

## **Synthesis and Characterization of Vinyl Ester Based Room Temperature Ionic Liquid Gels for Membrane Applications**

Brian Merritt  
Giuseppe R. Palmese, Ph.D.

Fuel cells have the potential for improved efficiency at elevated temperatures but are restricted to operating at temperatures below 100°C due to the limitations of the proton exchange membrane (PEM). The PEM in fuel cells acts both as a medium for proton conduction and as a barrier between the fuels. Work has been done to maintain both mechanical integrity and conductivity of PEMs at higher temperatures by incorporating room temperature ionic liquids (RTIL). RTILs offer the unique advantage of having negligible volatility, which potentially allows them to maintain conductivity at high temperatures. The specific material being considered as a PEM involves a cross-linked polymer network in a RTIL medium. For this work, the difunctional monomer, a vinyl ester based on the methacrylation of diglycidyl ether of bisphenol A (VE-DGEBA) was reacted with the monofunctional monomer 2-acrylamido-2-methyl-1-propanesulfonic acid (AMPS) in the presence of the RTIL 1-ethyl-3-methylimidazolium ethyl sulfate [EMIM][EtSO<sub>4</sub>]; each of these was selected to optimize the mechanical, thermal, and conductivity properties of resulting membranes. The resulting polymer gels have highly tunable properties, with glass transition temperatures ranging from -80°C to 45°C as determined using dynamic mechanical analysis (DMA) and compressive modulus values ranging from <1 MPa to >950 MPa as determined using servo-mechanical analysis.