Colloid Science and Nanoscale Engineering Course (CHE 596I)

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http://crystal.che.ncsu.edu/

Synopsis

Colloid science has for long provided the fundamentals of a wide range of practically important processes such as foam, emulsion and suspension stability, detergency, separations and product formulation. Vast areas of application of colloid science are currently being opened by the developing technologies of microfabrication, bioarrays and nanotechnology. Future progress in these areas will require understanding and modification of the molecular and surface interactions. This will allow engineering on the nanoscale similarly to the way process engineering is presently done for larger scale units and operations.

This course will begin with an in-depth coverage of the fundamentals of colloidal interactions between surfaces, particles, surfactants and biomolecules, and their relevance to self-assembly. The theory and practice of particle characterization by scattering methods and their manipulation by external fields will be presented. In the second part of the course, emerging colloid-related technologies in microfluidics, micropatterning, bioarrays and nanostructured materials will be presented. Ways to apply the colloidal fundamentals to the engineering on the nanoscale will be discussed.

The course is useful for students and scholars who want to understand and apply colloids and nanoscience in their research, and for practitioners who want an update on the fundamentals and new developments. The attendees should have some knowledge of thermodynamics, statistical mechanics and/or physics. The course will be also offered through NCSU Distance Education via streaming video and CDs (http://engineeringonline.ncsu.edu/).

CHE 596I, Spring 2003, Tue & Thu, 6-7:15 PM

Contents

Colloid Science

Surface thermodynamics
- Surface tension, contact angle, wetting
- Adsorption and adsorption isotherms
- Surfactants and micellization

Intermolecular and surface forces
- Van der Waals forces
- Electrostatics without and with electrolyte
- Colloidal interactions / DLVO
- Interactions between biological molecules

Interactions and manipulation of colloids with external fields
- Zeta potential and electrophoresis
- Dielectrophoresis
- Optical phenomena
- Scattering methods

Nanoscale engineering

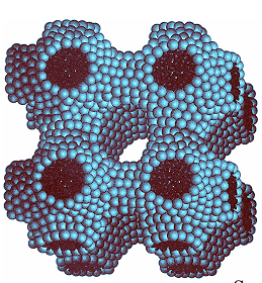
Nanoparticles and nanostructured materials

Microfabrication and MEMS

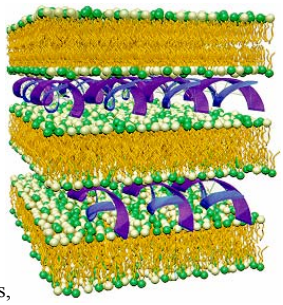
Microfluidics and lab-on-a-chip devices

Bioarrays and biosensors

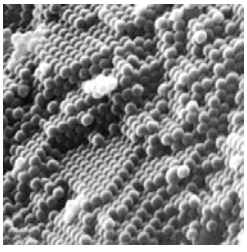
Microstructures with photonic and electronic functionality

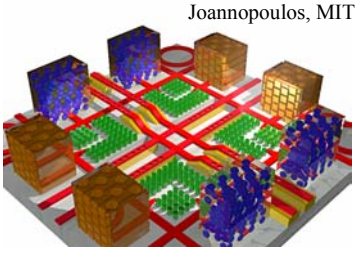


Colloidal crystal

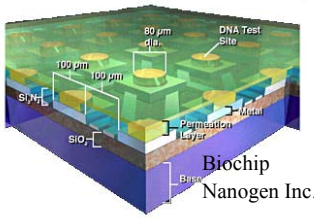


Surfactants, lipids, and DNA





Photonic device, Joannopoulos, MIT



Biochip
Nanogen Inc.