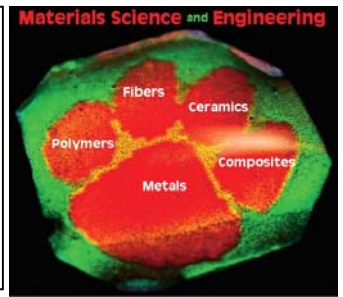


# Seminar Series

Sponsored by  
**School of Materials Science and Engineering**  
Friday, April 4, 2008  
2:00 PM – Room 364 Sirrine Hall



## " Polymer Brushes, Nanotemplates and Single Molecules – Routes to Functional Nanodevices "

### **Professor Manfred Stamm**

Physical Chemistry of Polymeric Materials at Technical University of Dresden, Germany  
Leibniz-Institute for Polymer Research Dresden (IPF)

#### **Abstract:**

Patterned and functional surfaces at nanometer scale are of interest for several possible applications. There are different approaches to modify and fabricate thin polymer films at nano-scale. With the advance in scanning probe microscopy it becomes possible to image individual polymer molecules adsorbed on a solid substrate. In this way it is possible to investigate a wide range of conformations of polyelectrolytes ranging from coils to pearl-necklace and globule conformational states. Metallization of those molecules leads to nanoscopic objects at molecular scale, where many architectures and arrangements are possible. Further functionalisation allows the fabrication of electrically conducting nanowires based on single polymer molecules.

A fairly robust way for the generation of a functional nanofilms is the attachment of polymer chains to the surface by covalent bonding. At high grafting density a brush-like layer will be formed, and surface properties can be changed significantly. Utilizing mixed polymer brushes the surface properties can be switched between different states, and it is even possible to switch between ultra-hydrophobic and ultra-hydrophilic behavior by introduction of an additional surface roughness, i.e. a combination of physical and chemical modification of the surface.

A quite versatile technique for surface structuring is based on self-organization of polymers and uses phase segregation at molecular level. Nano-domains based on microphase segregation in copolymer systems can result in structures with lateral dimensions as small as 5-20 nm. One can use the ordered copolymer structure as a template for further processing. One of the components may be removed, which leaves for instance cylindrical holes in the polymer film. The orientation of the cylindrical domains may be perpendicular to the surface to form regularly patterned chemically heterogeneous surfaces. The hole diameter can be of nanometer size and the morphology is ordered laterally on a relatively large scale. As an example we have prepared 5nm Ni-dots via copolymer templating and subsequent electro-deposition of nickel.

#### **Bio:**

1979 – 1985, Staff Scientist, Institute of Solid State Research in Jülich (small-angle neutron scattering, chain conformation, preparation of polymers, conductive polymers)

1984 – 1985, Visiting Scientist, Brookhaven National Laboratory (neutron reflectometry, polymer interface investigations, interdiffusion studies)

1985 – 1999, Staff Scientist and Project Leader, Max-Planck Institute of Polymer Research in Mainz, Germany (interfaces between polymers, structure and conformation, phase transitions, development of scattering techniques)

since 1999, Professor of Physical Chemistry of Polymeric Materials, Technische Universität Dresden and Head of Institute of Physical Chemistry and Physics of Polymers at Leibniz Institute of Polymer Research Dresden.