In-Situ Light Scattering for Characterization of Suspended Environmental Nanomaterials: Morphology, Structure and Dynamics

Blaustein Center for Scientific Cooperation (BCSC)
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Course Number: 001-2-0029
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Syllabus & Outline

Day 1

Introduction & Overview of Suspended Nanomaterials

- What are suspended nanomaterials
- Complex fluids and soft materials
  - Emulsions, foams, gels, dispersions
- Length scales
- A Little History…
- How do we investigate these samples
  - Other techniques: TEM, microscopy

Light Scattering basics & instrument operation

- How does light interact with matter?
- Intro to DLS – diffusion measurement
  - Frequency
    - Correlation function
    - Homodyne and heterodyne
  - Intensity
    - Energy squared
    - Inherently a volume-averaged technique
- ALV software
  - How to use it
  - What does it measure
  - How does the software fit the data

Lab 1:
- 100 nm PS latex in DI (DLS and SLS)
- Adjusting concentration and added salt
- (Zeta potential measurements, including PZC if possible)

Homework: plot size as a function of time and concentration

Day 2

Data Analysis from Lab 1
Colloidal stability: aggregation, growth, micellization

Interparticle Interactions
Importance of Surface Charge for Stability
Point of Zero Charge
Screening electrostatics
How does the zeta potential measurement work

Lab 2: Critical micelle concentration of surfactants (DLS)
Prepare PS latex samples in toluene
Refractometer measurements of dn/dc
(Zeta potential from Lab 1 continued, if necessary)
Homework: plot intensity as a function of concentration

Days 3 & 4

Data Analysis from Lab 2
Aggregate structures and internal dynamics

Static Light Scattering
What can we measure
Radius of gyration, interaction potentials, molecular weight
Understanding internal dynamics in a gel or polymer sample
Form and Structure factors
Spheres
Fractal Objects

Labs 3 & 4: Carbon Nanotubes (DLS and SLS)
BSA protein aggregation (DLS & SLS)
Gel measurements (SLS)
PS latex dissolved in toluene (SLS)
Homework: plot intensity and dynamics as a function of angle
Homework: Zimm plots for molecular weight

Day 5

Conclusions and Wrap-Up
Final Test/Quiz
Additional sample measurements from lab participants

Further Reading:

Berne & Pecora. Dynamic Light Scattering With Applications to Chemistry, Biology, and Physics. (2013).
van de Hulst. Light Scattering by Small Particles. Dover Books on Physics. Courier Corporation (2012).