

**MECHANICAL ENGINEERING DEPARTMENT
ME/IE 8773-8774**

**MAIN DEPARTMENT SERIES
Topic: NANOTECHNOLOGY
Host: Joachim V.R. Heberlein**

Simulation of Nanoparticle Coating in Low-pressure Plasma Reactor

by

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Wednesday, April 19, 2006

3:30 p.m.

Room 1130 ME

Coffee and refreshments will be available at 3:15 p.m. in Room 1130 ME before the seminar

ABSTRACT — Nanoparticles of various materials are building blocks and important constituents of ceramics and metal composites, pharmaceutical and food products, energy related products such as solid fuels and batteries, and electronics related products. The ability to manipulate the surface properties of these particles through deposition of one or more materials can greatly enhance their applicability. In this talk, we discuss simulation of a low-pressure, non-equilibrium plasma process for deposition on surfaces of nanoparticles. The plasma modeling is conducted via both particle-in-cell (PIC) method and ‘fluid’ transport equations for ions and electrons. Whereas the PIC approach is mainly limited to a single nanoparticle, due to excessive computational cost, it is capable of providing a detail fundamental understanding of charging and coating process. For practical purposes, the method of choice is via the solution of the ‘fluid’ transport equations augmented by an ionization model. The nanoparticle dynamics is modeled by considering a variety of forces acting on the particle. These include gravitational, electric, ion drag, and neutral drag forces. Finally, the chemical reaction modeling is discussed by considering a CH_4/H_2 plasma. The reaction model considers neutral species (CH_4 and H_2) introduced in the reactor, along with positive ions, radicals (which are the species that contribute to the growth of the nanoparticle surface) and other neutral molecules produced by reaction of the above.

BIO — **Farzad Mashayek** received a Ph.D. degree in Mechanical Engineering from the State University of New York at Buffalo in 1994. He is currently Associate Head and Director of Graduate Studies in the Department of Mechanical and Industrial Engineering at the University of Illinois at Chicago. Mashayek’s research interests are in the areas of turbulence, two-phase flow, combustion, nanoparticle coating in dusty plasma, drop dynamics and atomization, and interface modeling. He is a Fellow of ASME and an Associate Fellow of AIAA. Mashayek received the CAREER award from the National Science Foundation and the Young Investigator award from the U.S. Office of Naval Research in 1999.

Informal Faculty Luncheon: Wednesday, April 19, 2006, 12:00 noon. Meet in 1100 ME and walk to lunch with other faculty. Prof. Farzad Mashayek will be able to attend.