Mechanical Engineering SEMINAR

A closer look at the solid-liquid aqueous interface

Mark A. Shannon

Hosted By:
Qiao Lin

Pressing problems abound that involve in some way a solid-liquid aqueous interface: supplying clean fresh water to the peoples of the world, sensing and removing toxic compounds in water, diagnosing diseases with micro-nanofluidic devices, to name a few. The solid-liquid interface has been heavily studied for well over a century, so it may be surprising to some that more study is needed. But with advancements in micro-nanofluidic technologies in separations and sensing of constituents in water, new observations are being made. Structured surfaces can exhibit remarkably different transport behaviors of water, ions, and charge, particularly when very close to the surface, when functionalized with different moieties. For instance, the effective damping of an oscillating AFM tip within nanometers of a surface can change many fold by changing the end-group of a surface assembled monolayer from a trifluoro- to a methyl group, with all else the same, even though the wetting angles of these surfaces are similar. Even for exactly the same surface, the interaction stiffness and damping varies with surface potential alone. These effects are only observed within the space charge layer of the surface. Similarly, surface charge, applied potential, and electrolyte properties have a significant affect on the chemistry at the inner and outer Helmholtz plane, even without the presence of redox active species. The resulting change in surface chemistry can in turn change the transport properties of fluids within the space charge layer. I will present some of our observations and analysis of this rich field of study, along with some open questions that need to be answered, which I hope will help us better address some of the pressing problems facing the world.

Mark A. Shannon is the Director of the U.S. National Science Foundation Science and Technology Center for Advanced Materials for the Purification of Water with Systems (*WaterCAMPWS),* which is a multiple university and government laboratory center for advancing the science and engineering of materials and systems for revolutionary improvements in water purification for human use. He is also the Director of the *Micro-Nano-Mechanical Systems (MNMS) Laboratory* at the *University of Illinois at Urbana-Champaign in Mechanical Science and Engineering Department*, a 2000 sq. ft class 10 and 100 cleanroom laboratory devoted to research and education in the design and fabrication of micro- and nanoelectromechanical systems (MEMS & NEMS), microscale fuel cells and gas sensors, micro-nanofluidic sensors for water and biological fluids. He was a Charter Member and Chair of the Instrument Systems Development Study Session for the National Institutes of Health. He is the James W. Bayne Professor of Mechanical Engineering at UIUC, and received his B.S. (1989) M.S. (1991) and Ph.D. (1993) degrees in Mechanical Engineering from the *University of California at Berkeley*.

Friday, April 24, 2009
10:00 – 11:00am Room 233 Mudd
9:30pm Breakfast in ME Lobby