Schedule for the 3rd Mid-Atlantic Soft Matter workshop, October 17, 2008

8:00 am
Registration and Breakfast, (Clayton Hall)

8:55 am
Opening Remarks

9:00 am
Michael Mackay (University of Delaware)
Thermodynamics in thin films and how it affects self assembly

9:45 am
Sound-bite Session I

10:30 am
Coffee Break

11:15
Ahmed Alsayed (University of Pennsylvania)
Phase-Transitions in Temperature Sensitive Colloidal Suspensions

12:00 pm
Lunch, (Clayton Hall)

1:30 pm
Patrick Spicer (Procter & Gamble Co.)
Microstructural Heterogeneity and Large-Scale Soft Matter Manufacturing

2:15 pm
Sound-bite Session II

2:50 pm
Coffee Break (Clayton Hall)

3:15 pm
Eric Dufresne (Yale University)
Colloidal Electrostatics at Vanishing Ionic Strength

4:00 pm
Sound-bite Session III

4:30 pm
Break

4:45 pm
Kathryn Beers (NIST)
High Throughput Approaches to Polymer Science using Microreactor Technology

Kathryn L. Beers
Polymers Division, NIST
High Throughput Approaches to Polymer Science using Microreactor Technology
Advanced polymeric materials in applications as diverse as tissue engineering, electronics and personal care products require superior control of a wide range of properties. From molecular properties such as molar mass and chain composition, to the properties of complex mixtures, high throughput and combinatorial techniques are providing researchers access to enormous libraries en route to both improved fundamental understanding of structure-property relationships and better products. The appeal of microreactor technology to this scientific community is three-fold: further reduction of scale in expensive specialty applications; faster, less expensive process integration in laboratory-scale investigations of complex, multi-step manufacturing protocols; and potential discovery of new and improved products from the unique microreaction environment. Our work demonstrates three basic routes to using the micro-environment to prepare both gradient and discrete polymer libraries. These routes, in addition to several commensurate measurement methods and the potential transformative impact of this technology will be discussed.

Eric R. Dufresne
Departments of Mechanical Engineering, Yale University
Colloidal Electrostatics at Vanishing Ionic Strength
Electrostatic interactions play important roles in most complex fluids and biological systems. In these environments, charged interfaces do not interact directly, but through a sea of mobile ions in solution that screen the electric field over a characteristic length called the screening length. The physics is relatively simple in the limit of large separations and low surface potentials. Here, the governing "Debye-Huckel" equation is linear and the fields and forces are conveniently pairwise-additive. However, this approximation fails at the nanoscale, where the separation between interacting charges can be significantly smaller than the screening length. In this regime - important for proteins, polyelectrolytes and nanocolloids - electrostatics is typically modeled with the mean-field "Poisson-Boltzmann" equation. Direct tests of Poisson-Boltzmann at this length scale are limited.

I will describe our preliminary observations of many-body contributions to electrostatic interactions in a charged colloidal suspension. We mimic nanoparticles in water with an easy-to-manipulate system of microparticles in oil - where the screening length can be much greater than one micron. We measure interparticle forces with femtoNewton precision by analyzing the relaxation of systems that have been gently perturbed with optical tweezers. By systematically measuring the interactions of 2, 3, and 7 identical spherical particles in identical solvent conditions, we directly observe the breakdown of pairwise-additivity.

Michael Mackay
Department of Chemical Engineering, University of Delaware
Thermodynamics in thin films and how it affects self assembly
We are interested in assembling nanoparticles to interfaces and use polymer molecules as the engine. Since a nanoparticle will lose only a couple of degrees of freedom while the loss of configurational entropy a polymeric molecule suffers at a solid substrate is considerably greater, the assembly energy is quite large. So, when nanoparticles and polymers are spin coated onto a solid substrate and the polymer softened all the nanoparticles are driven to the hard interface. In fact, the assembly energy is so large a liquid film will rise over 100 nm obstacles rather than disassemble the nanoparticle layer. Yet, this energy can be overcome if the dielectric constant of the nanoparticle is low enough and complete assembly can occur at the air interface with equal robustness. So, in general the overall free energy of the system is minimized through a balance of enthalpy (dielectric ordering) and entropy. This type of nanoparticle assembly is useful in a variety of applications and we use it to make polymer based solar cells which will be briefly discussed.

Ahmed Alsayed
Department of Physics, University of Pennsylvania
Phase-Transitions in Temperature Sensitive Colloidal Suspensions
Colloidal suspensions are good model systems to study phase transitions. Compared with atoms, micrometer-sized colloidal particles are large and their thermal motions are slow so that they can be directly observed in real space and real time using conventional microscopy. In our lab we use thermally responsive microgel colloidal particles to study phase transitions. These particles are micron-size nearly-hard-sphere. The thermal response of the particles enables precision control of particle volume fraction. Thus by changing sample temperature slightly, we precisely vary the suspension volume fraction. This phenomenon have enabled us to directly observe premelting of three-dimensional crystals near grain boundaries [1], to directly observe melting in 2-D wherein intermediate hexatic phases form [2], and to create and observe dynamics in geometrically frustrated colloidal 'anti-ferromagnets' [3]. In the talk, I will review these three experiments.

Patrick T. Spicer
Complex Fluids Microstructure Group, P&G
Microstructural Heterogeneity and Large-Scale Soft Matter Manufacturing
When preparing a structured fluid sample on the bench scale, it is relatively easy to ensure fluid homogeneity because the energy per volume input is usually high. As a process to make a structured fluid increases in scale, for example to twelve metric tons, the microstructural length scales can be much larger, much more heterogeneous, and much harder to control. In the case of commercial structured fluids, however, small-scale homogeneity may never be achieved and might not even be desirable. So, given that most commercial structured fluids are always heterogeneous at certain length scales we are motivated to determine the heterogeneity of the fluid, how processing affects heterogeneity, and the effects of heterogeneity on product quality and performance. I will discuss how we are using microrheological techniques to try and answer these questions, show some examples, and suggest some paths forward for increasing our understanding of this open research area.

Sound-bite Session I

1. Richard Arevalo (Georgetown University)
   Stress Inhomogeneities In Sheared Collagen Networks
2. Aaron Baldwin (University of Delaware)
   Heparinized extracellular matrix-mimetic scaffolds for controlled release of therapeutic macromolecules
3. Anindita Basu (University of Pennsylvania)
   Shear deformation in fibrin gels
4. Brendan Brelsford (Georgetown University)
   Semiflexible Polymer Networks: Dissipative Particle Dynamics Simulation
5. Ted Brzinski (University of Pennsylvania)
   Drag Forces in a Granular Bed
6. Daniel Chen (University of Pennsylvania)
   Gelation of Rigid Rod Networks
7. Sudeep Dutta (Georgetown University)
   Confocal rheology of disordered colloidal dispersions
8. Wouter Ellenbroek (University of Pennsylvania)
   Charge inversion of walls exposed to salt solution
9. Sarah Grieshaber (University of Delaware)
   Hybrid Elastin Mimetic Polymers with Alternating Molecular Architecture for Vocal Fold Tissue Engineering
10. Hongyu Guo (Johns Hopkins University)
    XPCS Study of Nanoparticle Motion within Concentrated Entangled Polymer Solutions
11. Elizabeth Knowlton (Georgetown University)
    Where rheology meets the confocal
12. Ohm Divyam Krishna (University of Delaware)
    Design of collagen mimetic peptide : self assembly from nano to micro scale

Sound-bite Session II

13. Ke Chen (University of Pennsylvania)
    Breaking of jams in granular flows
14. Andrzej Latka (Saint Josephś University)
    Direct imaging of colloidal suspensions with short-range attractive potential
15. Julie Lawson (University of Delaware)
    Generating Surface Energy Gradients for Block Copolymer Thin Film Studies
16. Myung Han Lee (Johns Hopkins University)
    Microrheology of Protein Layers at The Air-Water Interface
17. Matthew Lohr (University of Pennsylvania)
    Continuing Studies of Correlation in Constrained Thermosensitive Colloids
18. M. Lisa Manning (Princeton University)
    Shear banding in amorphous solids
19. Armstrong Mbi (Georgetown University)
    Force Distribution in Colloidal Glass: Breaking Down The Boundaries...
20. Naa Larteokor McFarlane (University of Delaware)
    Phase behavior of uncharged polymer - colloid suspensions
21. Jason McMullan (University of Delaware)
    Directed Assembly of Particle Suspensions with Electrical Fields
22. Manish Mittal (University of Delaware)
    Assembly of ellipsoidal titanium dioxide particles
23. Ting Nie (Materials Science & Engineering, University of Delaware)
    Molecularly engineered hydrogel for regulating the controlled release of biomolecules and cell responses
24. Maki Nishida (Georgetown University)
    Development of Raman Correlation Spectroscopy for nanoparticle analysis.
25. Kerstin Nordstrom (University of Pennsylvania)
    Microfluidic Rheology of Microgel Pastes

Sound-bite Session III

26. Bum Jun Park (University of Delaware)
    Two-dimensional self-assembled crystals of colloids underneath oil-water interfaces
27. Kelly Schultz (University of Delaware)
    Material assembly and gelation kinetics of PEG-heparin hydrogels using multiple particle tracking microrheology
28. John P. Singh (University of Delaware)
    Directed self assembly of micrometer-sized anisotropic particles
29. Chris Snively (University of Delaware)
    Green Polymers from ÜnpolymerizableM̈onomers
30. Indira Sriram (University of Delaware)
    Two particle measurements in the direct limit
31. Kimani A. Stancil (Howard University)
    Drying Assembly of CdSe Nanorods
32. Maeva S. Tureau (University of Delaware)
    Nanostructured Networks as Active Capture Devices for Environmental Metabolomics using Block Copolymers
33. Paula Vasquez (University of Delaware)
    Condensed Structures of MR Fluids in Microgravity
34. Wen-Shiue (Owen) Young (University of Delaware)
    Effect of salt-doping on PS-PEO copolymer.
35. Peter yunker (University of Pennsylvania)
    Growth of Local Order During Aging
36. Zexin Zhang (University of Pennsylvania)
    Quench the Colloidal Suspensions