Using Hydrophobic Microporous Layers and Enhanced Air Flow to Reduce Methanol Crossover in a Direct Methanol Fuel Cell

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Due to the finite supply of fossil fuels and the ecological dangers associated with their use, there has been a push in recent years to find new ways of efficiently producing energy. The direct methanol fuel cell (DMFC) is a popular energy producing unit due to its high energy density. One remaining obstacle to the vast commercialization of methanol fuel cells is its inefficiency at high current densities. In this investigation Ultra-capacitors were used as energy buffers to approach this problem, yielding a 33.36% increase in efficiency. Another remaining obstacle lies with the DMFC's inability to process higher concentration methanol solutions as fuel. This is due a phenomenon known as methanol crossover, in which methanol fuel crosses the proton exchange membrane (PEM) and thus diminishes the voltage of the cell. In this investigation Hydrophobic Microporous Layers (MPLs) were inserted into the PEM of the DMFC to reduce this methanol crossover when the DMFC operated on higher molarity methanol solutions. The Micropourous membranes were composed of a mixture solution containing XC72R carbon black and 15wt% Teflon coated on a carbon paper. This layer prevents both methanol and water from crossing the PEM without severely preventing the proton flow to the cathode. The results of this investigation showed that that the DMFC with the MPLs and the standard DMFC preform at the same efficiency when they are operated using a low molarity methanol solution (less than 4M). However, when the DMFCs are operated using higher molarity methanol fuel (5 M methanol solution), the DMFC with MPLs are 18.875% more efficient than the standard DMFC. The results clearly show that the MPLs developed in this investigation effectively reduced methanol cross over.

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