Preparation and Characterization of a Non-Fluorinated Covalent Organic-Inorganic Hybrid Proton Exchange Membrane for Fuel Cell

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Fuel cell technology is one of the key technologies of the 21st century for stationary and transportation applications. The proton exchange membrane (PEM) is key component in polymer electrolyte membrane fuel cells. The current state-of-the-art PEM is Nafion. The major limitations of perfluorosulfonic polymers such as Nafion are high cost, high methanol permeability, and loss of membrane performance at elevated temperature. In this study the feasibility of a silicon-containing non-fluorinated proton exchange membrane with semi-interpenetrating polymer network (IPN) for use in fuel cells was studied. Poly(vinyl chloride)-based poly(styrene-co-methacrylate)-silica covalent hybrid membranes were prepared by sol-gel condensation and monomer sorption with semi-IPN. The morphological analysis showed homogeneous membranes without phase sepatation. The prepared membrane had a reasonable proton conductivities compared to Nafion 117. Without a large sacrifice of proton conductivity, the hybrid mambranes with nanosized silica particles were more chemically and thermally stable than silica-free membrane.