UNH Materials Science Seminar

11:10-12:00, Thursday, April 30, 2009
DeMeritt Hall 240
University of New Hampshire

Stimuli-Responsive Polyelectrolyte Multilayers: From Mechanomutable Surfaces to Functionalized Living Cells

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In this work, we show that suitably designed polyelectrolyte multilayers can exhibit a range of interesting stimuli-responsive properties. Through the use of weak polyelectrolytes and track-etched polycarbonate membranes, for example, it is possible to fabricate a surface anchored array of nanotubes that can be rendered reversibly nanoporous with suitable pH changes. The mechanical properties of such nanotube arrays can be switched dramatically by simply exposing the surface to different aqueous solutions. This mechanomutable effect is a direct consequence of changes introduced in the size, compliance and orientation of the nanotubes. When hydrophobic poly(acrylamides) are combined with weak polyelectrolytes, it is further possible to create coatings that undergo a temperature induced release process; the films are stable at room temperature in water but dissolved when the temperature is reduced to 5°C. This behavior, associated with the lower critical solution temperature (LCST) of the poly(acrylamide), can be utilized to create “on-demand” releasable layers. Using this approach, functionalized polymer multilayer backpacks have been attached to only a portion of the surface of living immune system cells. As a result, the cells retain their native cell migration functions and can interact with local environments. The multilayer backpack provides the living cell with additional functionality such as the ability to release beneficial drugs and to be manipulated spatially with magnetic fields. This latter development opens the door to synthetically functionalized living cells with novel cell tracking, drug delivery and imaging capabilities. Stimuli-responsive anti-bacterial coatings will also be discussed.

Dr. Rubner is currently the TDK Professor of Polymer Materials Science and Engineering within the Department of Materials Science and Engineering at MIT and the Director of MIT’s NSF supported Center for Materials Science and Engineering. He received his undergraduate degree in Chemistry from the University of Lowell (Summa Cum Laude, 1982) and his Ph.D. in Polymer Science from the Department of Materials Science and Engineering at MIT (1986). While pursuing his undergraduate and graduate degrees, he

also worked as a full time staff member in GTE Laboratories. He accrued a total of over twelve years industrial experience before accepting a faculty position at MIT in 1986.

Since moving to MIT, he has held two other term chairs; Class of '57 and IBM Professorships. Professor Rubner to date has received all of the major teaching awards given at MIT including the Everett Moore Baker Memorial Award for Excellence in Undergraduate Teaching (1990), the DMSE Graduate Teaching Award (1990), the Bose Award for Excellence in Teaching (1994) and the MacVicar Fellowship for Outstanding Teaching at MIT (1996). He has given more than 190 invited lectures including the Dow Distinguished Lecture at Northwestern University (1995), the GE Distinguished Lecture at RPI (2009) and plenary lectures at the Tenth International Conference on Organized Molecular Films, Beijing, China (2003) and PolyDays 2004, Berlin-Brandenburgischer Verband fur Polymerforschung, Potsdam, Germany. He has published more than 200 technical papers including 5 book chapters. He is the holder of 9 U.S. patents.

His current research interests include the synthesis, molecular-level processing and electrical, optical, and biomaterial property investigations of conjugated polymers, self-assembling polymers, various functionalized polymers, sequentially adsorbed polyelectrolyte layers and polymer-inorganic nanocrystallite nanocomposites.

Host: Professor Marshall Ming x1446