

CHEMISTRY-MORPHOLOGY-PROPERTY  
RELATIONSHIPS OF NOVEL PROTON EXCHANGE  
MEMBRANES

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A new series of proton exchange membranes (PEMs) has been synthesized for use in fuel cell applications. The membranes are based on direct polymerization of sulfonated monomers to form poly(arylene ether sulfones). One advantage of this synthetic scheme is that the polymer properties can be optimized for the specific fuel cell application by simply adjusting the ratio of sulfonated to unsulfonated monomer. Polymer properties are greatly influenced by their sulfonation content and the polymer's equivalent weight can be varied over a large range. The overall objective of this research is to produce PEMs that perform well in a wide range of fuel cell environments. However, fundamental understanding of the polymers is key to producing future generations fuel cell membranes. Through extensive studies of a series of these polymers with varying levels of sulfonation, our group is gaining a fundamental understanding of the relationships between the chemistry, morphology, and physical properties of these polymers. The membranes have been tested in hydrogen and methanol fuel cells to make connections between the membrane's physical properties and its performance in a fuel cell. We are developing the methodology to relate the membrane's performance in a fuel cell to its intrinsic polymer properties of microphase separation, water absorption, and most importantly protonic conductivity. By identifying the key membrane properties that affect fuel cell performance, PEM candidates can be effectively screened to ease the demand for fuel cell testing.