Mechanics of Polymer Electrolyte Membranes for Low Temperature Fuel Cells

ABSTRACT
Proton exchange membrane fuel cells enable clean, efficient, and mobile conversion of fuel to electricity. A polymer electrolyte membrane at the core of these devices is responsible for conducting protons and preventing fuel crossover. This membrane undergoes significant mechanical loading due to hygrothermal cycling within a constrained environment. The current benchmark membrane, Nafion, is deficient for commercial applications. This talk will cover two major research thrusts: (1) analyzing the benchmark membrane in the fuel cell context and (2) designing a new membrane. First I will present a mechanical model for the coupled constitutive behavior of Nafion and application of this model in understanding and avoiding mechanical failure of the membrane within a fuel cell stack. Then I will present micromechanical modeling of non-woven electrospun mats and its use in the design of alternative polymer electrolyte membranes. In each case the microstructurally motivated model is shown to capture a range of experimental behavior and to provide insight into the governing physics.

BIO
Meredith N. Silberstein is a doctoral candidate in the Department of Mechanical Engineering at MIT. She received her B.S. from MIT in 2005 and her M.S. from MIT in 2008. Her research focuses on the experimentally driven development of microstructurally based material models for the design of active and multifunctional systems. This work is fundamental to driving improvements in these materials which play a performance limiting role in many energy conversion and harvesting systems. She is currently developing mechanically robust composite polymer electrolyte membranes for direct methanol fuel cells.

Drinks will be served at 3:45 p.m.