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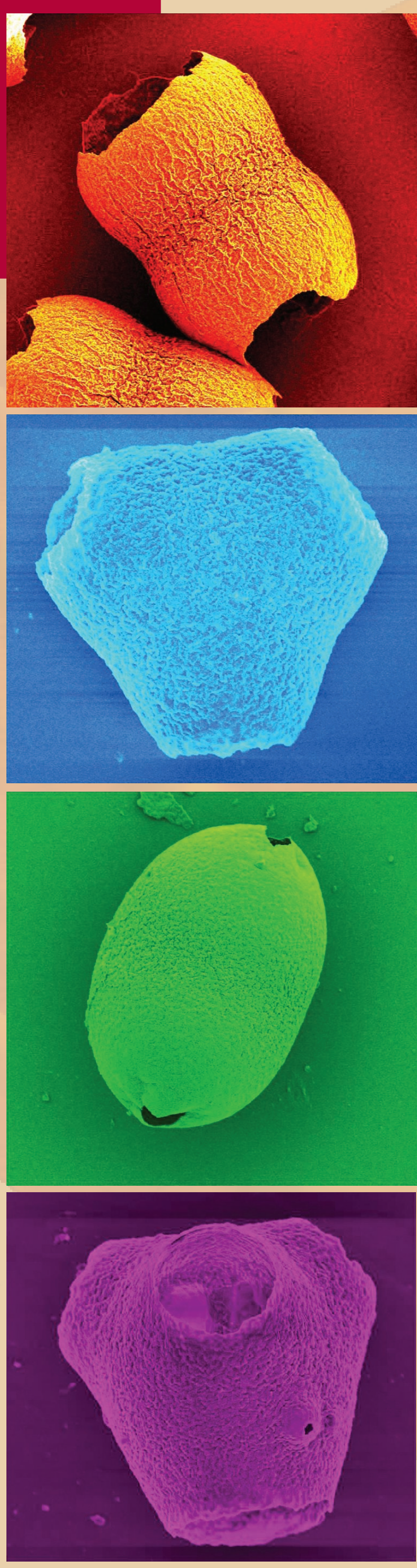
Universidad de Puerto Rico en Humacao

4th Annual Symposium

Soft Matters in Materials Science



Speakers:

Peter Collings
Physics & Astronomy, Swarthmore College

Monica Olvera de la Cruz
Materials Science and Engineering
Northwestern University

Paul Janmey
Physiology, University of Pennsylvania

Daeyeon Lee
Chemical & Biomolecular Engineering
University of Pennsylvania

David Pine
Physics, New York University

Arjun G. Yodh
Physics & Astronomy
University of Pennsylvania

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Four Points By Sheraton
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Humacao, 00791 PR
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MRSEC Penn

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for more information, visit http://prem.uprh.edu/symposium/
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Daeyeon Lee, University of Pennsylvania
Designer Drops, Capsules and Bubbles Using Microfluidics

Emulsion droplets, hollow capsules and gas bubbles have a wide range of applications in encapsulation of nutrients and flavors for food additives, controlled release of substances, separation, and bioimaging. Traditional preparation methods of these structures typically lead to generation of polydisperse and poorly controlled structures, limiting their utilization in some applications. In this talk, I will describe our recent efforts in utilizing glass capillary microfluidic devices to generate emulsions and bubbles with precisely controlled properties and structures. By carefully controlling the multiphase flow in microfluidic devices and the wetting properties of fluids, we are able to generate highly uniform compound emulsions and bubbles. These precisely controlled compound structures serve as ideal templates for generating well-defined particles and functional shells. I will also discuss some new opportunities that these monodisperse drops and bubbles present in solving fundamental questions in the field of soft matter.

David Pine, New York University
Pacman Particles and Colloidal Life

We are developing colloids with a variety of specific programmable interactions with the intent of making colloidal motifs that self replicate, much like a biological organism. The idea is to encode within particles themselves the information required for them to replicate themselves when they are subjected to some cyclic process in which energy (but not information!) is provided from the external environment. The approach employs linear chains of colloidal particles with the information required for self replication encoded using either the shape of the particles or coatings of single-stranded DNA.

Arjun G. Yodh, University of Pennsylvania
Melting and Frustration in Temperature-Sensitive Colloids

Temperature-sensitive microgel particles present experimenters with a fantastic new variable for creation of novel phases and control of phase transformations. I will describe recent experiments from my laboratory which exploit this phenomenon to learn new condensed matter physics. Recent experiments, for example, permit us to explore first steps of bulk melting in three-dimensional crystals [1], to elucidate melting mechanisms in liquid crystalline phases of matter [2], to characterize melting in two-dimensions wherein intermediate hexatic phases form [3], to create geometrically frustrated colloidal 'anti-ferromagnets' [4], and to study aging [5] and jamming [6] of glassy media.

[1] A.M. Alsayed, M.F. Islam, J. Zhang, P.J. Collings, A.G. Yodh, *Science* **309**, 1207-1210 (2005).
[2] A.M. Alsayed, Z. Dogic, A. G. Yodh, *Physical Review Letters* **93**, #057801 (2004).
[3] Y. Han, N.Y. Ha, A.M. Alsayed, and A. G. Yodh, *Phys. Rev. E* **77**, #041406 (2008).
[4] Y. Han, Y. Shokef, A. M. Alsayed, P. Yunker, T. C. Lubensky, A. G. Yodh, *Nature* **456**, 898-903 (2008).
[5] P. Yunker, Z. Zhang, K.B. Aptowicz, A. G. Yodh, *Physical Review Letters* **103**, #115701 (2009)
[6] Z. Zhang, N. Xu, D.T.N. Chen, P. Yunker, A. Alsayed, K.B. Aptowicz, P. Habdas, A.J. Liu, S. Nagel, and A.G. Yodh, *Nature* **459**, 230-233 (2009).

Peter Collings, Swarthmore College
Liquid Crystal Science and Technology: From Oil to Water

As one of the phases of matter, liquid crystals represent materials with unique properties that provide a wealth of opportunity for new scientific knowledge. In addition, liquid crystals are the basis for a very important display technology that touches our lives everyday. In spite of decades of intense scientific work and successful applications, liquid crystals still play an important role in soft matter research, both in designing more complex materials and in the development of aqueous based systems.

Monica Olvera de la Cruz, Northwestern University
Self-Assembly in Molecular Electrolytes

Assemblies of oppositely charged molecules generate solid structures in aqueous solutions. In particular, cationic-anionic molecules co-assembled in spherical geometries such as vesicles, buckled as it they were tethered membranes. When the molecules co-assemble in cylindrical geometries, such as fibers of cationic-anionic amphiphiles, they developed helical arrangements on their surface. Chiral structures at the nanoscopic level are ubiquitous in nature. Helical structures are quintessential examples of chirality and spontaneously arise in collagen, actin, viruses and synthetic materials at the nanometer scale. We are able to show that the formation of helical patterns on the surface of cylindrical fibers or porous aqueous channels is due to symmetric electrostatic interactions. Furthermore, through a straightforward approach we control the strength of the electrostatic interactions through the concentration of ions and the dielectric constants of the media thereby having a mechanism to pattern the surface of fibers or channels into helical patterns with different pitch angles. In spheres, on the other hand, ionic correlations may lead to faceting of ionic shells into icosahedra that break spherical, icosahedral and rotational symmetries. This buckling appears on vesicles of cationic-anionic molecules, which we synthesize and analyze by x-rays scattering, as well as in oppositely charged molecules co-adsorbed onto interfaces, which form ionic rafts.

Paul Janmey, University of Pennsylvania
Soft Materials for Cell Growth and Wound Repair

Most cells in the body are surrounded by soft networks of polymer chains that determine the stiffness of various tissues and organs. In contrast, most laboratory studies of cells use glass or plastic surfaces that allow better imaging by microscopy, but force the cell to adapt to an un-naturally rigid environment. Many diseases are characterized by changes in tissue stiffness, and in many cases such as abnormal wound healing, tumor growth or fibrosis, this change in stiffness contributes to the disease. A new generation of soft materials is being developed to allow studies of cells under more realistic biological conditions. These soft materials also have potential for use in tissue engineering and other clinical applications.