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CHEMICAL AND BIOLOGICAL ENGINEERING DEPARTMENT SEMINAR SERIES

Degradation Processes and Degradation Mitigation in Polymer Electrolyte Fuel Cells

Presented by: Vijay Ramani, Department of Chemical & Biological Engineering at Illinois Institute of Technology

Time: Wednesday, September 23; 3:15 – 4:30 pm

Location: Perlstein Hall Auditorium

Abstract

Existing polymer electrolyte membrane (PEM) technology permits PEM fuel cell operation at 80°C under fully saturated conditions. By increasing the operating temperature to 120°C and above, systems advantages such as easier heat rejection and improved impurities tolerance by the anode electrocatalyst can be achieved. Perfluorosulfonic acid based membranes (e.g. Nafion®) that are in use today are incapable of operating effectively at these temperatures, especially at low relative humidities, because of rapid reduction in proton conductivity and enhanced rates of chemical and mechanical degradation. To improve PEM properties (especially conductivity and durability) at elevated temperatures, organic/inorganic composite membranes and hybrid electrocatalysts are explored.

Prevailing modes of component (membrane, electrocatalyst/electrode, and interface) degradation will be outlined. Challenges associated with oxidative degradation of PEMs will be elucidated. PEM degradation mitigation approaches based on: 1) composite membranes containing rare earth metal oxides/metal nanoparticles; and 2) hybrid electrocatalysts with embedded peroxide decomposition functionalities will be presented. The role of in -situ diagnostics in the context of PEM degradation will be briefly addressed. The conflicting role of O2 permeability through polymer electrolytes vis-à-vis electrolyte durability and kinetic/transport properties within the electrode will be discussed.

Biography

Vijay Ramani is an Assistant Professor of Chemical Engineering at Illinois Institute of Technology, Chicago. His research interests lie in the broad area of electrochemical engineering. Specific directions of current research in his group include designing multi-functional electrolyte and electrode materials for polymer based electrochemical systems, analyzing the source and distribution of overpotential (losses) in electrochemical systems, and mitigating degradation in electrochemical devices, especially polymer electrolytes. NSF and DOE currently fund his research. Vijay has a Ph.D. in from the University of Connecticut, Storrs, and a B.E. from Annamalai University, India; both in Chemical Engineering.