포스터 발표 P-4

직접 메탄올 연료전지용 Rotaxane/Nafion 전해질막

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Rotaxane/Nafion Composite Membranes for Direct Methanol Fuel Cells

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Introduction

Nowadays, fuel cells are an environmentally friendly source of power of high energy efficiency. Direct methanol fuel cells (DMFC) that use a proton exchange membrane as electrolyte are an attractive option for electricity generation, because of high energy density and simplicity of operation.

Membranes for DMFC are required a high proton conductivity and a low methanol permeability. The most widely used membrane in DMFC is based on a perfluorosulfonic acid membrane such as Nafion. While Nafion membrane has a good proton conductivity but suffer from methanol permeability. This phenomena of "methanol crossover" through the Nafion membranes must be overcome in order to avoid the efficiency loss due to the methanol crossover.

This study aims at dispersing a nano-scaled barrier rotaxanes inside of the Nafion membranes.

Experimental

Materials

Nafion prefuorinated ion-exchange resin (5 wt% Aldrich). Rotaxane, inclusion compound of poly(ethylene glycol) (M_n=1000, Aldrich) and α-Cyclodextrin (hydrate, 98%, Acros) was prepared by mixing each aqueous solutions. α-Cyclodextrin is cyclic oligosaccharides consisting of 6 glucose units connected by α-1.4 linkages.

Membrane preparation

The rotaxane/Nafion composite membranes were prepared by Nafion/DMF (1:1) mixture solution. First, rotaxane was dissolved in Nafion/DMF (1:1) solution, and the solution was poured into glass Petri dish, and then dishes were dried at 80°C in oven for 1 day. Before any characterization, the membranes were immersed in 0.5 M H_2SO_4 solution for 1 day and washing with deionized water for 2 hours. The membranes were stored in deionized water.

Results and discussion

The proton conductivity and methanol permeability of rotaxane/Nafion recast membrane determined by impedance spectroscopy and home made diffusion cells are shown in figure 1. Methanol permeability follows with that of the proton conductivity, i. e., the membrane having high proton conductivity, shows high methanol permeability and vise versa. Data taken after two weeks kept in deionized water shows the similar trend.

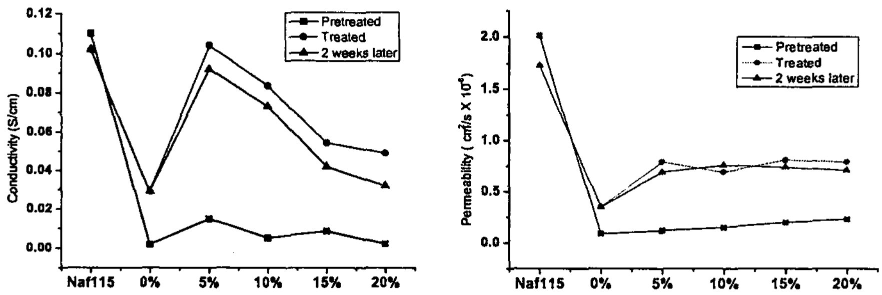

Figure 1. Proton conductivity and methanol permeability of rotaxane/Nafion composite membranes.

The selectivity parameter determined from the division of proton conductivity to methanol permeability is shown in Figure 2. A 5 wt% of rotaxane/Nafion composite membrane shows a good selectivity ($13.2x10^4 Ssec/cm^3$) more than commercial Nafion115 membrane ($5.9x10^4 Ssec/cm^3$).

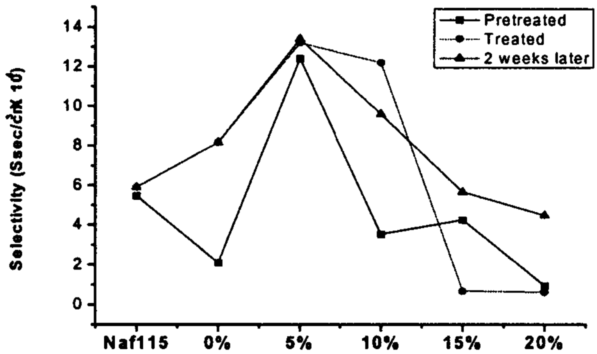

Figure 2. Selectivity of rotaxane/Nafion recast membranes and Nafion 115 film.

Summary

Rotaxane/Nafion composite membranes were prepared and characterized. Proton conductivity was 0.1 S/cm and the methanol (10 wt%) permeability was 7.88×10^{-7} cm^2/sec at 5 wt% of rotaxane/Nafion composite membranes. The characterization of the status of retaxane inside of Nafion membranes is under study.

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