Characterization of Membrane Surface Ionic Activity and Its Effect on the Performance of a PEM Fuel Cell

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ABSTRACT

In a Proton Exchange Membrane (PEM) fuel cell, a proton conducting membrane like Nafion® is used as the electrolyte. The proton conductivity of this membrane, which strongly affects the performance of a PEM fuel cell, depends on the characteristics of the ionic clusters both within the polymeric structure and on its outer surfaces. The bulk conductivity of these membranes has been extensively studied. However, no study has been conducted to determine the effect of the morphology and activity of the ionic clusters on the surface of these membranes on the performance of PEM fuel cells.

Recent experimental work has shown that the surface ionic activity, mainly the S to C ratio, of the proton exchange membrane has a strong effect on the performance of the membrane-electrode-assembly of a PEM fuel cell. The results from this work will be presented [1-2].

This work will also discuss a new approach to measure the surface ionic activity of proton conductive membranes using a technique called conductive atomic force microscopy (CAFM). Using this technique, we are trying to determine how the topography and activity of the ionic clusters on the surface of a proton conducting membrane are affected by the membrane's hydration state, contact with liquid water, pretreatment and post-treatment processes, and conditions used in the preparation of the membrane and electrode assemblies for PEM fuel cells. Preliminary results will be presented.

References

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2. Minh Vu Nguyen, "Development of High Performance Membrane and Electrode Assemblies for PEM Fuel Cells," MS Thesis, Department of Chemical and Petroleum Engineering, The University of Kansas, Lawrence, Kansas, USA, May 2003.