Schedule for the 4th Mid-Atlantic Soft Matter workshop, February 20, 2009
Lecture room D, 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
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 Aggrecan
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.