Physical and electrochemical properties of Nafion/Polypyrrole composite membrane for DMFC

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Nafion/Polypyrrole composite membrane was prepared by chemical in-situ polymerization for a direct methanol fuel cell. The composite membrane was characterized by quantitative analysis, DMA, TGA, EPMA, water and methanol uptake tests, conductivity and permeability measurements, and unit cell operation.

The mechanical and thermal properties of the composite membrane were enhanced due to the interaction between the polar phase of Nafion and secondary ammonium groups of polypyrrole. In addition, the transport properties of the composite membrane were influenced by the equilibrium factor rather than the kinetic factor because of its non porous structures. The optimization of cell performance was related to the distribution of polypyrrole particles over the cross section of the membrane. When the content of the polypyrrole particles was mainly present in the surface rather than in the internal space, the difference in the relative proton conductivity and the relative methanol permeability was largest. The existence of the polypyrrole particles in the surface such as thin film was favorable to reducing methanol crossover with remaining proton conductivity. In particular, N/P 003 had higher performance than Nafion under the specific condition.