center for excitonics

STRUCTURING MATERIALS ON MULTIPLE LENGTH SCALES FOR ENERGY APPLICATIONS

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Abstract Nanoporous and nanostructured materials are becoming increasingly important for advanced applications, including energy storage and conversion materials. Templating methods based on hard templates (colloidal crystal templating, nanocasting) and soft templates (surfactant systems) provide access to nanostructured porous materials in which both the internal pore architecture and the material's morphology can be controlled at a range of length scales from the subnanometer to the millimeter scale. Significant benefits of materials with structural features of nanometer and submicrometer dimensions have been demonstrated, at least at the proof-of-concept stage. Some applications profit from short diffusion paths in hierarchical nanostructures. Other applications take advantage of the relatively high surface areas of nanoporous solids and improved reactivity. Yet others benefit from the precise spacing of active materials in a periodic porous host. Using examples of porous materials for excitonics, lithium ion batteries, solar thermal energy conversion, and gas separation, this presentation will highlight methods of controlling pore architecture and materials morphology at various length scales. In particular, factors that influence structural assembly and interactions between multiple components (multiple templates, host-guest interactions) will be emphasized, as these determine the distribution and spacing of components in the porous solids, factors that control optical, electronic, and reactive properties of the materials.

Bio Professor Stein obtained his B.Sc. in Chemistry at the Univ. of Calgary in 1986 and his Ph.D. at the Univ. of Toronto in 1991 specializing in synthesis and characterization of zeolite materials. He was a NSERC postdoctoral fellow at the Advanced Inorganic Materials group at Bayer A.G. Germany , then a postdoctoral researcher at the University of Texas, Austin, and Penn State. In 1994 he joined the faculty at the University of Minnesota, where he is now a *Distinguished McKnight University Professor of Chemistry*. His research interests are in the field of solid state chemistry, in particular porous materials and nanocomposites targeting a wide range of applications, including membranes, solar thermal energy conversion, bioactive glasses, lithium ion batteries, ion-selective sensors, catalyst materials, polymer-clay nanocomposites, photonic crystal materials, and pigments. and polymer/inorganic nanocomposites.