PVDF COMPOSITE ELECTROLYTE MEMBRANE FOR DIRECT METHANOL FUEL CELL APPLICATION

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Many attempts to improve membrane performance for direct methanol fuel cell (DMFC) have been reported. Their purposes are mainly to reduce the methanol transport while retaining the proton conductivity. In this work, we prepare the laminated composite polymer electrolyte for DMFC. The laminated composite polymer membrane successfully reduces the methanol crossover and overcomes the problem of the interfacial resistance of MEA interface. [1],[2]

The laminated composite polymer electrolyte membrane was prepared with Nafion - Poly Vinylidene Fluoride (PVdF) blend membrane and Nafion 112 membrane. The Nafion-PVdF blend membrane was manufactured by special blending technique of Nafion and PVdF.[3] The laminated membrane is fabricated as sandwich structure, nafion112 / Nafion-PVdF blend membrane / Nafion 112. (Fig. 1.)

The conductivity of the laminated composite membrane is 1.1×10^{-2} S/cm at 20% PVdF containing polymer. As increasing PVdF content, the conductivity decreased linearly, but maintained above 10^{-2} S/cm up to 20% of PVdF content. (Fig. 2.) Simultaneously, the methanol crossover rates decreased as increasing PVdF content. At PVdF content 20% of the laminated blend membrane, the methanol crossover rate decreases by about 18% of Pure Nafion. At the performance of single cell, all laminated composite membranes have higher power densities than Nafion membrane. At the cell temperature 110^{o}C, the highest cell current density was 217.64mA/cm^2 with 20wt% of PVdF containing laminated composite membrane at the constant cell voltage of 0.3V. Current densities of laminated composite membranes are 1.13-1.37 times higher than that of Nafion. On the other hand, the highest cell current densities with 10 and 30wt% of PVdF containing composite membrane at a constant cell voltage 0.3V were lower than 20wt% of PVdF content, which is 180 and 190.6 mA / cm^2 respectively. The single cell performance at 130^{o}C (Fig. 3.) shows that the blend membrane is more effective than pure Nafion membrane. At 130^{o}C, Nafion loses its performance drastically, but all blend membranes maintain their performance as the same extent at 110℃. At 150 ^{o}C, PVdF 30% blend membrane still shows some extent of performance. This result means that PVdF stabilizes membrane at high temperature and blend membrane get more thermally stable performance in DMFC.

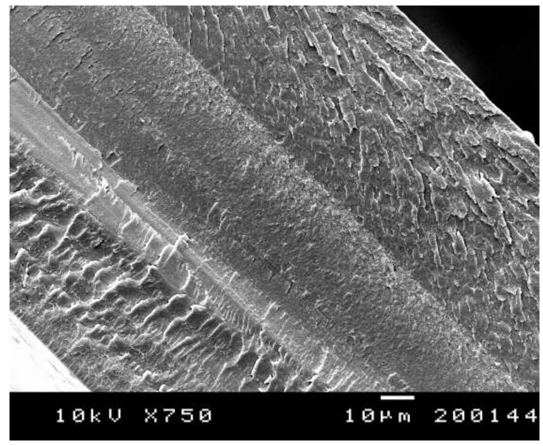

Fig. 1. Fracture surface of Laminated Nafion-PVdF composite membrane. Outside of layer is Nafion 112 and inside is Nafion-PVdF composite membrane

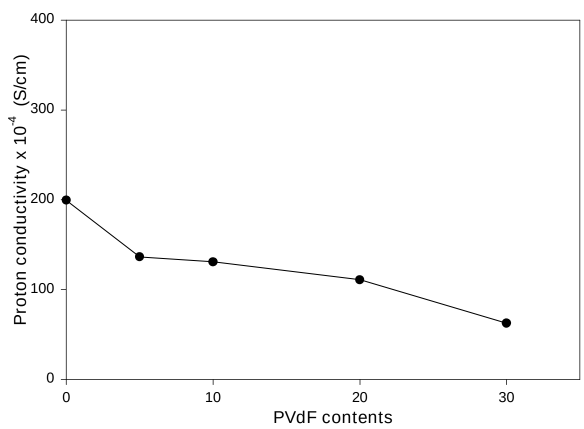

Fig. 2. Relationship between PVdF contents and Proton conductivity of the laminated composite membrane

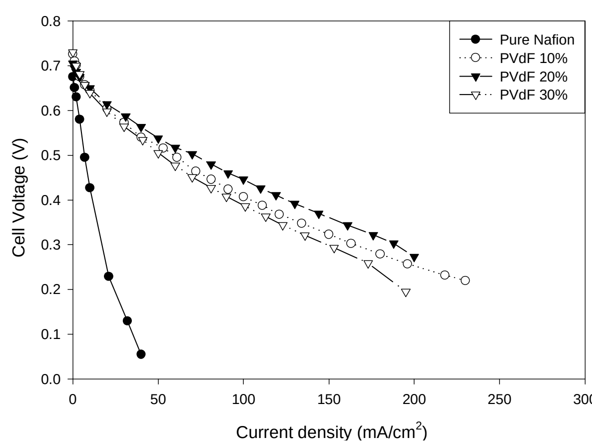

Fig. 3. Performance of laminated membrane at 130^{o}C

Reference

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[3] R.B. Moore, C.R. Martin, Macromolecules, (1998), 21, 1334-1339