

The Effect of Membrane Ion Exchange Capacity on the Performance of PEM Fuel Cell

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The effect of ion exchange capacity (IEC) of polymer electrolyte membranes on oxygen reduction at the membrane / catalyst layer interface is investigated using a hydrogen - oxygen proton exchange membrane fuel cell and a series of radiation grafted-partially fluorinated membranes. The steady state polarization curves show an increase in fuel cell performance with increased IEC of the membrane. The electrochemically active surface area (ESA) of the catalyst layer, measured by stripping of CO from Pt surface, reveals a slight dependency on the membrane's IEC –the trend is consistent with a previously investigated using a half-fuel cell system[1] and is attributed to the membrane regulating the extent of wetting in the catalyst layer. Measurement and analysis of uncompensated resistances in the fuel cell provide information on membrane dehydration and membrane / electrode interfacial resistance, both of which are influenced by the IEC. The membrane, by virtue of its IEC, water content and osmotic pressure, regulates the water content at the membrane / electrode interface; which in turn influences the electrochemical characteristics. Using both the agglomerate model for PEMFC cathode and percolation theory, a comparison between polarization data obtained from half-fuel cell and fuel cell systems reveals that the ESA in the fuel cell is lower as a result of reduced wetting of the catalyst layer but this is offset by an order of magnitude improvement of the effective diffusion coefficient of oxygen in the catalyst layer[2]. Consequently orr performance is higher in the fuel cell system. Electrochemical data obtained from fuel cells and half-fuel cells are compared and discussed. The roles of membrane's IEC on the fuel cell electrochemical performance are highlighted.

References

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