

Carnegie Mellon

Materials Science and Engineering Seminar Series

Steven J. Sibener

The James Franck Institute and Department of Chemistry
University of Chicago

**“Dynamics of Molecular and Polymeric Interfaces Probed with Atomic Beam
Scattering and Scanning Probe Imaging”**

**Friday, April 8, 2011
10:30 AM Seminar in Scaife Hall 125**

This presentation will focus on an examination of the dynamical properties and self-organizing behavior of thin films spanning 2D molecular systems through nano-confined 3D polymeric films. Such information can be extracted successfully from the powerful combination of surface-sensitive atomic beam scattering coupled with real-time/real-space variable-temperature scanning probe imaging. Several recent accomplishments will be highlighted: (i) building upon our initial studies of collisional energy transfer at polymeric interfaces as a function of composition (PMMA, PS, PB), molecular weight, thickness & nanoconfinement, temperature, and annealing [1-3], we are examining the surface dynamical properties of PET polymer thin films in their glassy vs. crystalline phases [4], and are elucidating for the first time clear changes in the energy accommodation characteristics due to such polymer structural changes; (ii) helium atom scattering has been used to measure the surface structure and vibrational dynamics of (1x1) CH₃- and CD₃-terminated Si(111) [5]. The high quality of the observed diffraction patterns indicate a high degree of long-range ordering for this novel, atmospherically stable, and technologically interesting interface, while inelastic measurements have quantified the lateral and perpendicular displacements – with energy accommodation being dominated by local Si-CH₃ librations; (iii) The self-assembly of either NiTPP or NiOEP on reconstructed Au(111) leads to the formation of a racemic mixture of domains. We find that it is possible to control the chirality of the assembly using the handedness of kinked steps [6]. C₆₀ molecules deposited on the NiTPP and NiOEP monolayers lead to the formation of a fascinating variety of coplanar and bilayer structures; and (iv) if time permits, we shall also briefly examine the fluctuations, phase separation characteristics and organizational dynamics of diblock copolymers in unconfined thin films as well as under nano-confinement [7]. Such phase-separated diblock copolymers have attracted much fundamental and technological interest due to their ability to act as templates for the bottom-up formation of metallic, molecular, and nanoparticle arrays with high lateral spatial definition. Such hierarchical systems are of technological interest due to applications in magnetic, electronic, photonic, and catalytic systems.

Steven J. Sibener, the Carl William Eisendrath Distinguished Service Professor in Chemistry and The James Franck Institute at the University of Chicago, has made seminal contributions to chemical physics, surface and materials chemistry, catalytic reaction kinetics, polymeric systems, and nanoscience. Amongst his many honors is the Marlow Medal of the Royal Society of Chemistry. He is a Fellow of the American Physical Society and the American Association for the Advancement of Science, and has been twice elected a Visiting Fellow of the Joint Institute for Laboratory Astrophysics. He has served as Director of The James Franck Institute, the Materials Research Science and Engineering Center, and the Center for Materials Chemistry in the Space Environment. In 2010 Sibener became the founding Director of the multi-university NSF Center for Energetic Non-Equilibrium Chemistry at Interfaces. Sibener received his Sc.B. in chemistry and B.A. in physics, both with honors, from the University of Rochester, and M.S. and Ph.D. degrees in chemistry from the University of California, Berkeley, under the guidance of Nobel Laureate Yuan T. Lee. He was a postdoctoral fellow at Bell Laboratories.