DEVELOPMENT OF THIN-FILM FUEL CELL ELECTRODES CONTAINING NOVEL POLYMERS

M.A. Hickner, F. Wang, Y.S. Kim, *B. Pivovar, *T.A. Zawodzinski, J.E. McGrath

Department of Chemistry
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061

*Los Alamos National Laboratory, MST-11
Los Alamos, NM 87544

Nafion® thin-film electrodes are the industry standard due mainly to the widespread use of Nafion membranes in hydrogen and methanol fuel cells. Recent interest has centered on developing new fuel cell membranes and success has been achieved on several fronts. However, to test the true fuel-cell performance of these new membranes, electrode development must parallel membrane development. The problem lies in the fact that Nafion is not compatible with many of the other polymers being investigated. Electrodes containing Nafion do not adhere well to the new membranes and interfacial resistances at the electrode/membrane interface could become a dominating factor in the performance of the new membrane. The directly polymerized sulfonated poly(arylene ether sulfones) (BPS) produced at Virginia Tech show promise as the next generation fuel cell proton exchange membranes. Up to now, fuel cell studies of these polymers have been limited due to the poor performance of electrodes cast from solutions of these polymers. Nafion electrodes have been used for some experiments, but stability of the electrode/membrane interface has always been an issue. Recently, a method has been developed to produce clear, low-viscosity dispersions of BPS polymers analogous to the commercially available water/alcohol dispersions of Nafion. Light scattering measurements have shown that the size of the polymer particles is greatly influenced by the composition of the solvent. Due to the ampiphilic nature of the sulfonic acid containing polymers, aggregates of chains have been observed in water/alcohol mixtures, while the polymer exists as single coiled chains in DMAc or NMP solutions. It is believed that the nature of the polymer in solution has a large effect on the properties of the electrode. Specifically, polymer dispersions could be used to create a more porous electrode structure and facilitate increased catalyst activity and gas transport.