

Preparation and characterization of anhydrous polymer electrolyte membranes based on poly (vinyl alcohol-co-ethylene) copolymer

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Anhydrous polymer electrolyte membranes with cross-linked structure have been prepared based on poly(vinyl alcohol-co-ethylene) (PVA-co-PE) copolymer. The PVA units of copolymer served to induce thermal cross-linking with 4,5-imidazole dicarboxylic acid (IDA) via esterification while PE units controlled the membrane swelling and the mechanical properties of films. Upon doping with phosphoric acid (PA, H₃PO₄) to form imidazole-PA complexes, the proton conductivity of membranes continuously increased with increasing PA content. As a result, proton conductivity reached 0.01 S/cm at 100 °C under anhydrous conditions. X-ray diffraction analysis revealed that both the d-spacing and crystalline peak of membranes were reduced upon introduction of IDA/PA due to the cross-linking effect. The PVA-co-PE/IDA/PA membranes exhibited good mechanical properties, e.g., 150 MPa of Young's modulus, as determined by a universal testing machine. Thermal gravimetric analysis also represented that the thermal stability of membranes was increased up to 200 °C upon introduction of IDA/PA.