PBI Polymers for High Temperature PEM Fuel Cells

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Abstract

Polybenzimidazole (PBI) polymers are excellent candidates for PEM fuel cell membranes capable of operating at temperatures up to 200˚C. The ability to operate at high temperatures provides benefits such as faster electrode kinetics and greater tolerance to impurities in the fuel stream. In addition, PBI membranes doped with phosphoric acid can operate efficiently without the need for external humidification and the related engineering hardware to monitor and control the hydration levels in the membrane. PBI membranes are currently being investigated as candidates for portable, stationary, and transportation PEM fuel cell applications.

A new sol-gel process was developed to produce PBI membranes loaded with high levels of phosphoric acid.[1,2] This process, termed the PPA process, uses polyphosphoric acid as the condensing agent for the polymerization and the membrane casting solvent. After casting, absorption of water from the atmosphere causes hydrolysis of the polyphosphoric acid to phosphoric acid. The change in the nature of the solvent induces a sol-gel transition that produces membranes with high loadings of phosphoric acid and a desirable suite of physical and mechanical properties. The new membranes were characterized through measurements of acid doping levels, ionic conductivity, NMR, mechanical properties and fuel cell testing.[3] The durability of these new membranes in multiple operating environments is of particular importance for the further development of practical fuel cell devices. Testing protocols have been developed to examine the behavior of PBI membranes under both static and cyclic conditions. The results of long-term testing under these conditions as well as long term static testing will be presented.

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