Characterization of Proton Exchange Membranes Modified with a Base Polymer for use in DMFC

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A base monomer (1-vinyl imidazole, VIDz) was polymerized in the Nafion 112 membrane by UV irradiation in order to reduce methanol permeability. Small angle X-ray scattering analysis revealed that the size of hydrated ion cluster in the composite Nafion membranes was reduced and equilibrium water uptakes from liquid and vapor water were decreased with increasing VIDz content of the membrane.

The transport properties such as ion conductivity, methanol permeability and electro-osmotic drag were also affected by equilibrium water uptake and hydrated pore size. Even a little incorporation of base polymer showed a significant effect on proton conductivity and methanol permeability. Electro-osmotic drag of methanol was evaluated by using ex-situ methanol permeability test and in-situ limiting current density measurement. Although it was not easy to obtain the absolute number of methanol transported by electro-osmotic drag, it was possible to correlate the electro-osmotic drag of methanol with the state of water present in the composite membrane. The composite membrane with an optimum amount of VIDz was found to increase DMFC performance higher than that of Nafion membrane because of reduced methanol permeability and electro-osmotic drag effect.