Northeastern University
College of Engineering

Please join us for a

Chemical Engineering Seminar

Wednesday, April 20, 2011
325 Shillman Hall
11:45 a.m. – 1:00 p.m.

"Engineering Nanostructured Materials for Clean Energy"

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ABSTRACT

A rising energy demand and a continued reliance on fossil energy will hasten fossil energy depletion as well as the global climate change associated with the increase in the atmospheric CO_2 concentration. In this seminar, I will discuss how my research can impact these two societal demands, with a focus on advanced separation technologies for clean energy applications of minimal environmental impact.

Nanocomposite membranes are emerging separation devices that can combine attributes of polymeric and zeolitic membranes for pre-combustion capture, whereby H_2/CO_2 separation from the syngas streams has been recognized as an important technological challenge. Novel nanoporous layered materials of nanoscale thickness (ca. 1~2 nm) were prepared from the swelling of 3-D nanoporous AMH-3 silica. Incorporation of these nanoporous additives in the polymer matrix leads to a nanocomposite structure with highly-dispersed selective layers, allowing for significantly improved H_2/CO_2 selectivity over the pristine polymer. The development of these novel membranes will be described in detail. Subsequently, a description of a new type of supported-amine adsorbent with tunable capacity and outstanding stability, hyperbranched aminosilica materials (HAS), will be presented. These materials have provided new insights into approaches for CO_2 control in conventional post-combustion capture as well as emerging air capture applications.

My potential research on the theme of alternative energy aims at developing clean and efficient routes for H_2 production and purification. As an example, the concept of the hollow-fiber photoelectrochemical cells will be proposed. This system will generate H_2 using sunlight and water as the inputs, in which the tubular architecture of proton-conducting materials prevents mixing of the gaseous products but allows the transport of oxidation products (H^+) to the inside of fibers. Once generated, H_2 can be purified further using Pd-filled nanotube membranes that can facilitate synergistic separation of chemoselective metallic membranes assisted by size-selectivity of nanotubes. Hence, these works will contribute towards making H_2 an energy source alternative that is more practical, economically feasible, and environmentally-benign.

Refreshments will be served