Mesoscale Priority Research Direction

Interfacial control of polymer properties

Opportunity

The polymerization of liquid-phase monomers assembled adjacent to a solid surface to form a stable ultrathin film is heavily influenced by long-range interfacial interactions between the solid and the molecules. The interactions control the reaction mechanism as well as chemical, mechanical and interfacial bonding of the final film in ways that cannot be predicted from single-phase studies.

Meso Challenge

The challenge is to understand how to predict the final polymer properties through knowledge of the specific molecular orientations controlled by the interface and of the impact of those orientations on polymerization kinetics.

Approach

Detailed investigations of kinetics and products formed from related series of monomers polymerized in contact with systematically varied solid surfaces will reveal chemical and physical drivers controlling film characteristics.

Methods to determine average orientation of complex molecules at a surface and follow oriented chemical transformations in a few nm-thick mobile condensed phase environment are needed.

Impact

This research would provide information critical to successful design and use of self-assembled, stabilized layers in functional thin film architectures, and improved methods for nanoscale patterning.

References:
"Intermolecular and surface forces, 2nd Ed", J. Israelachvili, Academic, San Diego, 1991.
Nanoimprint Materials Systems, F. A. Houle, D. C. Miller, A. Fornof, H. Truong, S. Raoux, R.Sooriyakumaran, H. Ito and M. Hart, J. Photopolymer Sci Technol **21,** 563-572 (2008).

Contact: Frances Houle, LBNL