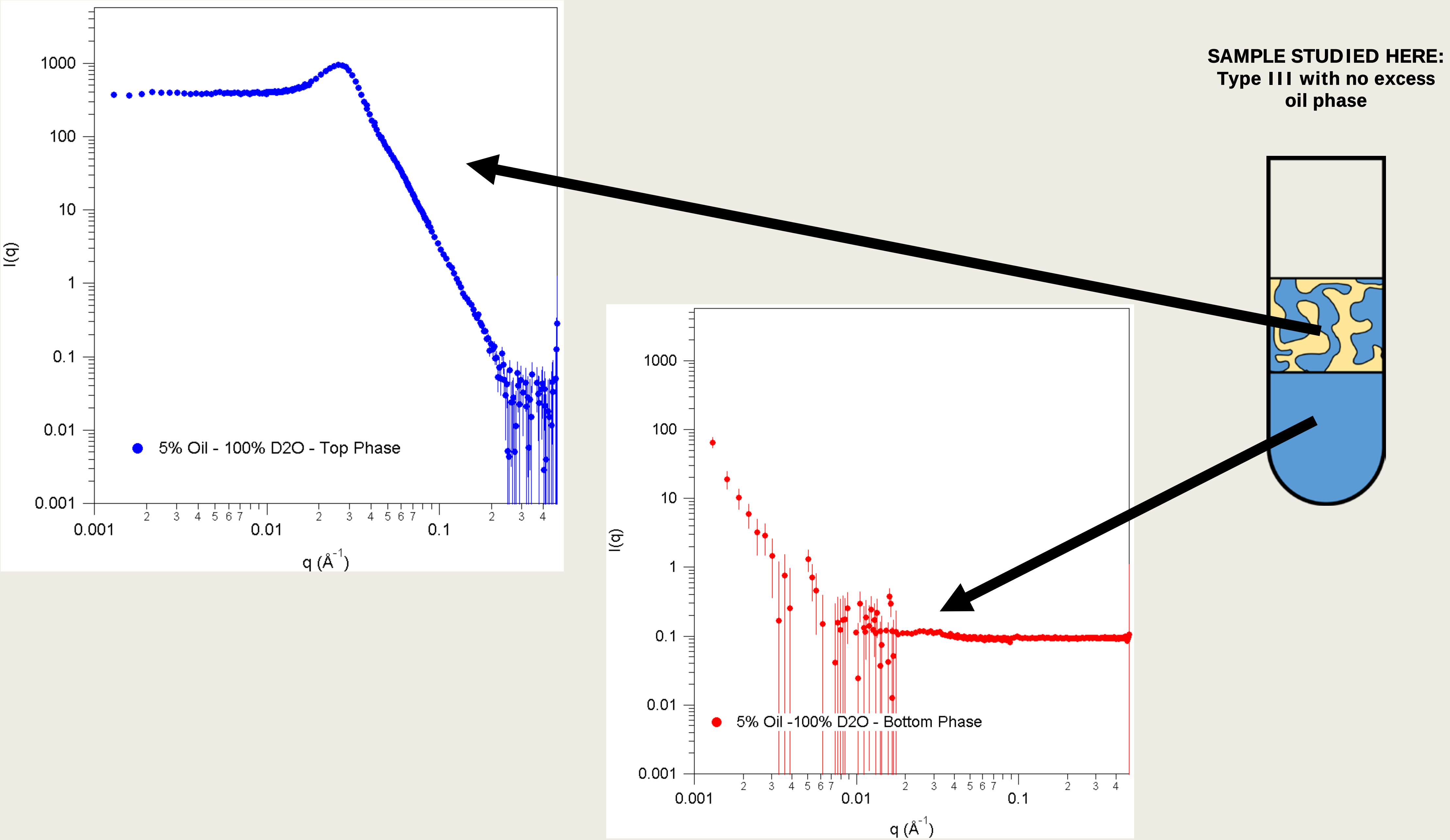
Small Angle Neutron Scattering (SANS)



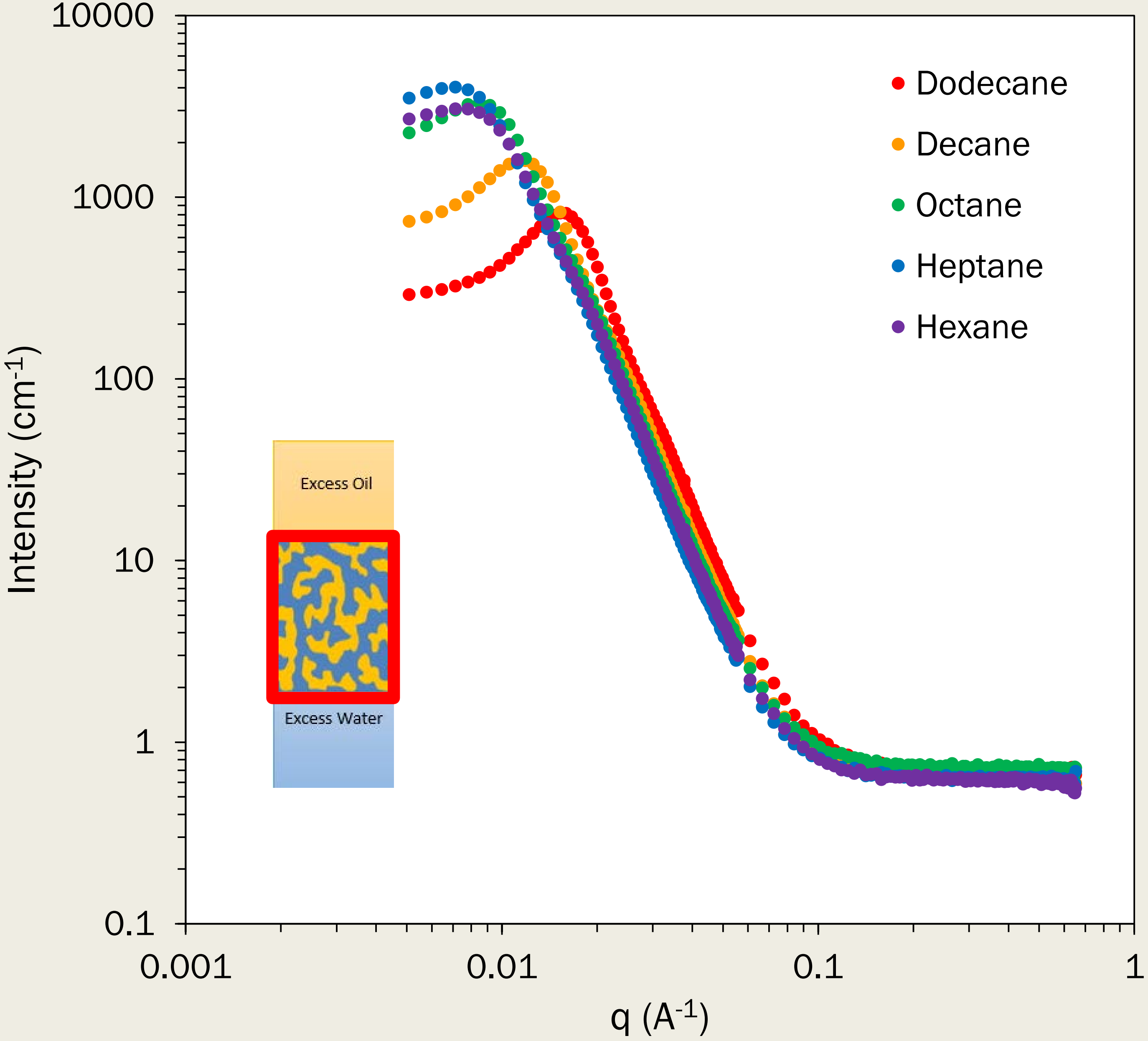
Various Alkanes



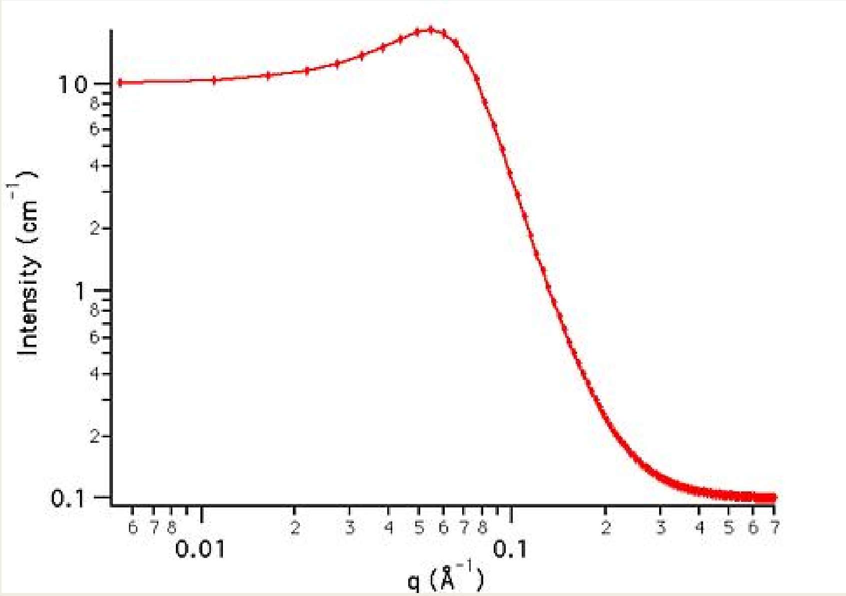
SANS of Two Phases

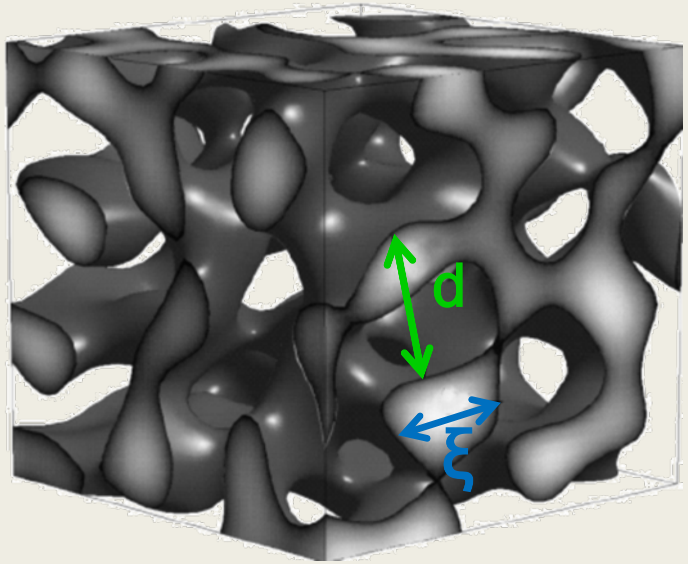


Middle Phase of Various Alkane at the Optimal Salinity

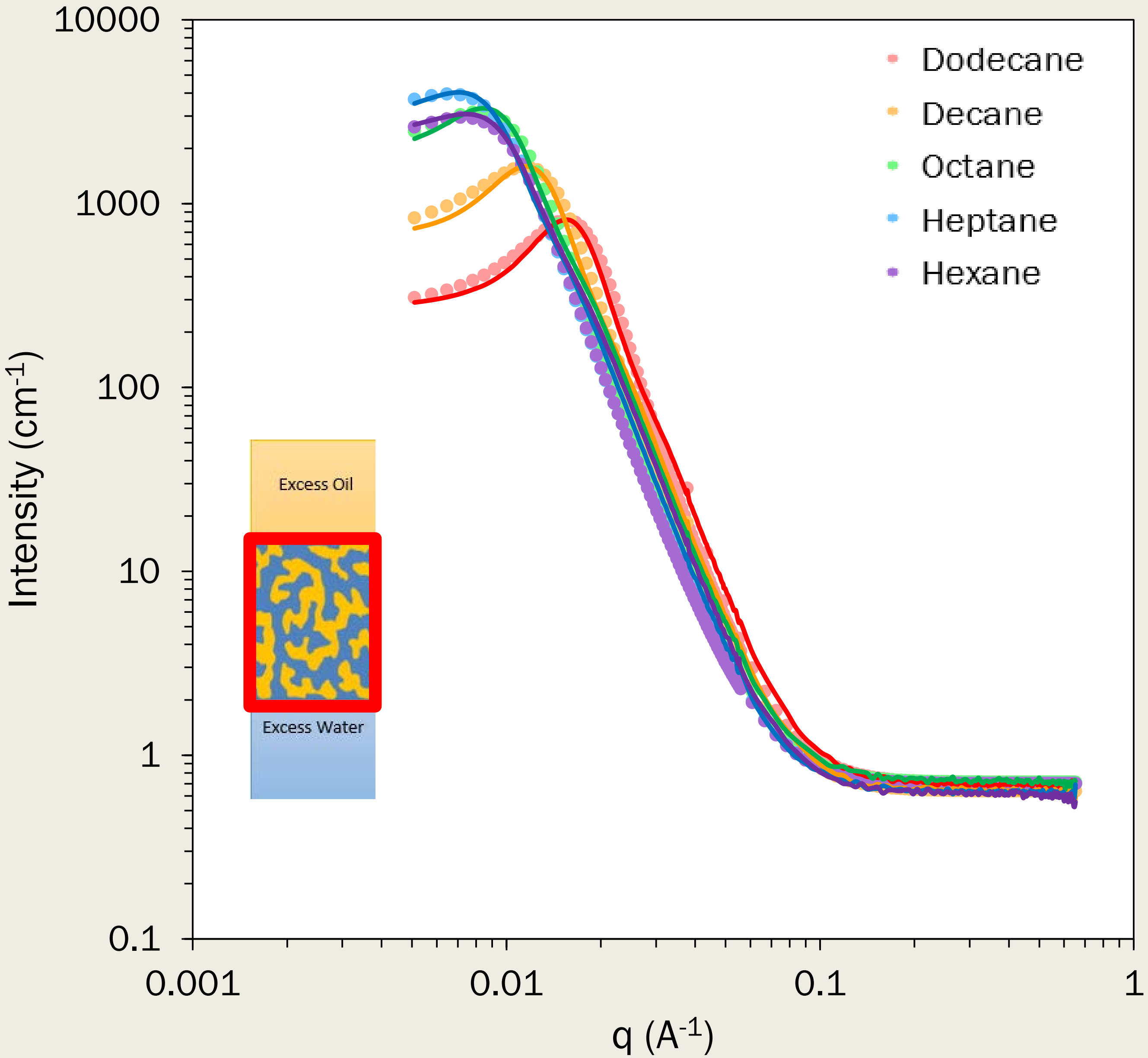


Teubner-Strey Model Fitting

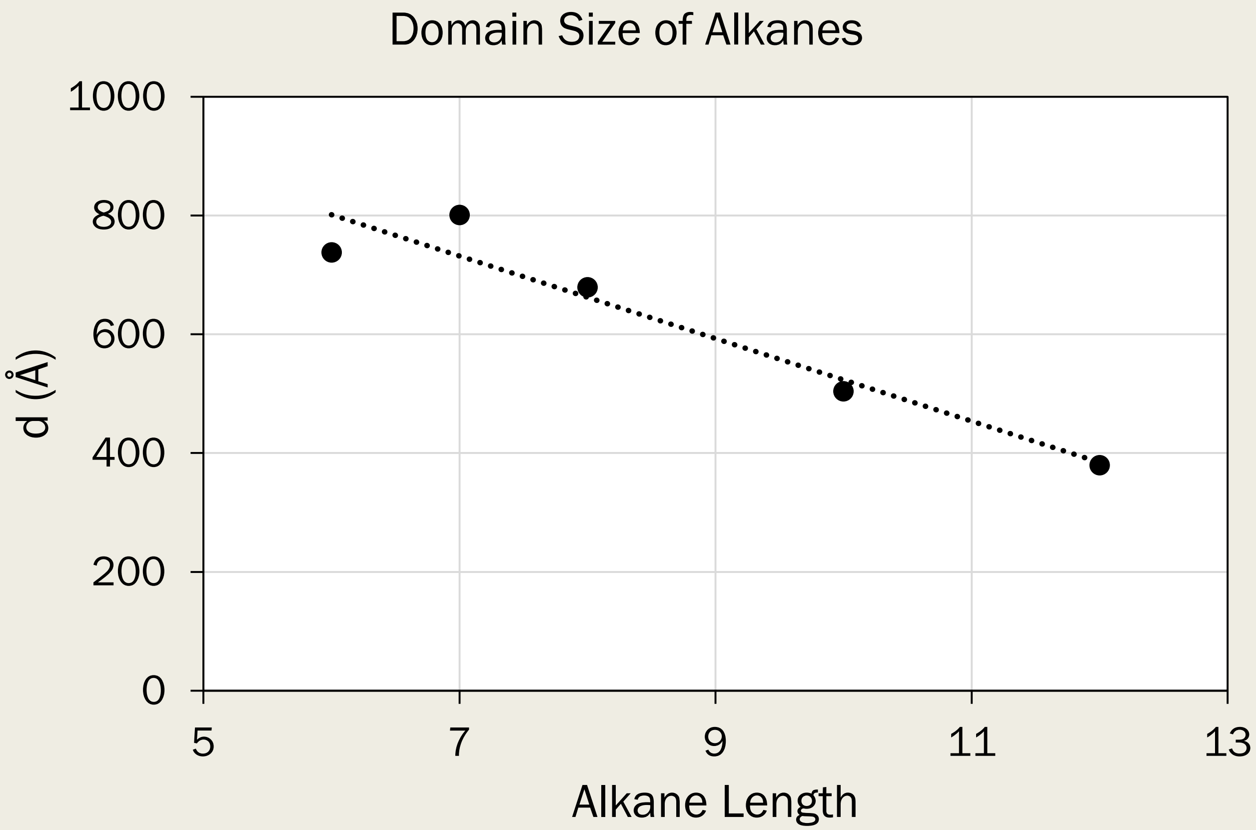




Mihailescu et al. Journal of Chemical Physics 2001



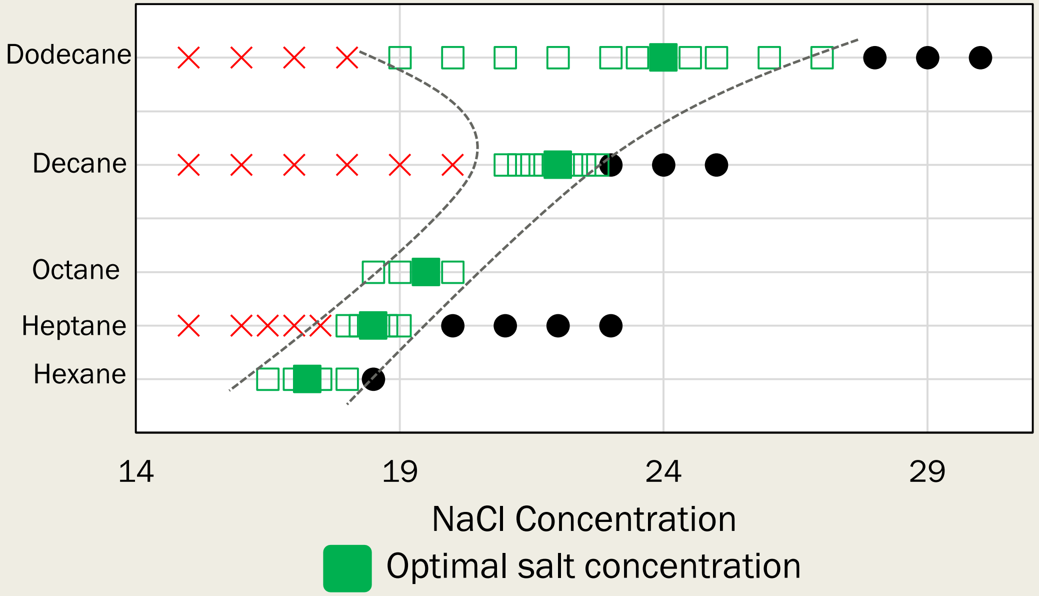
Domain Size for the Middle Phase of Various Alkanes

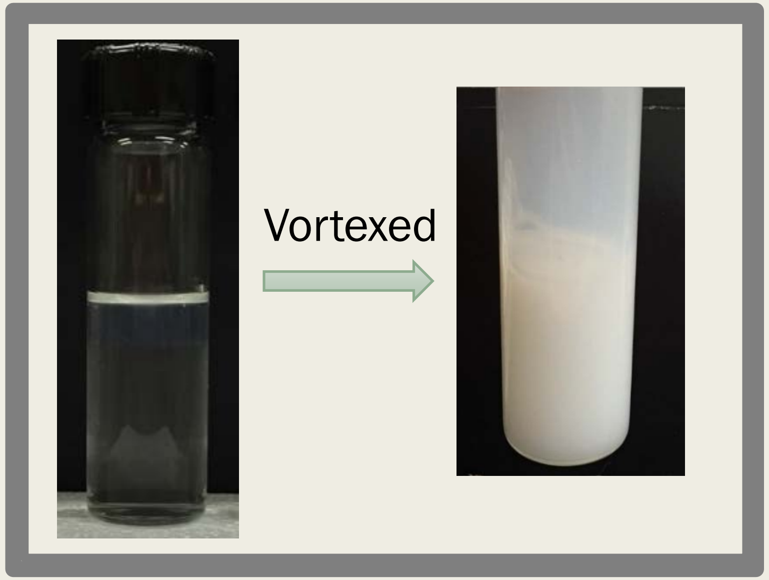


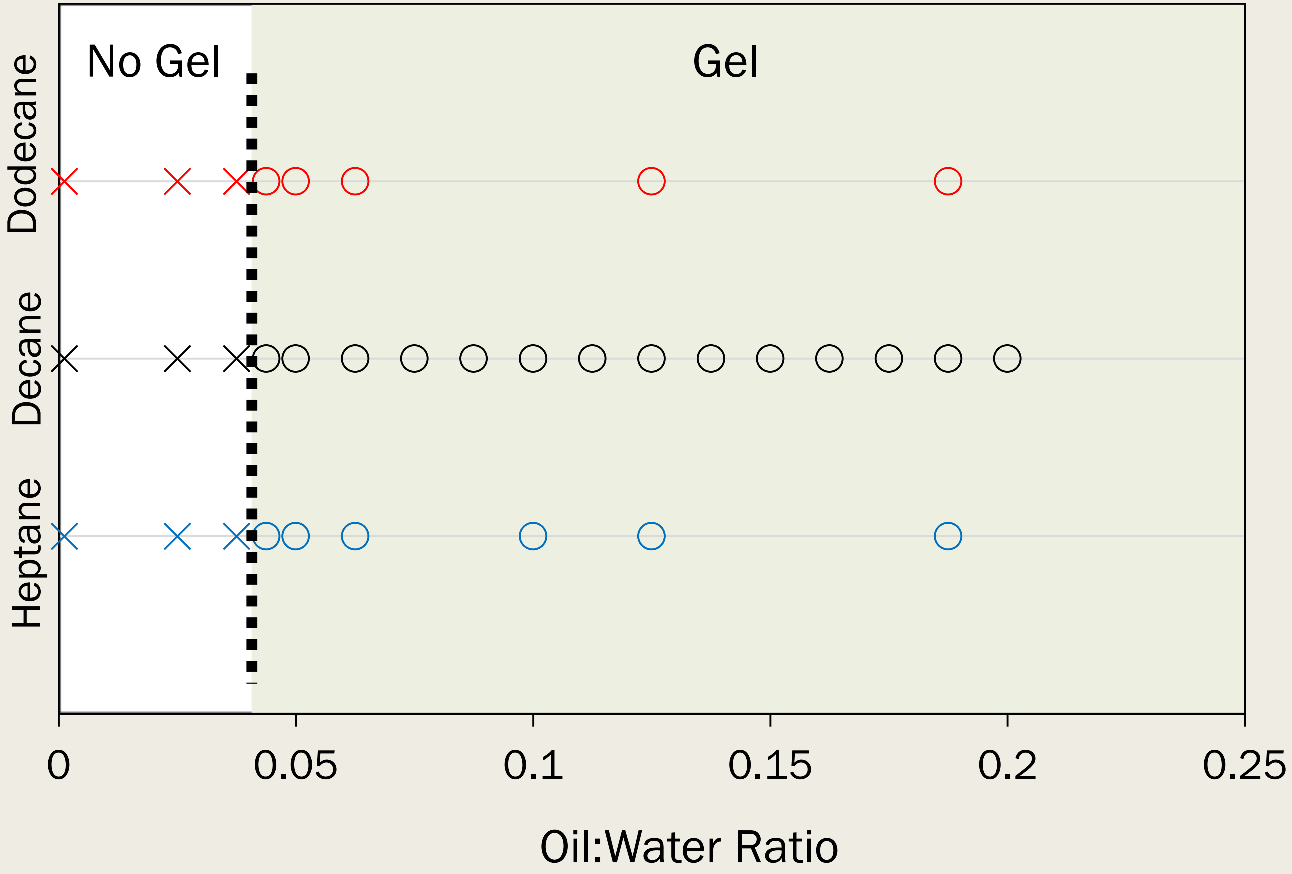
Objective

- To reproduce the gel but with pure alkane and a similar anionic surfactant system
- To investigate the shear-induced gelation phenomenon

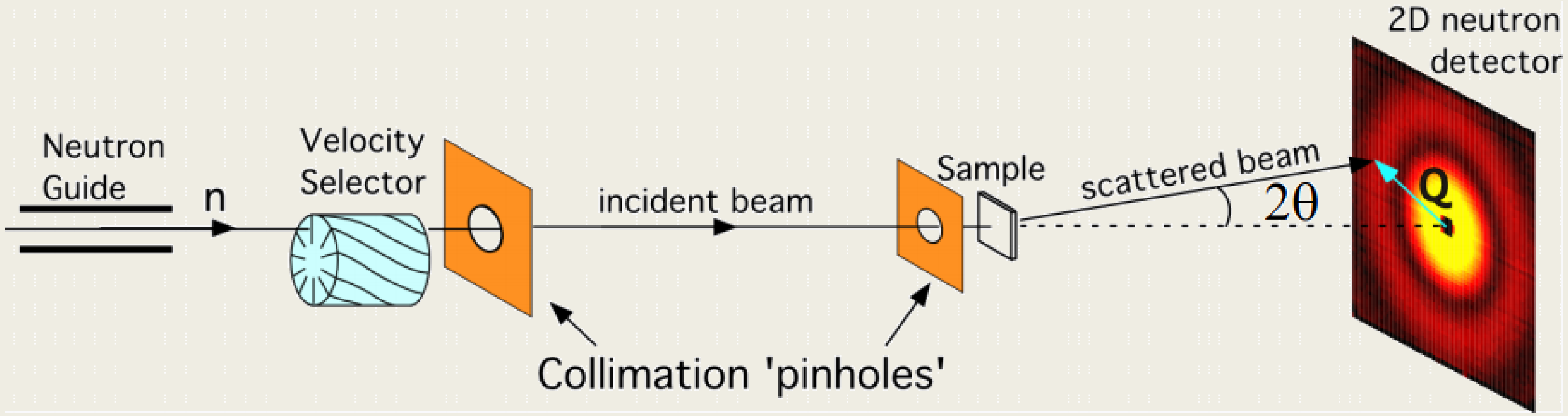
Shear-Induced Gelation



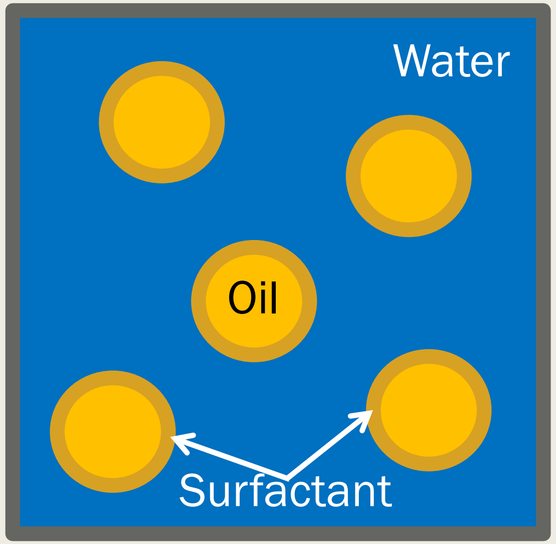




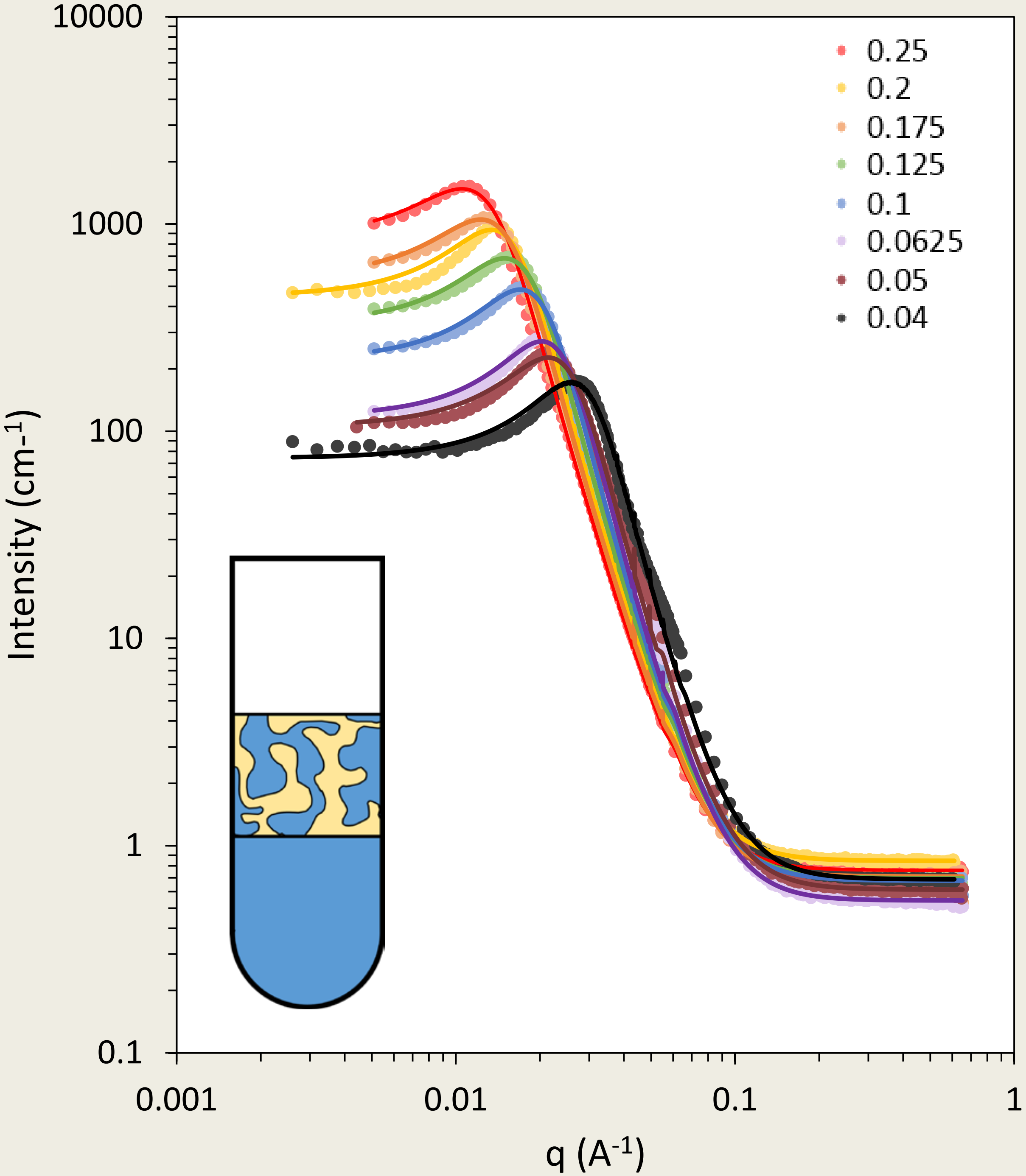
Small Angle Neutron Scattering (SANS)



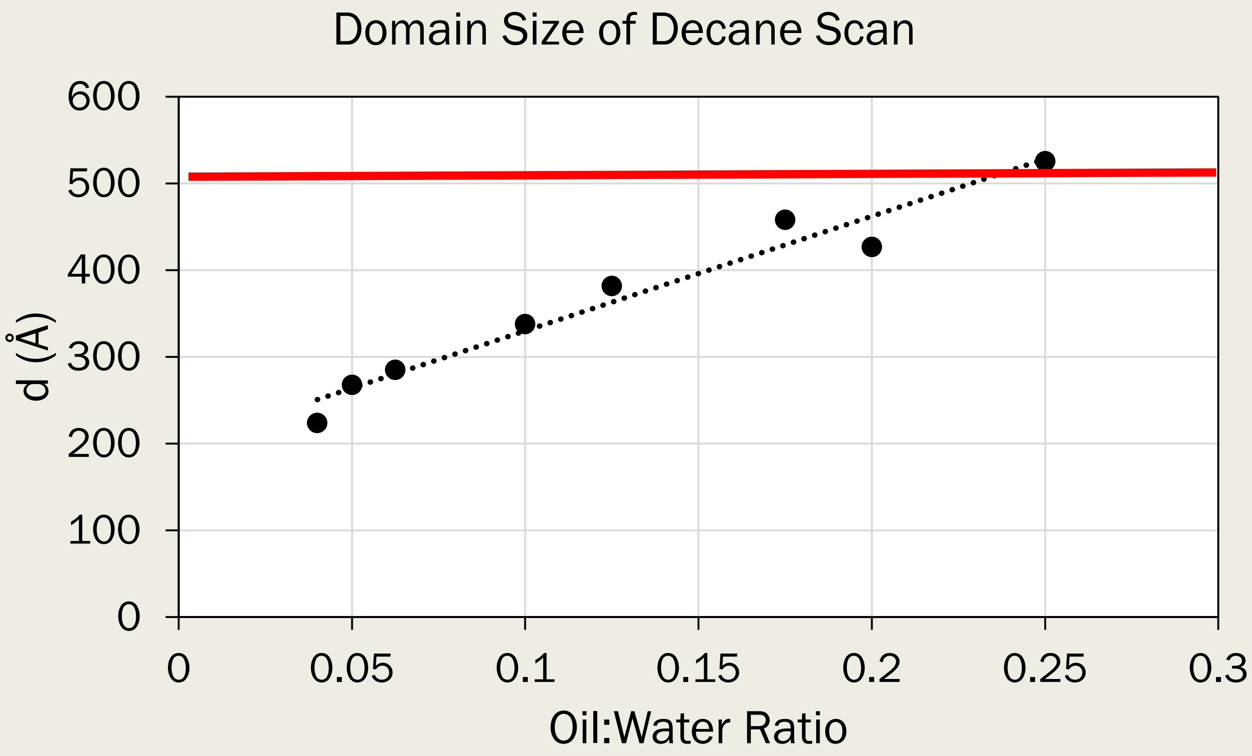
Oil to Water Ratio Scan



Oil scan at 22% NaCl in Decane and D_2O and H_2O

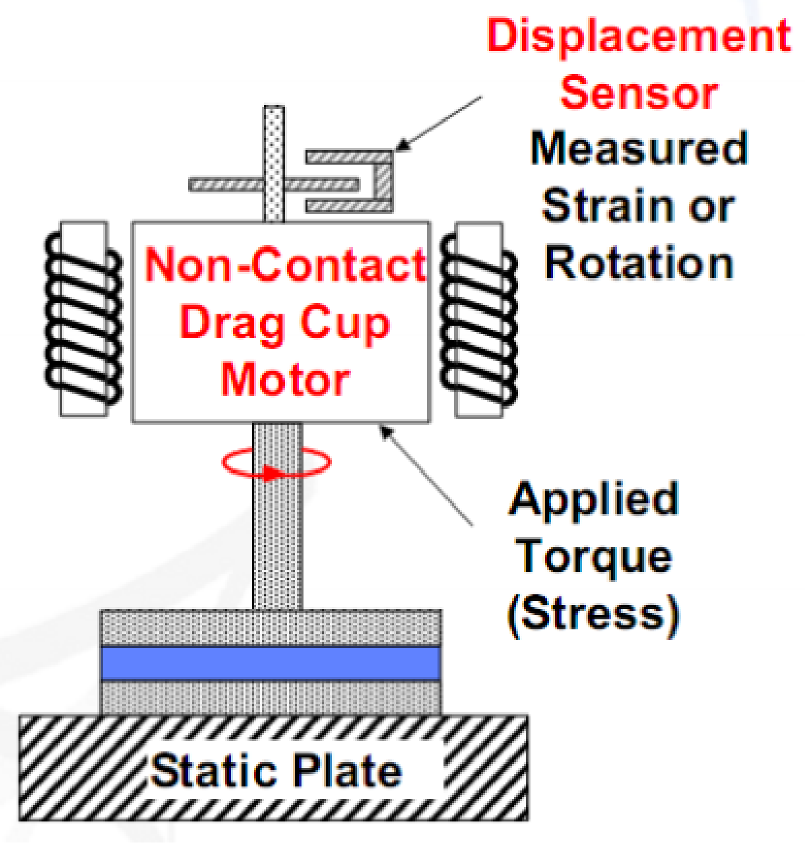


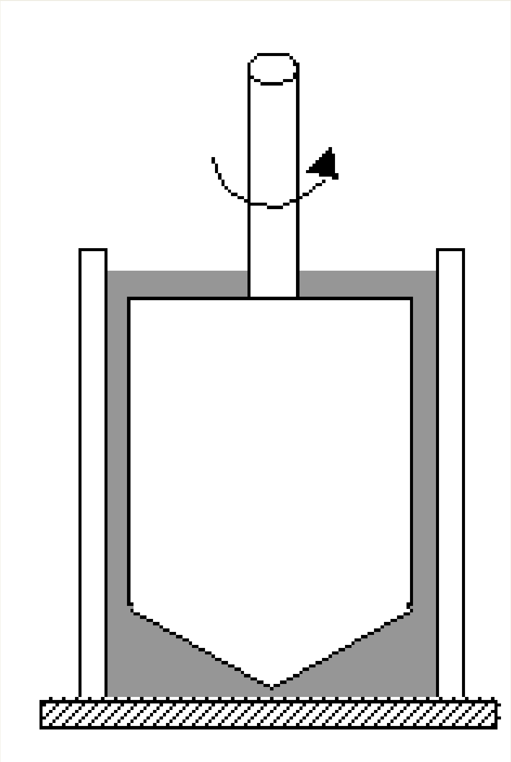
Domain Size for the Oil Scan



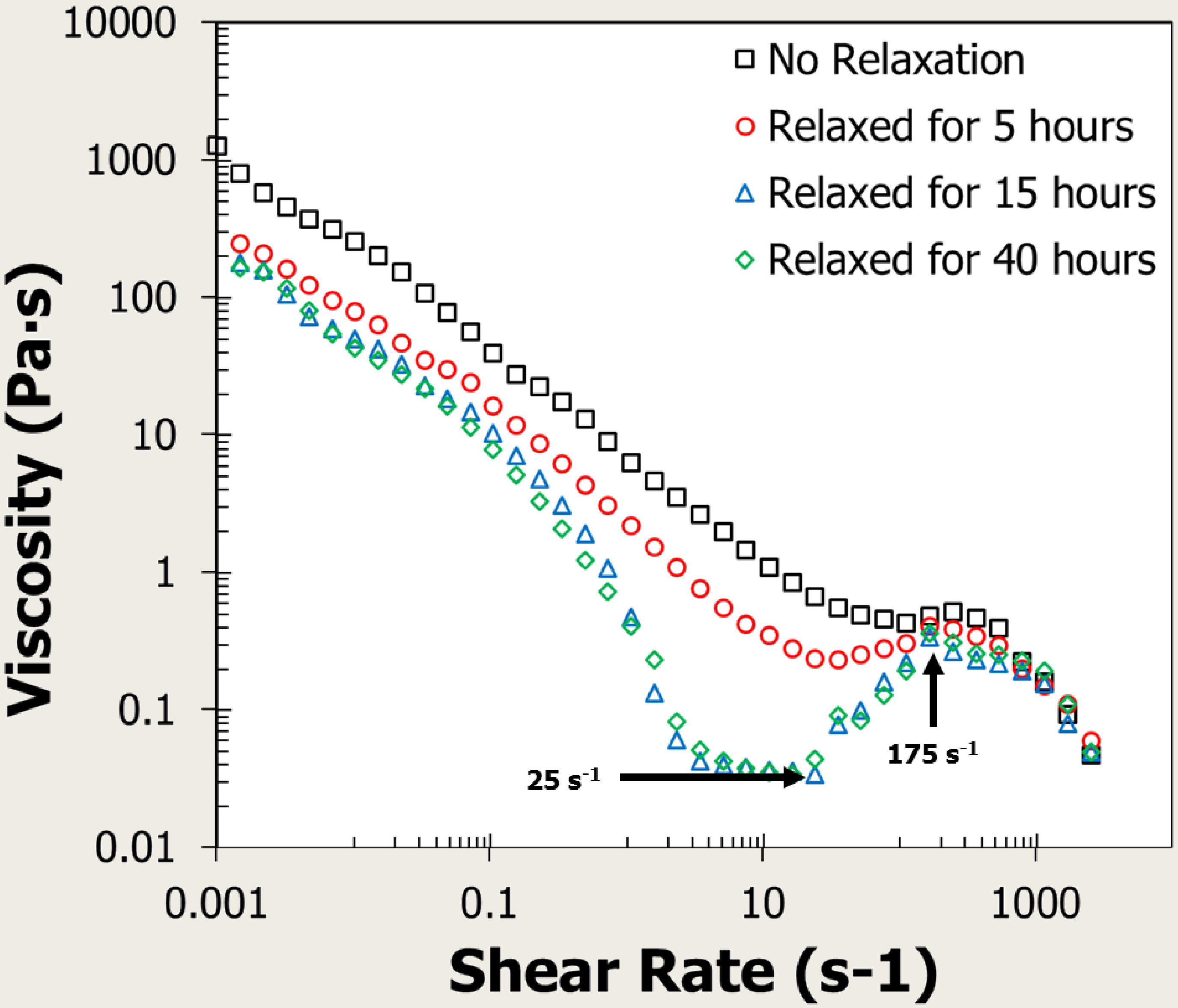
Rheology

- The study of flow and deformation of materials
- Investigate the viscoelastic properties of the shear-induced gel
  - *Time scale of thixotropy (change of viscosity due to stress)*
  - *Mechanical property—strength of gel*





Flow Curve

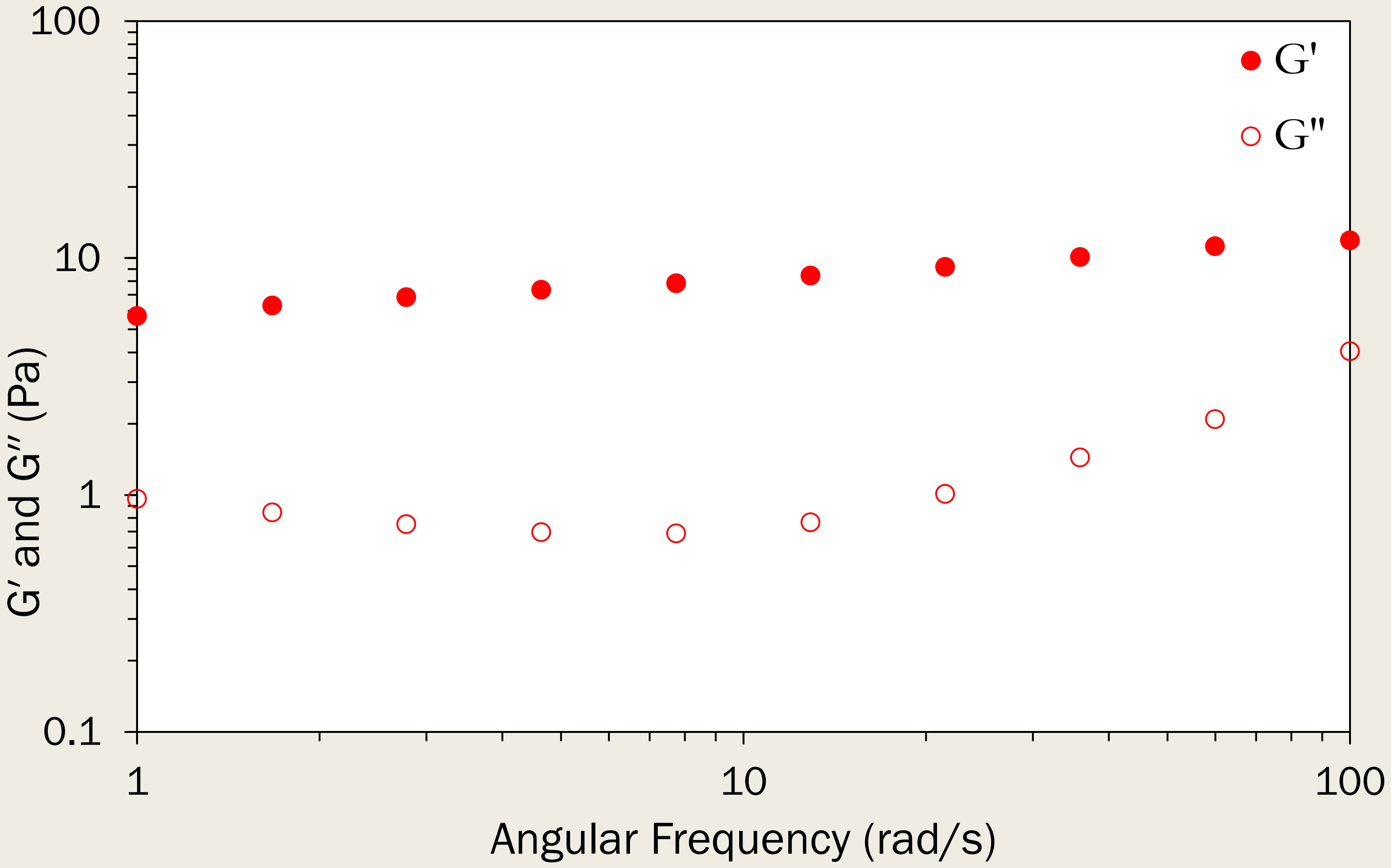


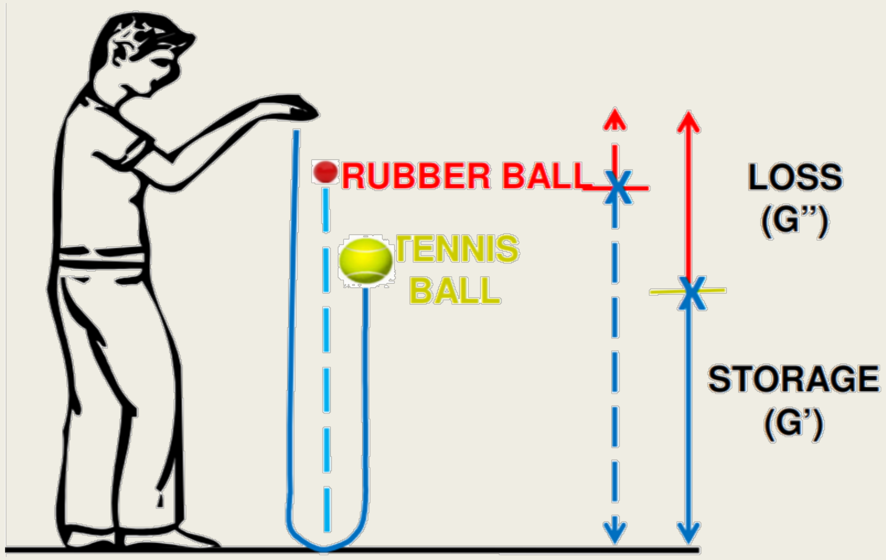
Critical Shear rate

- Below —phase separation
- Above —stable system and shear thickening

Gel decays over time

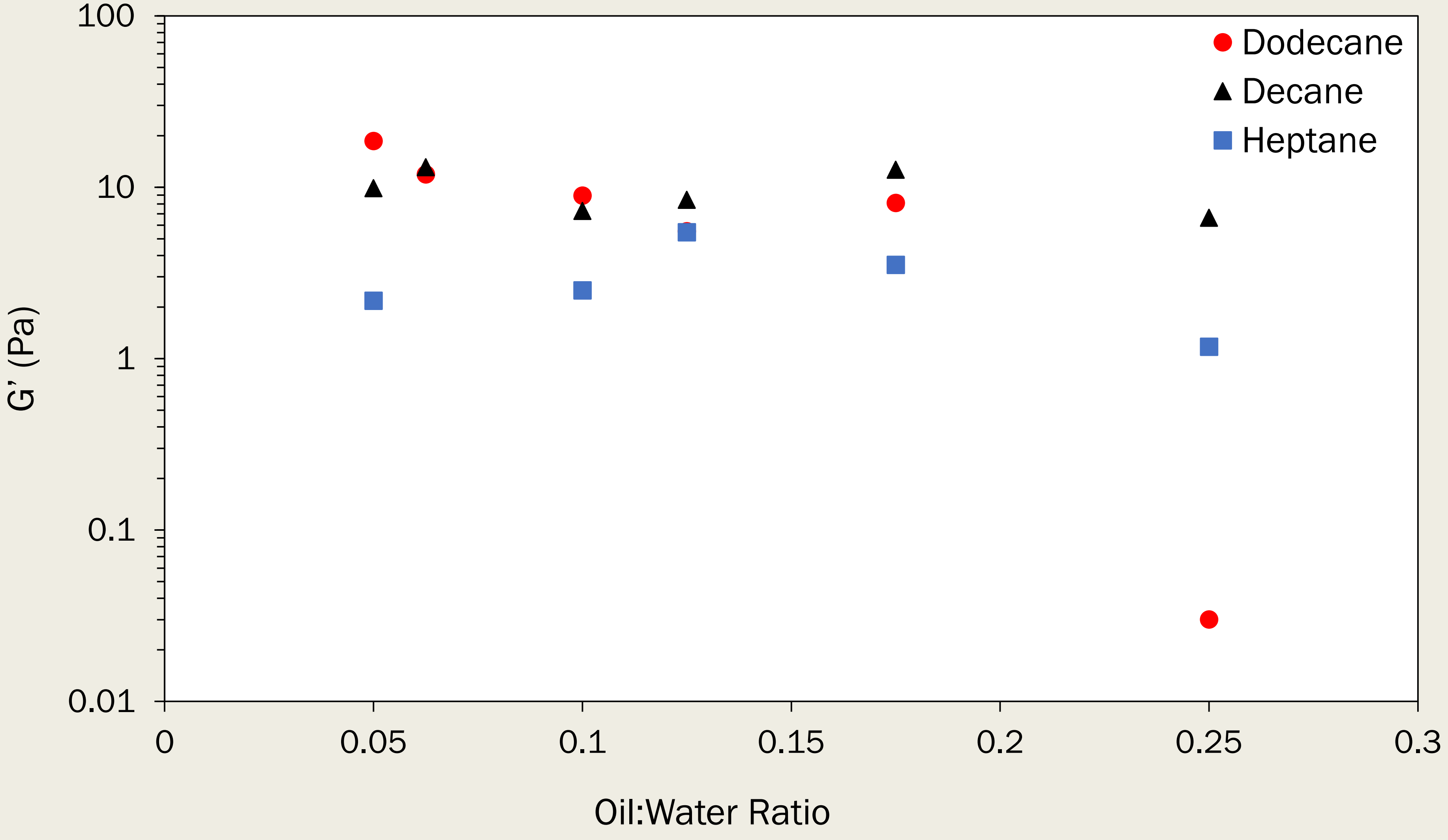
Frequency Sweep for Dodecane Emulsion





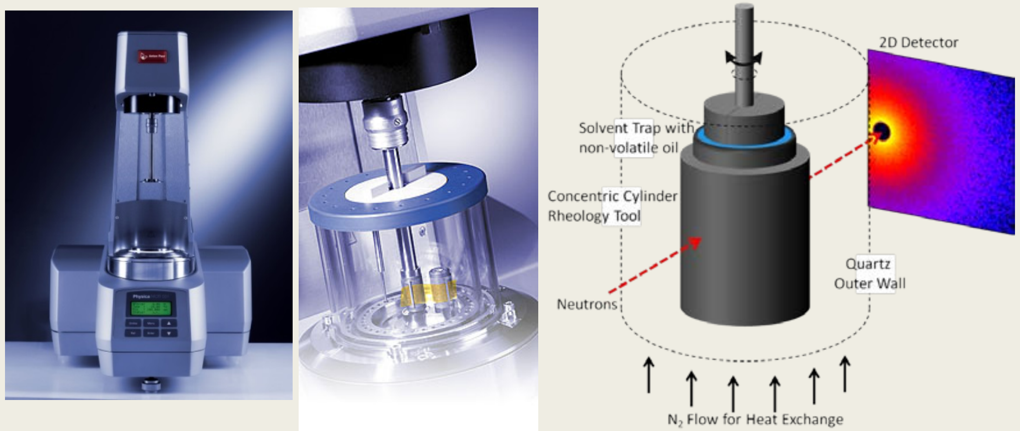
- G′ - Storage modulus or storage of elastic energy
- G″- Loss modulus or dissipation of elastic energy

Strength of Various Alkane Gels

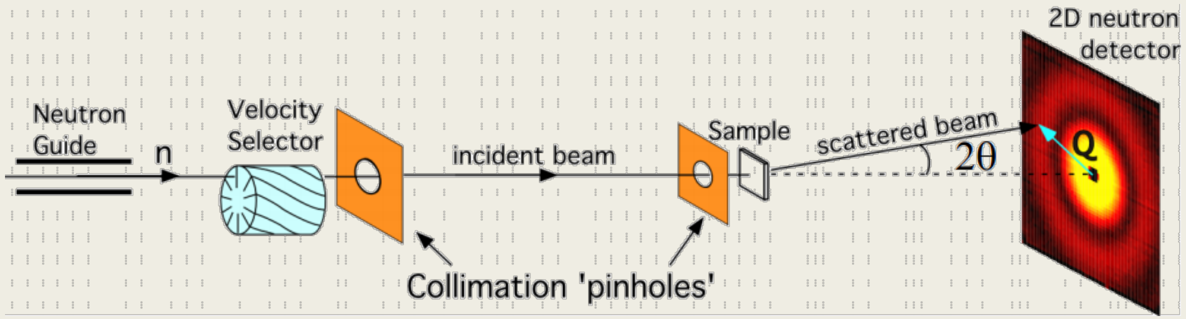


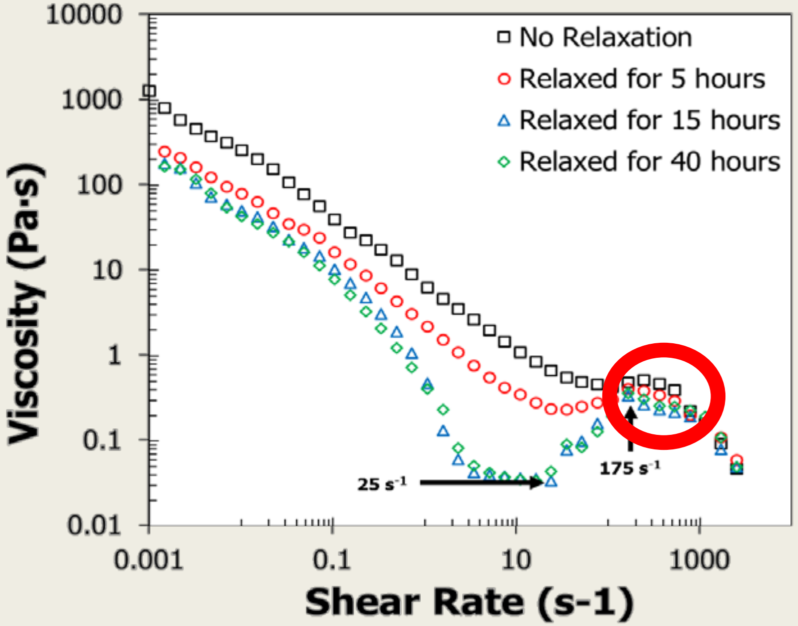
RheoSANS Preliminary Results

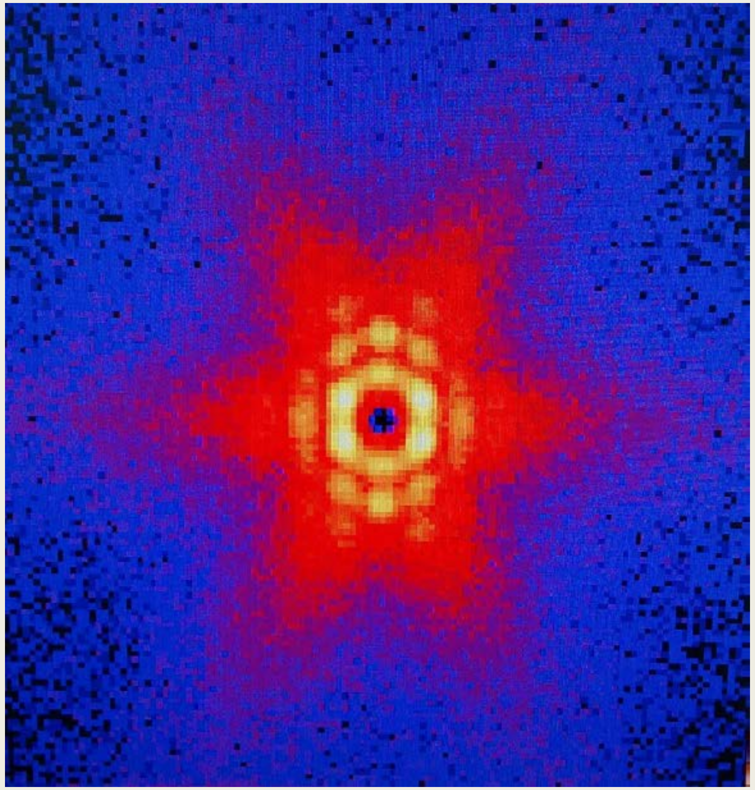
RheoSANS



L. Porcar (NIST), J. Moyer (NIST), P. D. Butler (NIST), L. D. Pozzo (NIST, UW)
G. Langenbucher (Anton Paar)







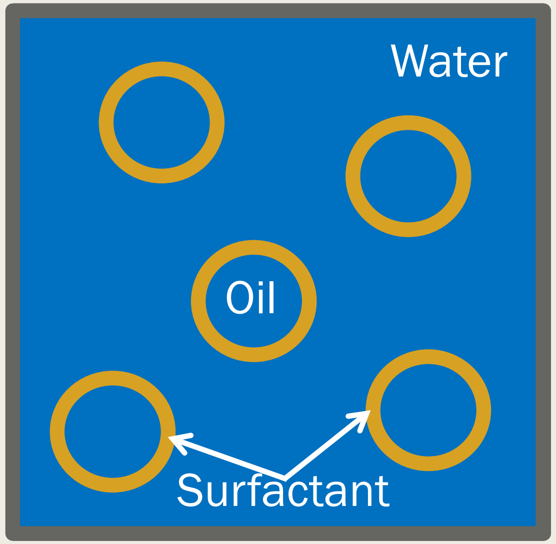
Scattering of 5% Decane at 350 s^{-1}

Conclusions

- Increase in alkane length increases the optimal salt concentration and decreases the domain size
- Alkane length does not affect the conditions where shear-induced gels form
- Heptane gel is weaker compared to that of decane and dodecane

Future Works

- RheoSANS –Below and above oil:water gel ratio
- RheoSANS with different contrast points



Acknowledgement

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