PHYSICAL & MATERIALS SEMINAR

Monday
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3:30 p.m.

Room 1315
Chemistry

From Imperfection to Perfection in Soft Materials Self-Assembly

Professor Mahesh K. Mahanthappa
Department of Chemistry
University of Wisconsin-Madison

In this seminar, I will present an overview of two major thrusts in my research group that address the effects of molecular heterogeneity and molecular homogeneity on the self-assembly behavior of soft materials. The first part of this talk will focus on the effects of chain length polydispersity, a type of molecular heterogeneity, on the self-assembly behavior of ABA-type triblock copolymers. Relying on tandem polymerization techniques, we have synthesized three classes of ABA triblock copolymers in which a polydisperse B block ($M_w/M_n \sim 2.0$) is flanked by monodisperse A end blocks ($M_w/M_n \leq 1.20$). By mapping the morphology diagrams for these polydisperse block copolymers, we have demonstrated that narrow copolymer dispersity is *not* a necessary condition for microphase separation into well-defined supramolecular morphologies. Surprisingly, block polydispersity substantially *stabilizes* these self-assembled structures. The second part of this talk will describe the unusual self-assembly behavior of pure, small-molecule gemini surfactants into complex aqueous lyotropic liquid crystals. We have recently demonstrated that the gemini architecture strongly favors the formation of technologically useful, triply periodic, multiply continuous morphologies such as the double gyroid and "Plumber's Nightmare" structures. Based on this molecular design principle, I will also describe a method for producing mechanically robust nanoporous media with well-defined pore geometries, pore diameters, and pore functionalities with potential applications as water desalination and fuel cell membranes.