

## *Seminar*

9:45 a.m. Thursday, September 8 • 331 Smith Hall



Professor

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### *What's the Point of Nanostructures in Energy Storage Materials?*

Research involves materials synthesis by templating and self-assembly methods. Using polymer or surfactant templates we can control the architecture of porous and nanostructured materials and create products with special properties.

Website: <http://www.chem.umn.edu/groups/stein/>

#### **Abstract**

Materials containing pores in size ranges from micropores to macropores offer interesting features for a number applications involving energy storage and conversion, such as batteries, fuel cells, hydrogen storage, and sunlight-to-fuel conversion. Depending on the specific application, they can provide large surface areas for reaction, interfacial transport, or dispersion of active sites; they can provide nanostructured features which enhance reactivity, alter materials properties, or shorten diffusion paths; they can act as host materials to stabilize other active components; or, in the case of porous carbons, they can provide electrically conductive phases as well as intercalation sites. However, the higher reactivity brought about by nanostructured features can also lead to decreased stability, particularly in applications where phase changes may alter the structure of the material. This talk will focus on lithium-ion battery systems, in which templated porous materials provide a platform for electrical energy storage. The role of pore architecture in carbon-based electrodes will be discussed. Improved rate capabilities for lithiation/delithiation are observed for hierarchically porous carbon electrodes. In composites with tin or tin oxide for anodes these structures maintain electrical contact between tin-based particles, even when those particles undergo significant volume changes during cycling, and hence the composite anode maintains good capacities over multiple cycles. Composites of hierarchically structured carbon with poorly conducting but otherwise desirable electrode materials (like sulfur or  $\text{LiFePO}_4$ ) can be used to overcome limitations in electrical conductivity of those materials, increasing the choice of feasible electrode materials.

Refreshments will be served prior to the seminar.