

Schedule for the 4th Mid-Atlantic Soft Matter workshop, February 20, 2009
Employee Lounge, Building 101, NIST Gaithersburg Campus

8:00 am

Registration and Breakfast, NIST Cafeteria

8:45 am

Opening Remarks
Eric Amis (NIST)

8:50 am

Overview of NIST and soft matter at NIST
Kalman Migler (NIST)

9:00 am

Denis Wirtz (Johns Hopkins U)
Nucleus-cytoskeleton connections in health and disease

9:35 am

Sound-bite Session I

10:05 am

Coffee Break, Cafeteria

10:20 pm

Sound-bite Session II

10:50

Jeff Fagan (NIST)
Purification and Characterization of Single-Wall Carbon Nanotubes

11:10

Jun Young Chung (NIST)
Advances in Surface Wrinkling as a Metrology

11:30

Norm Wagner (Univ. of Delaware)
An Intro to The Center for Neutron Science

11:35

Lunch, NIST Cafeteria

12:30 pm

Tour of NCNR, Dan Neumann (NIST)

1:40 pm

Ferenc Horkay (NIH)
Ionic Effects on the Hierarchical Assembly of a Stiff Biopolymer Aggregan

2:15 pm

Sound-bite Session III

2:40 pm

Coffee Break, Cafeteria

3:00 pm

Mihai Peterca (U Penn)
Branching, Free Energy and the Self-Assembly of Amphiphilic Dendrons

3:35 pm

Sound-bite Session IV

Afterward...

Informal Happy Hour at Dogfish Head Alehouse

Jun Young Chung

Polymers Division, NIST

Advances in Surface Wrinkling as a Metrology

Nanotechnology promises to revolutionize a growing set of materials applications ranging from electronics to drug delivery to ballistic protection. However, the quest to engineer materials on the nanoscale is met with the daunting task of measuring the material properties (e.g., stiffness and elasticity) of these systems at these same length scales. For polymers, the challenge is even greater since conventional materials testing platforms do not always offer a means to measure systems that need to be conditioned by a controlled environment, such as for temperature and humidity. In response to these challenges, we introduce a new measurement platform for assessing the surface structural and physical properties of nanoscale polymeric materials via surface wrinkling. Our technique accommodates the challenges of small specimens, in situ evaluation, spatial modulus imaging, and high-throughput measurement capabilities. This metrology is also simple and inexpensive to implement without the need for investment in intricate and often delicate instrumentation, thus lowering the barrier for broad and widespread application of this measurement technique. This presentation will briefly review the current research and progress on wrinkling-based metrology.

Jeff Fagan

Polymers Division, NIST

Purification and Characterization of Single-Wall Carbon Nanotubes

Liquid phase processing has become the dominant method for the purification and separation of single walled carbon nanotubes (SWCNTs). Although multiple techniques are available for both purification and separation of dispersed SWCNTs, chromatography and centrifugation have become the most popular tools, and allow under various conditions extraction of populations with different lengths, electronic type, band gaps, and even single enantiomers. Each of these methods require individualization of the SWCNTs, and the choice of dispersant(s) significantly affects the final results for reasons that are not fully understood. We have carried out significant characterization by UV-visible-near infrared absorption and fluorescence spectroscopy, dynamic light scattering, Raman scattering, small angle neutron scattering, atomic force microscopy and other techniques to both measure the properties of the SWCNT dispersions and the effects of the dispersant. Comparisons will be shown that illustrate the importance of the dispersant on the exhibited behavior and the necessity of understanding the complex behavior of the combined dispersant-SWCNT system to enable the emerging technologies base on SWCNTs.

Ferenc Horkay

The National Institutes of Health

Ionic Effects on the Hierarchical Assembly of a Stiff Biopolymer Aggrecan

Aggrecan is a large negatively charged bottle-brush shaped biopolymer whose complexes with hyaluronic acid provide the compressive resistance of cartilage. Osmotic pressure and scattering measurements on aggrecan solutions reveal self-assembly into microgels. Complexation with hyaluronic acid modifies the long-range spatial organization of the assemblies but does not affect their structure in the length scale range below 1000 . Aggrecan assemblies are exceptionally insensitive to changes in the ionic environment. This behavior is in stark contrast to previous observations on highly charged synthetic and biological polyelectrolytes such as sulfonated polystyrene and DNA. The structural stability of aggrecan assemblies, even in the presence of calcium ions, suggests that these microgel-like particles may act as an ion reservoir mediating calcium metabolism in cartilage and bone.

Mihai Peterca

Department of Physics, University of Pennsylvania

Branching, Free Energy and the Self-Assembly of Amphiphilic Dendrons

Amphiphilic dendrons have been recently used in applications such as aquaporine mimic, selective water transport, dendritic capsules, and nano-actuators. Their self-assembly and self-organization process is driven by a complex network of short range inter- and intra- molecular interactions that cooperatively minimize the supramolecular assemblies free energy. Development of complex supramolecular architectures with new functions requires a profound understanding of their self-assembly process. Based on recent advances in the structural and retrostructural analysis, this talk relates the branching of amphiphilic dendrons with their free energy in the self-assembled state. This provides some of the basic tools needed to program the self-assembly process via the rational design of the dendritic building block.

Denis Wirtz

Chemical and Biomolecular Engineering, Johns Hopkins

Nucleus-cytoskeleton connections in health and disease

The nuclear envelope (NE) is composed of two lipid bilayers: the outer nuclear membrane, which is continuous with the rough endoplasmic reticulum (ER), and the inner nuclear membrane, which adheres to the nuclear lamina, a thin meshwork of intermediate filaments composed of A- and B-type lamins. Mutations scattered along Lmna, which encodes A-type lamins, have been associated with a broad range of human diseases, collectively called laminopathies. The recent characterization of the LINC complex, an evolutionary-conserved protein complex that spans the NE and interact both with the nuclear lamina and the cytoskeleton of mammalian cells suggest that nucleus and cytoskeleton are intimately connected. Here, using quantitative biophysical assays, we find that these connections play a critical role in physiological processes that drive nucleus dynamics, cytoskeleton re-arrangements, and cell polarization, migration, and shape. Disease-associated Lmna mutations and the disruption of the LINC complex alter these cellular processes.

Sound-bite Session I

1. Daniel J. Beltran (Johns Hopkins University)
Role of hydrodynamic interactions in colloidal crystallization
2. Kelly Schultz (University of Delaware)
Material assembly and gelation of PEG-heparin hydrogels using multiple particle tracking microrheology
3. Daniel Chen (University of Pennsylvania)
Gelation of Carbon Nanotube Networks
4. Ke Chen (University of Pennsylvania)
Vibrational Density of States in 2D Colloidal Systems
5. Joannie Chin (NIST)
Polymeric Materials Group Research Projects
6. Indira Sriram (University of Delaware)
Two particle drag microrheology in the direct limit
7. Julie Lawson (University of Delaware)
Generating Surface Energy Gradients for Block Copolymer Thin Film Studies
8. Matthew Dowling (University of Maryland)
Making Gels with Cells: Self-Assembly of New Tissues Directed by Associating Biopolymers
9. Pushkar Lele (University of Delaware)
Harnessing 2D assembly of latex microspheres for novel anisotropic particle arrays
10. Elijah George (University of Maryland)
Linking Magnetic Nanoparticle Containing Capsules

Sound-bite Session II

11. Basavaraja Madivala Gurappa (University of Delaware)
Vesicle-polymer mixtures
12. Steve Hudson (NIST)
Polyelectrolyte and particle adsorption to nanopatterned surfaces
13. Ji Yeon Huh (National Institute of Standards and Technology)
Purification and characterization of double wall carbon nanotubes
14. Frederick R. Phelan Jr. (NIST)
Separation of Nanotubes using Field-Flow Fractionation Techniques
15. Jaime Juarez (Johns Hopkins University)
Interactions, Dynamics, and Microstructures in Electric Field Induced Colloidal Assembly
16. Manish S. Kelkar (University of Delaware)
Interaction between surfactant and polymer molecules: an ITC study
17. Elizabeth Knowlton (Georgetown University)
Glassy Packing

18. Daniel Koch (Georgetown University, Dep. of Physics)
Growth cone motility in a 3d collagen matrix
19. Rakesh Kumar (University of Maryland, College Park, MD)
Smart Materials: Self-Assembled Systems with Flow Properties Tunable by Light
20. SILVIA LACERDA (CBER - FDA)
Blood clotting induced by carbon-based-nanoparticles

Sound-bite Session III

21. Hee-Young Lee (University of Maryland in college park)
Cylindrical Fibers Induced by Multivalent Cations in Organic Solvents
22. Jae-Ho Lee (National Cancer Institute)
Superparamagnetic iron oxide nanoparticles for Multimodal Imaging and Drug Delivery
23. Yun Liu (NCNR University of Maryland)
Intra-molecular structural change and counterion association in PAMAM dendrimers
24. Matthew Lohr (University of Pennsylvania)
Chiral Structures of Thermoresponsive Soft Spheres in Cylinders
25. Vincent Luciani (NIST Center For Nanoscale Science and Technology)
The CNST NanoFab and its capability
26. Jeffrey Martin (NIST)
Interfacial Rheology in Complex Flow
27. ARMSTRONG MBI (Georgetown University)
Force Distribution in Colloidal Glass: Preparation of Mono-dispersed Silica Particles
28. Manish Mittal (University of Delaware)
Electric field driven assembly of ellipsoidal titanium dioxide particles

Sound-bite Session IV

29. Ryan Murphy (National Institute of Standards and Technology)
The Dynamics of Polyelectrolytes at Surfaces
30. Tinh Nguyen (NIST)
Nanoparticle Release during Life Cycle of Polymer Nanocomposites
31. Mark Panczyk (University of Delaware)
Dicolloid Synthesis and Arrangement
32. Jai A. Pathak (MedImmune LLC (Astra Zeneca))
Monoclonal Antibody Solution Rheology: Challenges and Opportunities
33. Denis Pristinski (NIST)
Diffusing Wave Spectroscopy of Concentrated Microgels
34. Daniel Sanborn (Anton Paar USA, Inc.)
Technical Representative, Rheology & Surface Potential Analysis
35. Nripen Singh (University of Delaware)
Synthesis and Characterization of Interfacially Modified Block Copolymers

36. Li-Piin Sung (BFRL/NIST)
Characterizing Nano-TiO₂ Suspensions by Photo Correlation Spectroscopy and Relate Dynamic Behavior of TiO₂ agglomerates to Photoactivity Assessment
37. Paula A. Vasquez (University of Delaware)
Buckling of MR Structures in Microgravity
38. Jing Zhou (NIST)
Mechanics of polymers under nanoscale confinement
39. Chris Forrey (NIST)
The Effect of Configurational Entropy on Molecular Association