UW Chemical Engineering

Fall 2013 Seminar Series

Date: Monday, October 7
Time: 4:00 - 5:00 p.m.
Place: PAA A118
Topic: *Self-assembled hybrid materials for electrochemical and photophysical applications*

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Biography

Prof. Chmelka received his Ph.D. degree in chemical engineering from the University of California, Berkeley in 1990 under the supervision of Profs. Clayton Radke and Eugene Petersen. He was a NSF Post-Doctoral Research Fellow in Chemistry at UC-Berkeley with Prof. Alexander Pines and an NSF-NATO Post-Doctoral Research Fellow at the Max-Planck-Institut für Polymerforschung in Mainz, Germany with Prof. Hans Spiess. He joined the faculty at UCSB in 1992, was promoted to Associate Professor in 1995 and to Professor in 1999. He has received a David and Lucile Packard Foundation Award, a Camille and Henry Dreyfus Teacher-Scholar Award, an Alfred P. Sloan Foundation Research Award, and has been an invited professor at universities in France, Sweden, Israel, and Spain.

Abstract

Surfactant- or copolymer-directed inorganic solids can be synthesized with a variety of compositions, structures, and morphologies that result in materials with diverse and adjustable properties. Such inorganic-organic systems are composed of dissimilar species, whose co-self-assembly involves simultaneous considerations of thermodynamics, chemical reaction kinetics, and mass transport that are challenging to elucidate and control. The challenges are exacerbated by the multicomponent and heterogeneous characters of the hybrid solids, including surface effects and/or the incorporation of functional guest species or additives that can greatly and beneficially influence material properties. Nevertheless, by combining characterization and modeling insights across multiple length scales, the compositions and structures of these versatile materials can be understood, along with their influences on macroscopic material properties. Recent results will be presented for functionalized self-assembled inorganic-organic materials that exhibit photovoltaic and/or ion-conduction properties. Such properties depend on molecular interactions and distributions of component species, especially at surfaces. Solid-state NMR analyses, together with X-ray scattering, electron microscopy, UV-vis spectroscopy, and modeling, provide insights on complicated order and disorder in these heterogeneous materials. The physicochemical processes and interactions that underlie the compositions, structures, and properties of functionalized self-assembled materials will be discussed, along with correlated molecular and macroscopic insights for photovoltaic and fuel cell applications.