Schedule for the 11th Mid-Atlantic Soft Matter workshop, July 11, 2013

The University of Delaware, CMET & Dept. of Chemical and Bimolecular Engineering

8:15 am
Registration and Breakfast

8:50 am
Opening Remarks

9:00 am
Darrin Pochan (U.Del):
Construction of Exotic Nanoparticles with Kinetic Control

9:40 am
Sound-bite Session I

10:20 am
Coffee Break

10:40 am
Ilona Kretzschmar (CCNY):
Designer Particles and Their Applications

11:20 am
Sound-bite Session II

12:10 pm
Lunch

1:20 pm
Salvatore Torquato (Princeton):
Designer Materials via Optimization Techniques

2:00 pm
Sound-bite Session III

2:40 pm
Break

3:00 pm
Dan Hammer (U.Penn):
Designer vesicles from synthetic surfactants – block-co-polymers and recombinant proteins

3:40 pm
Sound-bite Session IV

4:20 pm
Break

4:40 pm
Marco Caggioni (P&G):
Designer consumer products via microstructure design

5:20 pm
End of Workshop

Darrin Pochan, University of Delaware

Construction of Exotic Nanoparticles with Kinetic Control

Kinetic pathways and temporal stabilities of different micelles and nanoscale aggregates have been used to construct exotic nanoparticles in solution. Due to low chain exchange dynamics between block copolymeric micelles and solvent, global thermodynamic equilibrium is extremely difficult, if not impossible, to achieve in block copolymer assembly. However, by taking advantage of this slow kinetic behavior of polymeric micelles in solution, one can purposely produce multicompartment nanoparticles and mulitgeometry nanoparticles by forcing different block copolymers to reside in the same nanoscale structure through kinetic processing. While kinetically trapped in common nanostructures, local phase separation can occur producing compartments. This compartmentalization can be used within common micelle geometries to make complex spheres and cylinders or can be used to make new nanostructures such as multigeometry aggregates (e.g. hybrid cylinder-sphere aggregates, disk-cylinder nanoparticles).

Ilona Kretzschmar, City College of New York

Designer Particles and Their Applications

Modification of particle surfaces in an anisotropic fashion has garnered the interest of the colloids community due to the recognition that these designer particles, also called patchy particles, present interesting new building blocks for the directed assembly of desired target structures. Controlled surface modification has been achieved employing various methods such as shadow evaporation and templating. Directed assembly is often achieved with the help of electric, magnetic, and convective fields. The resulting colloidal structures are interesting in that they can be rendered addressable owing to their patchiness and the material properties of the patch.

In this talk, we will report on our resent work with magnetic Janus particles that has led to the development of a microviscometer. Magentic Janus particles are prepared via iron evaporation onto a silica particle monolayer in the presence of an argon:oxygen mixture. Variation of the evaporation rate allows the fine tuning of the magnetic properties of the resulting Janus particles. Subsequent exposure to electric and magnetic fields results in a chain structure that can be either reversibly or irreversibly switched between two configurations enabling its use as an in situ microviscometer.

Salvatore Torquato, Princeton University

Designer Materials via Optimization Techniques

We use inverse statistical-mechanical techniques to challenge conventional wisdom about the nature of classical low-temperature states of matter. A number of questions are posed that have surprising answers. Can low-coordinated crystal structures, such as solid forms of carbon (graphene or diamond crystal structures) be the ground states of many-particle interactions that involve only non-directional (isotropic) pair potentials? Are there single-component many-particle systems characterized by isotropic pair potentials that possess exotic low-temperature bulk properties, such as negative thermal expansion or negative Poisson's ratio? Can ground states ever be disordered? In other words, can cooling a liquid to absolute zero result in a completely disordered many-particle configuration, as opposed to the usual crystal ground state? I will show that the answers to all of these questions are in the affirmative, and have fundamental and practical implications.

Dan Hammer, University of Pennsylvania

Designer vesicles from synthetic surfactants - block-co-polymers and recombinant proteins

Vesicles are biomimetic capsules with large payloads for drug delivery and imaging. Vesicles are self-assembled from surfactants of appropriate physical properties, such as phospholipids. We have developed vesicles from novel surfactants, including block-co-polymers and protein surfactants, in which the materials properties, adhesiveness and responsiveness can be widely tuned. Vesicles assembled from polymers, also known as polymersomes, can be engineered with tunable elasticity. By incorporating hydrophobic optical emitters within the membrane of polymersomes, we have developed vesicles which can disassemble upon illumination and be used as stress sensors. Recently, we have discovered a recombinant surfactant protein that can be expressed in bacteria, purified, and widely engineered through properties of molecular biology. We show that this protein can assemble into vesicles, but engineered variants can make unique materials, such as worm-like micelles and sheets. In summary, we have a spectrum of surfactant molecules that can assemble into nano-vesicles and be used for a wide variety of technological applications.

Marco Caggioni, Procter and Gamble

Consumer products via Microstructure Design

In the last 20 years consumer products and more specifically liquid detergents evolved from simple surfactant solution to multiphase complex fluids in which surfactant, polymers, solid particles, encapsulated materials and emulsion droplets coexist in a delicate equilibrium. Such evolution enabled the addition and fine tuning of multiple functions but also increased the complexity of the liquid microstructure in a way that resembles the transition from prokaryotic to eukaryotic cells. Many of todays liquid detergent rely on colloidal gels or glasses microstructure to provide physical stability and include suspended colloidal particles to deliver benefit beyond just cleaning. In this talk I will review some of the challenges we face in designing and modeling the stability and the performance of liquid detergents with emphasis on the open fundamental questions that would certainly benefit from a strong partnership with the soft matter community.

Soundbite Talks: *MASM 11*

Session I

1. Gregg Duncan (Johns Hopkins University)
   Tuning colloidal phase behavior though protein-carbohydrate interactions
2. Tara Edwards (Johns Hopkins University)
   Size Dependent Thermodynamics and Kinetics of Tunable Colloidal Crystal Assembly from Measured Energy and Diffusivity Landscapes
3. Ariel Ekblaw (Yale & Georgetown University)
   Giardia Motility: Soft Matter Analysis of the Gastrointestinal Track
4. Jillian Emerson (University of Delaware)
   Phase separation in poly(3-hexylthiophene)/polystyrene blends
5. Franklin Feingold (Clark University)
   Surface wave dispersion of Oil and Gel
6. Daniel Greene (University of Delaware)
   Order from disorder: A closer look at protein precipitate
7. Angela Holmberg (University of Delaware)
   Lignin- and fatty acid-based block copolymers for nanostructured thermoplastic elastomers
8. Michael J. A. Hore (NIST NCNR)
   Cononsolvency of PNIPAM in d-Ethanol / d-Water Mixed Solvents
9. Xiaoqing Hua (Johns Hopkins University)
   Modeling adsorption/desorption of gold nanoparticles at the oil-water interface
10. Wei-Fan Kuan (University of Delaware)
    Design and Synthesis of Network-Forming Triblock Copolymers Using Tapered Block Interfaces
11. Pramukta Kumar (Georgetown University)
    Flow Behavior in an Aggregating SU8 Microrod Suspension
12. Ankit Kumar (University of Pennsylvania)
    Patchy Janus Particles at Fluid Interfaces

Session II

1. Sang-Wook (University of Pennsylvania)
   Bio-inspired hygromorphic actuator exhibiting controlled locomotion
2. Steven Atkinson (Princeton University)
   Maximally Dense Packings of Two-Dimensional Convex and Concave Noncircular Particles
3. Carlos A. Silvera Batista (NIST)
   Hydrodynamic Behavior of Carbon Nanotubes and Characterization of Length Distributions
4. Jonathan Bauer (University of Delaware)
   Directed self-assembly via pulsed magnetic field
5. Peter Beltramo (University of Delaware)
   A Soft Matter PhD Thesis in Three Minutes
6. Katherine Borner (NIST / UT Dallas)
   Investigation of Stability of Silica Particles in Lutidine/Water Solvent
7. Duyu Chen (Princeton University)
   Modeling the Switch from Tumor Dormancy to Rapid Proliferation

8. Jie Chen (Tsinghua University, NIST NCNR)
   Toward accurate determination of inter-particle interaction for polydisperse system
9. Maria Magdalena Cid (Universidade de Vigo)
   Chromonic phases as anisotropic solvents in NMR
10. Jake Cohen (University of Pennsylvania)
    Propagation of stress through collagen biopolymer networks on PDMS substrates
11. Anna Coughlan (Johns Hopkins University)
    Particle Interactions in a Rotating Magnetic Field

Session III

1. Julia Swavola (Johns Hopkins University)
   Conservative and Dissipative Forces between Mucus and Differently Coated Drug Particles
2. Alex C Szatmary (NIH)
   Development of a quantitative agarose spot chemotaxis assay
3. Pasha Tabatabai (Georgetown University)
   Silk Electrogel Rheology
4. Fuquan Tu (University of Pennsylvania)
   thermodynamically stable emulsion stabilized by Janus dumbbells
5. Nestor E. Valadez-Perez (NIST NCNR)
   Geometry of small colloidal clusters
6. Matthew Wasbrough (University of Delaware/NCNR)
   Direction and control of self-assembly using magnetism.
7. Kathryn Whitaker (University of Delaware)
   Direct measurement of depletion forces using optical tweezers
8. Richard Wool (University of Delaware)
   How the Soft to Hard Matter Transition Occurs with NanoConfinement
9. YUGUANG YANG (Johns Hopkins University)
   Constraint Stokesian Dynamics simulation for single rod
10. Ge Zhang (Princeton University)
    Unusual classical ground states of isotropic pair potentials
11. Mohan Zhang (Georgetown University)
    Derivatives of Ricinoleic Acid as Low-Molecular Mass Organic Gelators
12. Ming Zheng (NIST)
    Sorting colloidal carbon nanotubes by their atomic structures

Session IV

1. Ming Luo (University of Delaware)
   Manipulating nanoscale morphologies in block copolymer thin films using gradient approaches
2. Luz J Martinez-Miranda (University of Maryland)
   Liquid Crystal Nanocomposites: Structural properties in the vicinity of the nanoparticles
3. Sarah Mastroianni (University of Delaware)
   Poly(methyl methacrylate-block-m-triphenylamine): synthesis by RAFT polymerization and melt-state self-assembly

4. Sepideh Razavi (City College of New York)
   Particle Pinning at Liquid-liquid Interfaces

5. John Royer (National Institute of Standards and Technology)
   Shear-induced diffusion of cubic colloids

6. Bradley Rupp (Johns Hopkins University)
   Probing colloidal properties using low and high frequency electric fields

7. Bibek Samanta (Georgetown University/ IISER-Kolkata)
   Looking at faraday waves

8. Sameer Sathaye (University of Delaware)
   Introducing Protein like hydrophobic shape specificity in beta-hairpin peptide fibrils

9. Cameron Shelton (University of Delaware)
   Controlling triblock copolymer thin film orientation using raster solvent vapor annealing

10. Hao Shen (Chemical Engineering, University of Delware)
    The Improvement in Performance of Polymer-Based Solar Cells by Silica Nanoparticles

11. Clare Singer (Georgetown University)
    Colloidal Rods at the oil water interface

12. Justin Stimatze (Georgetown University)
    Simulating fiber motion in shear flow using Dissipative Particle Dynamics