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A Comparative Study: Influences of Polymerization Temperature on Phosphoric Acid Doped Polybenzimidazole Membranes

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Abstract : Fuel cells are electrochemical devices which convert the chemical energy of hydrogen into the electricity. Among the types of fuel cells, polymer electrolyte membrane fuel cells (PEMFCs) are attracting considerable attention as non-polluting power generators with high energy conversion efficiencies in mobile applications. Polymer electrolyte membrane (PEM) is one of the essential components of PEMFCs. Perfluorosulfonic acid based membranes known as Nafion® is widely used as PEMs. Nafion® membranes water dependent proton conductivity which limits the operating temperature below 100°C. At higher temperatures, proton conductivity and mechanical stability of these membranes decrease because of dehydration. Polybenzimidazole (PBI), which has good anhydrous proton conductivity after doped with acids, as well as excellent thermal stability, shows great potential in the application of high temperature PEMFCs. In the present study, PBI polymers were synthesized by solution polycondensation at 190 and 210°C. The synthesized polymers were characterized by FTIR, 1H NMR, and TGA. Phosphoric acid doped PBI membranes were prepared and tested in a PEMFC. The influences of reaction temperature on structural properties of synthesized polymers were investigated. Mechanical properties, acid-doping level, proton conductivity, and fuel cell performances of prepared phosphoric acid doped PBI membranes were evaluated. The maximum power density was found as 32.5 mW/cm² at 120°C.

Keywords : fuel cell, high temperature polymer electrolyte membrane, polybenzimidazole, proton exchange membrane fuel cell
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