Novel Aminated Cellulose Acetate Membranes for Direct Methanol Fuel Cells (DMFCs)

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Currently, enhancing the mechanical properties and decreasing methanol permeability is the major challenge for the polyelectrolyte membranes for the direct methanol fuel cells (DMFCs). In this study, novel aminated proton exchange membrane based on cellulose acetate (CA) for DMFC were prepared via activation process using epichlorohydrin (ECH) afterward amination reaction using ethylene diamine (EDA). The structure of the aminated cellulose acetate membranes (AMCA) were investigated by a Fourier transform infrared spectroscopy, Scanning electron microscopy, Thermogravimetric analysis. The adsorption of the AMCA membrane of water and methanol solution was also characterized. Additionally, the AMCA membranes were investigated as a function of a molar ratio of EDA concerning ion exchange capacity (IEC), dimensional stability, thickness change, thermal oxidation stability, and methanol permeability in detail. Results revealed that the modified CA membranes have excellent dimensional stability, admirable physicommechanical properties (32.13 N) and low methanol permeability (4.54×10^{-17} cm²/S) compared to 1.14×10^{-9} cm²/S for commercial Nafion®117 membranes. Furthermore, the membrane performance with various contents of EDA showed a vast improvement compared to Nafion®117. In conclusion, the obtained series of AMCA membranes offering the possibilities to reduce the DMFC membrane cost considerably while keeping high performance. These results suggested that these membranes are quite attractive candidates as an innovative polymeric electrolyte material for DMFCs applications.

Keywords: Proton exchange membranes; Cellulose acetate; Methanol permeability; Ethylene diamine; Direct methanol fuel cell.

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