Hybrid Polymer Electrolyte to Reduce the fuel cross-over in DMFC

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As early demonstrated [1], fuel crossover in direct methanol fuel cell cause the considerable reduction of cell performance. Electro catalysts, which are used for methanol oxidation or hydrogen reduction, have not been developed satisfying performance. Therefore, to reduce the crossover is the one of the important factor for improving fuel cell performance and fuel efficiency. To approach minimize or eliminate the fuel crossover, various researches have tried. Methanol impermeable composite electrolyte system [2], acid-doped polymer electrolyte [3,4], or new compositional polymer electrolyte [5] have been tried for DMFC. Organic-inorganic hybrid membranes also have been reported [6]. In report, as inorganic filler silica, silica network, TiO_2, and Zircornyl phosphate were synthesized by means of hydrolysis or sol-gel reaction. But the efforts for reducing of methanol crossover have been trade-off with ionic conductivity and cell performance. In this work hybrid membrane was fabricated with inorganic proton conductors. Hybrid membrane with inorganic proton conductor has ionic conductivity of 0.1S/cm and less methanol crossover compared with Nafion.

The reduction of methanol crossover should be characterized in terms of less potential drop and higher fuel efficiency. In this work hybrid membrane was characterized with ionic conductivity, water and methanol solution permeability, and fuel cell performance. For detecting methanol crossover, CO_2 analysis of cathode stream was observed by GC measurement. These CO_2 results from GC analysis were compared with permeability results. Fuel efficiency was characterized with various concentration of methanol solution, which was feed as anodic fuel. Hybrid membrane with inorganic proton conductor has 30% less methanol crossover than Nafion 115 at nominal potential with 30~50% higher cell performance than Nafion 115 membrane.

References.

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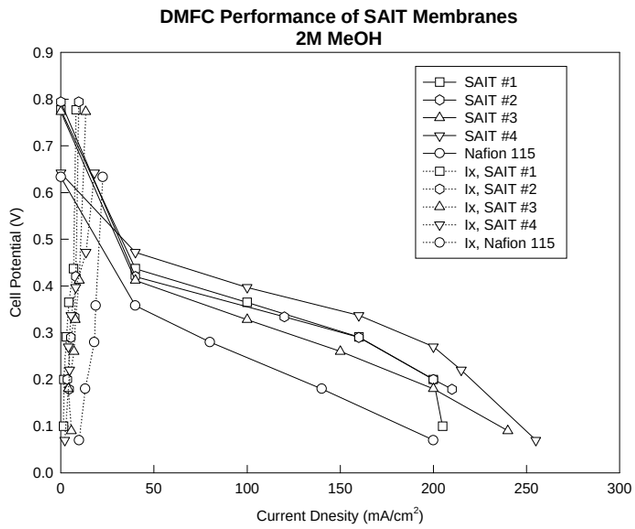

Figure 1. Methanol crossover current density and DMFC cell performance of Nafion and SAIT membrane

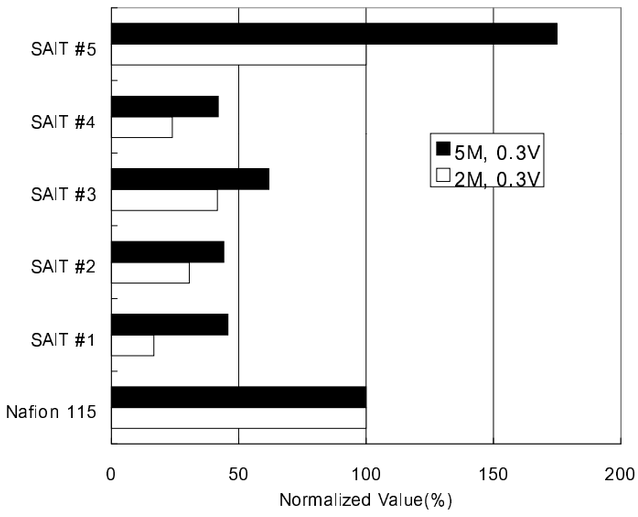

Figure 2. Methanol crossover reduction of Nafion and SAIT membrane at 0.3V