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PBI Based Composite Membrane for High Temperature Polymer Electrolyte Membrane Fuel Cells

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Abstract : Al-Si was synthesized and introduced in poly 2,2'-m-(phenylene)-5,5'-bibenzimidazole (PBI). As a result, a series of five Al-Si/PBI composite (ASPBI) membranes (0, 3, 6, 9, and 12 wt.%) were developed and characterized for application in high temperature polymer electrolyte membrane fuel cells (HT-PEMFCs). The chemical and morphological structure of ASPBI membranes were analyzed by Fourier transform infrared spectroscopy, X-ray diffractometer and scanning electron microscopy. According to the doping level test and thermogravimetric analysis, as the concentration of Al-Si increased, the doping level increased up to 475%. Moreover, the proton conductivity, current density at 0.6V, and maximum power density of ASPBI membranes increased up to 0.31 Scm-1, 0.320 Acm-2, and 0.370 Wcm-2, respectively, because the increased concentration of Al-Si allows the membranes to hold more PA. Alternatively, as the amount of Al-Si increased, the tensile strength of PA-doped and -undoped membranes decreased. This was resulted by both excess PA and aggregation, which can cause serious degradation of the membrane and induce cracks. Moreover, the PA-doped and -undoped ASPBI12 had the lowest tensile strength. The improved performances of ASPBI membranes imply that ASPBI membranes are possible candidates for HT-PEMFC applications. However, further studies searching to improve the compatibility between PBI matrix and inorganic and optimize the loading of Al-Si should be performed.

Keywords : composite membrane, high temperature polymer electrolyte membrane fuel cell, membrane electrode assembly, polybenzimidazole, polymer electrolyte membrane, proton conductivity
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