

# 2009-2010 Graduate Seminar Series

## The Department of Mechanical Engineering – Engineering Mechanics

Proudly Presents

**Dr. Kazuya Tajiri**

**Argonne National Laboratory**



Dr. Kazuya Tajiri earned his Bachelor degree from the Department of Aeronautics and Astronautics, University of Tokyo, and Master degree from the School of Aerospace Engineering, Georgia Institute of Technology. At Georgia Tech he worked on unsteady simulation of turbulent combustion. After three years work on fuel cell research at Nissan Motor in Japan, he came back to US to obtain his Ph.D. degree from the Department of Mechanical and Nuclear Engineering, The Pennsylvania State University. His dissertation was on subzero startup of automotive fuel cells. Then, he continues his research on automotive fuel cell systems at Argonne National Laboratory.

**Thursday, Nov. 5, 2009**

**3:00 – 4:00 p.m.**

**Room 112, ME-EM Bldg.**

### **Startup and Shutdown of Automotive Fuel Cell Stacks**

Polymer electrolyte fuel cells (PEFCs) for transportation must be able to start unassisted from temperatures below  $-20^{\circ}\text{C}$  and produce 50% of their rated power within 30 s using less than 5 MJ of fuel energy for startup and shutdown. At subfreezing temperatures, the water produced from the electrochemical reaction coats the cathode catalyst with ice that reduces the effective electrochemically active surface area and may terminate the reaction. A proper understanding of water transport during startup (and the previous shutdown) is essential to determining the conditions under which the stack can be started rapidly from subfreezing temperatures, even if some ice may be formed initially at startup.

The first part of this presentation is focused on the experimental study of PEFC startup at subfreezing temperatures with well-controlled initial conditions to understand the fundamentals, and with practical startup conditions for automotive application. Then, in the second part the computational results are presented about the subfreezing temperature startup and gas purge at shutdown, and the total energy estimation. The stack temperature at shutdown was found to be a key factor for successful cold start.