일반강연 A-2

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High-Ion Conductivity, Low-Methanol Permeability Proton Exchange Polymeric Membrane

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A direct methanol fuel cell (DMFC) is one of the most attractive power sources for a wide range of application from vehicles to portable utilities due to stable operation at a rarely low temperature, high energy generation yield and energy density, the simplicity of system, and low cost. Though it has a number of benefits, some serious problems of commercialization of DMFC are high methanol crossover and high cost in polymer electrolyte membrane (PEM). Methanol crossover is a main barrier to its commercial application, which introduced methanol as fuel at the anode transports to the cathode through the membrane and react at cathode without generation of electricity. This not only lowers fuel utilization, but also adversely effects the performance in cathode side. While perfluorinated ionomer, such as Nafion™, are usually used in DMFC for its good proton conductivity, while methanol permeability through the membranes is fairly high.

From the standpoint of high methanol crossover and its high cost,

alternative polymer electrolyte membranes are eagerly desired, and major research objective in recent would be to identify and to achieve novel, high performance, effective proton conductive electrolyte with low methanol crossover and low cost. Potential thermoplastic polymers such as polysulfones, polyethersulfones, polyetherketones, polyimides, polybenzimidazole, polyoxadiazole, and polyphosphazene have been suggested. However, the sulfonation to these polymers has caused the formation of water-soluble polymers with low sulfonation, side reaction including crosslinking, cleavage of polymer chain, and low realibility.

In addition, another way to prepare sulfonated polymers is based on chemical modification of polymer or monomer sulfonation and subsequent polymerization. Among many methods, the synthesis of sulfonated polymer using sulfonated monomer is the most favorable owing to easily controlling sulfonation degree and preventing the polymer decomposition.

Proton conducting polymer should satisfy a number of criteria as well as high proton conductivity (>0.1S/cm) and low methanol permeability

- easily synthesized from available, low cost starting materials
- film formation without difficulty
- swellable but insoluble in hot water
- chemically stable to acids/free radicals
- thermal and hydrolytical stability

In this study, novel high performance polymer electrolyte membranes having proton conductivity close to that of Nafion™ while having lowest methanol permeability were prepared by introducing various pendant groups in aromatic polymer backbone.

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