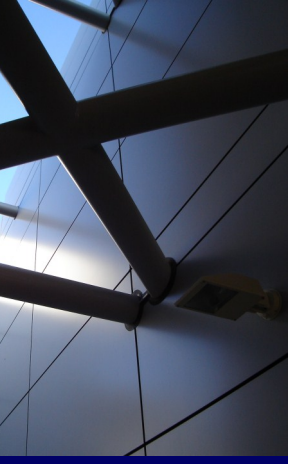

COLLOQUIUM
MECHANICAL ENGINEERING

The Department of Mechanical Engineering presents:

Timothy S. Fisher

Purdue University, Birck Nanotechnology Center and
School of Mechanical Engineering, West Lafayette, IN USA

Friday, January 27, 2012
11:10AM-12:00PM
Bourns Hall A265

Optimization of Nanoparticle Assemblies for Amperometric Biosensing and Electrochemical Energy Storage

Abstract

Hybridization of nanoscale metals and carbon nanotubes into composite nanomaterials has shown promise in electrochemical biosensing—providing some of the most sensitive sensors to date [1-3]. The challenge remains to develop scalable nanofabrication protocols that are amenable to the development of sensors with broad sensing ranges. This talk considers the integration of these materials and will first introduce a heterogeneous nanostructure that contains vertical single-walled carbon nanotubes (SWCNTs) within an ordered nanoporous alumina template. The utility of this structure has been demonstrated recently in amperometric biosensing. These initial SWCNT/metal nanoparticle hybrid sensors provide fascinating results—displaying some of the most highly sensitive glucose sensing to date [4]; however, a comprehensive understanding of the relationship between the nanofabrication/biofunctionalization protocols and biosensor performance is still lacking. In an effort to elucidate the tradeoffs among kinetics, mass transport, and charge transport, the SWCNT/Pt nanosphere biosensors are computationally modeled in an enzymatic biosensing scenario. The results, corroborated experimentally, demonstrate how the Pt nanosphere density along the SWCNTs can dramatically alter the biosensor detection limit, linear sense range, and sensitivity [5]. The talk will conclude with results from a study of granular nanoparticle assemblies [6] for use as battery electrodes. The results indicate that columnar ordering of nanoplatelets causes a catastrophic loss in electrode function, and a mitigation strategy involving the dilute addition of inert nanoparticles is shown to frustrate this behavior.

Biography

Timothy S. Fisher is Professor of Mechanical Engineering at Purdue University. He received Ph.D. and B.S. degrees in Mechanical Engineering from Cornell University in 1998 and 1991, respectively, and joined the Purdue's School of Mechanical Engineering and Birck Nanotechnology Center in 2002 after several years at Vanderbilt University. In 2008 he was a Visiting Professor in the Chemistry and Physics of Materials Unit of the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR, Bangalore, India), and he now holds the position of Adjunct Professor in the International Centre for Materials Science at JNCASR and co-directs the JNCASR-Purdue Joint Networked Centre on Nanomaterials for Energy. From 2009 to 2011, he has served as a Research Scientist at the Air Force Research Laboratory's newly formed Thermal Sciences and Materials Branch of the Materials and Manufacturing Directorate. Prior to his graduate studies, he was employed from 1991 to 1993 as a design engineer in Motorola's Automotive and Industrial Electronics Group. His research has included efforts in simulation and measurement of nanoscale heat transfer, coupled electro-thermal effects in semiconductor and electron emission devices, nanoscale direct energy conversion, molecular electronics, microfluidic devices, hydrogen storage, and computational methods ranging from atomistic to continuum scales.