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Proton Conducting Nanocomposite Membrane for PEMFC and DMFC
고분자전해질연료전지용 이온전도성 나노복합막

김영택 · 박승배 · 송민규 · 이희우
서강대학교 화학공학과

We prepared structurally stable organic-inorganic hybrid ionomer membrane in which nano-sized solid proton conductors were uniformly dispersed in an ion exchange polymer matrix. Nafion membrane was cast from 5 wt% Nafion/dimethlyacetamide solution containing a hydrophobic plasticizer. It was leached out from Nafion membrane by solvent extraction using diethyl ether and methanol. The resultant Nafion membrane was in-situ doped with zirconium hydrogenphosphate (ZHP). SEMicrographs showed that nano-porous structure in Nafion membrane was well developed by the solvent extraction process and the poreswere completely filled with in-situ doped ZHP particle It was confirmed by FTIR study that hydrophilic ZHP fillers improved water retention of composite ionomer membrane at high temperature regions above 100 °C. Consequently, high temperature conductivity of Nafion/ZHP membranes was much higher than that of a neat Nafion 115 membrane.

We prepared Nafion/clay nonocomposite membrane to reduce methanol permeability while maintaining essential proton conductivity. Chemically treated clays were ultrasonifically dispersed in Nafion/ DMA solution, and exfoliated during solvent casting at 100 °C. Featureless diffraction pattern of Nafion/clay nanocomposite indicated disordered exfoliated composite structure. TEMicrogrphs also showed nanolayers are well dispersed in Nafionresin. It was confirmed that nano-dispersed clay particles improved both tensile strength and elongation at break. Reflective index measurement indicated that methanol permeability of Nafion 117 was *ca.* 6×10^{-5} mol/cm^{2}s while that of 1 wt% Nafion/clay nanocompositemembrane (~50 mm) decreased down to the order of 10^{-7} mol/cm^{2}s. Consequently, 1 wt% Nafion/clay nanocomposite membrane showed the synergetic improvement in all aspect of methanol permeability, mechanical property, and proton conductivity.