Yale Institute for Nanoscience and Quantum Engineering

Friday, March 9, 2012

12:00 to 1:00 p.m.

MASON LAB
9 Hillhouse Avenue, ML211
Light lunch will be served at 11:45 a.m.

Professor Menachem Elimelech
Department of Chemical and Environmental Engineering, Yale University

"Antifouling Membranes Incorporating Surface-Tailored Nanomaterials for Energy-Efficient Desalination and Wastewater Reuse"

Water scarcity is one of the greatest global crises that we currently face. The only methods to increase water supply beyond what is available from the hydrological cycle are desalination and wastewater reuse. Highly effective, low-cost, robust technologies for desalination and wastewater reuse are needed, with minimal impact on the environment. Major developments in these membrane-based technologies are possible due to recent advances in materials science, nanotechnology, and the fundamental understanding of the solid-water interface. In this presentation, it will be shown that we can exploit novel nanomaterials, such as carbon nanotubes, block copolymers, and engineered nanoparticles to develop better approaches to design and fabricate membrane materials. By integrating the facile processability, light-weight, and low-cost features of organic polymers with functionality provided by inorganic nanostructures we can develop a new membrane materials platform with applications in desalination and wastewater reuse.

Professor Gary Brudvig
Department of Chemistry, Yale University

"Water Oxidation Catalysis for Solar Fuels"

Photosystem II (PSII) uses light energy to split water into protons, electrons and O_2 (1). In this reaction, Nature has solved the difficult chemical problem of efficient four-electron oxidation of water to yield O_2 without significant side reactions. In order to use Nature's solution for the design of materials that split water for solar fuel production, it is important to understand the mechanism of the reaction. X-ray crystal structures of cyanobacterial PSII provide information on the structure of the Mn and Ca ions, the redox-active tyrosine called Y_Z, and the surrounding amino acids that comprise the O_2-evolving complex (OEC). We have used computational studies to refine the structure of the OEC and obtain a complete structural model of the OEC that is in agreement with spectroscopic data (2). Insights from studies of the natural photosynthetic system are being applied to develop bioinspired materials for photochemical water oxidation and fuel production. Our progress on the development of synthetic water-oxidation catalysts (3-4) and their use in materials for artificial photosynthesis will be discussed (5-6).

1. **J.P. McEvoy and G.W. Brudvig, *Chem. Rev.* (2006) 106, 4455-4483.**
2. **S. Luber *et al.*, *Biochemistry* (2011) 50, 6308.**
3. **J.D. Blakemore, N.D. Schley *et al.*, *Chem. Sci.* (2011) 2, 94.**
4. **N.D. Schley, J.D. Blakemore *et al.*, *J. Am. Chem. Soc.* (2011) 133, 10473.**
5. **G.F. Moore *et al.*, *Energy Environ. Sci.* (2011) 4, 2389.**
6. **G.F. Moore *et al.*, *J. Phys. Chem. C* (2012) 116, 4892.**

HOST: Professor Mark Reed