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"Functionalized Nanostructured Tri-Block Copolymer Ionomers for Separations and Fuel Cell Applications"

Proton exchange membranes (PEMs), commonly used in direct methanol fuel cells (DMFC), are typically limited by either high methanol permeability (also known as the cross-over limitation) or low proton conductivity. A potential alternative to this problem is to use thermoplastic elastomers (TPE) with rubbery and glassy thermodynamically immiscible microphases. The glassy segment is often composed of polystyrene, which can be sulfonated to high ion exchange capacities (IEC), and thus creates ion containing polymers or ionomers. Linear poly-styrene-isobutylene-styrene (SIBS) and both, linear and branched poly-styrene-isoprene-styrene (SIS), were sulfonated and functionalized with different cations (size and electronegativity). Controlling the degree of sulfonation and the functionalization allowed for selective membranes that could be used for applications such as fuel cells, gas sensors, and permselective separations. In addition, supercritical fluid processing allowed for additional morphological changes, especially with perfluorinated membranes. This presentation will review some of the critical materials characterization results including elemental analysis (EA), thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), dynamic mechanical analysis (DMA), and Fourier transform infrared spectroscopy (FT-IR). The kinetic and transport properties will also be discussed for the development of separation processes and catalytic nanochannel reactor arrays for fuel cell applications.