Nanostructural Materials and Processes Program

Self-Assembly at the molecular and colloidal scales is crucial to the performance of many industrial systems, including detergents, foams, adhesives, paints, pharmaceuticals, sensors, catalysts, composites, and emerging electronic and optical materials. The nanostructure of the materials involved as well as the process of nanostructure development are central to the function of the system.

Critical issues in such applications are to control the molecular and colloidal forces that govern the structure and properties of the self-assembled materials, to develop insights into the mechanisms governing these processes, and to elucidate and correlate the structure and behavior of such materials (particularly ordered films and crystals).

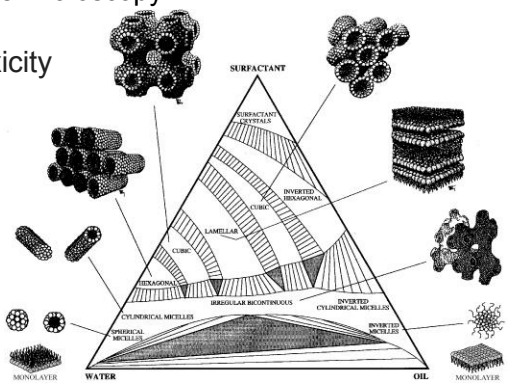
The researchers in this program combine experiment, theory and modeling to correlate molecular and process parameters with synthesis, phase behavior, structure, and performance of surfactants and novel self-assembled molecular and colloidal systems. The overriding goal is to enable interfacial engineers to synthesize materials which perform optimally with specified constraints.

Critical current research topics include:

- ***Phase behavior and dynamics of surfactant and colloidal systems:*** Regulation of molecular and colloidal forces yields a rich variety of ordered structures which are investigated by molecular simulation and novel forms of cryo-scanning and cryo-transmission electron microscopy.
- ***Nanostructural chemistry and processing:*** Templates and hydrogen bonding interactions yields nanostructured supramolecular networks, composite materials.
- ***Self-Assembly of molecular and colloidal films and crystals:*** Molecular assembly is driven epitaxially and on patterned surfaces to enable new applications in, for instance, flexible organic semiconductors and photonic materials.
- ***Interfacial forces, adhesion, and tribology:*** Films and gels, including biomolecular interfaces, are investigated with novel forms of molecular scanning probe microscopy.

Principal Investigators and their primary areas of expertise:

Alon McCormick	**Program Leader**. Materials Solution Synthesis, Self-Assembly, Cryo-Electron Microscopy
C.Dan Frisbie	Molecular Materials and Interfaces, Molecular Electronics
Wayne Gladfelter	Materials Chemistry, Inorganic Chemistry, Scanning Probe Microscopy
Greg Haugstad	AFM Scanning Probe Microscopy
Christy Haynes	Porous and plasmonic nanomaterials, nanoparticle toxicity
R. Lee Penn	Environmental Solid State Chemistry
Ilja Siepmann	Molecular Simulation and Theory
Andreas Stein	Solid State Chemistry of Porous Materials
Joe Zasadzinski	Molecular Fluids, Optical/Electron/Scanning Probe Microscopy



Contact: To learn more about the Nanostructural Materials and Processes Program and IPRIME contact Bob Lewis, Executive Director, at 612-625-1269 or boblewis@umn.edu.