1046-74-1243 **Jay Benziger*** (benziger@princeton.edu), Dept. of Chemical Engineering, Engineering Quadrangle, Princeton University, Princeton, NJ 08544. *Non-linear Dynamics of Transport and Mechanical Properties in PEM Fuel Cells.*

Non-linear changes in the transport and mechanical properties of polymer electrolytes in fuel cells gives rise to unusual non-linear dynamical behavior of multiple steady states and current density front propagation in PEM fuel cells. We demonstrate that water in PEM fuel cells is conceptually identical to temperature in flames! Current ignition in PEM fuel cells is analogous to thermal ignition in flames, current density fronts propagate due to a balance between convection and diffusion as seen with flame fronts. Mechanical properties of polymer electrolytes play a key role in the dynamics of PEM fuel cells. The mechanical properties of Nafion (elastic modulus and creep rate) show a complex behavior as functions of water activity and temperature. The elastic modulus goes through a maximum and creep rate goes through a minimum at intermediate water activity that depends on temperature. Water and temperature cause microphase structural changes in Nafion that alter the mechanical and transport properties of Nafion. In this talk we shall examine the complex dynamics associated with mechanical and transport properties in Nafion and their implications for PEM fuel cell operation. (Received September 15, 2008)