

Nanocomposites Membranes Based on Phosphonic Acid Functionalized Zirconium Phosphate for High Temperature PEMFC

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PEMFC operating at high-T has advantages such as higher system efficiency, flexibility in fuel selection and simplification in water management. However, most commercialized membranes which are based on sulfonic acid moieties give the relatively high proton conductivity only in the presence of water; this is the main obstacle to develop high-T PEMFC. So we developed nanocomposites with phosphonic acid-functionalized zirconium phosphate (ZrP). Phosphonic acid could be a candidate as high-T proton carriers with the relatively high proton conductivity without water due to its self-dissociation natures. We synthesized zirconium diphosphophenyl phosphate (Zr3P) and Nafion/Zr3P nanocomposites. This nanocomposites resulted in very high proton conductivity at high-T (0.02 S/cm at 120 °C, < 40% RH). The result may result from the improved self-humidification inside the nanochannels of Nafion. In addition, the nanocomposites will be expected to improve the mechanical strength and chemical stability at high-T. It may be used for high-T proton conducting membrane at low humid conditions due to conducting mechanism of phosphonic acid groups at these conditions.