Abstract No. 1209

Oxygen Transport and Reduction Kinetics at a Platinum Microelectrode Membrane Interface: Studies on some New Proton Conducting Membranes

L. Zhang, and S. Mukerjee
Department of Chemistry, Northeastern University
360 Huntington Avenue, Boston, MA 02115

Running a proton exchange membrane fuel cell (PEMFC) at elevated temperatures (<100-150°C) have many attractive options. Alternative hydrated membranes to the perfluorinated sulfonic acid based systems (such as Nafion®) possessing high proton conductivity at lower relative humidity and stability at elevated temperatures are currently the focus of a lot of research and development. Among the promising candidate membranes under active consideration include sulfonated poly(arylene-ether-sulfone) (SPES) and sulfonated poly sulfide sulfone (SPSS) polymers. To enable the use of these new membranes in fuel cells, it is of fundamental importance to know the ORR kinetics and mass transport properties at Pt/PEM interface, especially under conditions that closely mimic typical operation conditions of the PEM fuel cell. These characteristics are also important for designing the appropriate interface in the membrane electrode assembly (MEA).

The objective of this investigation is to determine and compare the oxygen reduction kinetics and oxygen permeability (transfer coefficient and solubility) at Pt/SPES and Pt/SPSS interface. A solid-state electrochemical cell has been built in-house to perform ORR studies under controlled temperature, pressure and relative humidity.

Experimental

The alternative proton transport membranes under investigation were Sulfonated poly(arylene-ether-sulfone) (SPES-40), Sulfonated poly (arylene-ether-sulfone) post sulfonation (SPES-PS) and sulfonated poly sulfide sulfone (SPSS) with different sulfonation levels (2:8, 4:6). These membranes were procured as a part of a collaborative effort from Virginia Polytechnic Institute (Professor Mcgrath's research group, for SPES-40) and from Foster Miller Inc., (Waltham, MA, for SPES-PS and SPSS).

A solid-state electrochemical cell was designed and built to perform ORR studies under controlled temperature, pressure and relative humidity. Design principles of the cell were based on those described before [1-3] although some improvements were made.

Results and Discussions

By performing slow-scan voltammetery (Fig 1.) under different conditions, the important ORR kinetics parameters such as the exchange current density, transfer coefficient and Tafel slope can be determined at the interface of Pt and alternative membranes.

Chronoamperometry method was used to estimate the solubility C and diffusion coefficient D of O_2 as a function of pressure and according to modified *Cottrell* Equation. (Fig 2.)

This investigation will present a full picture of O_2 transport characterizations within these new membranes.

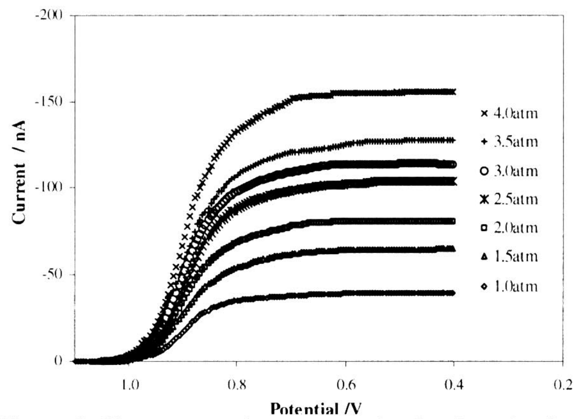

Figure1. Slow-scan voltammetry plot for O_2 reduction at the Pt/ SPES-40 interface as a function of pressure.

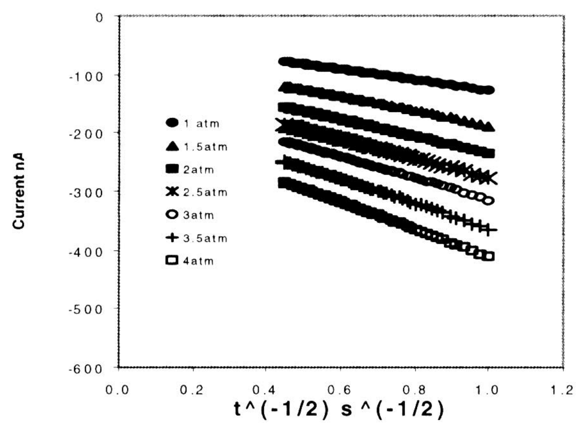

Figure 2. Chronoamperometric plot for O_2 reduction at the Pt/ SPES-40 interface as a function of pressure.

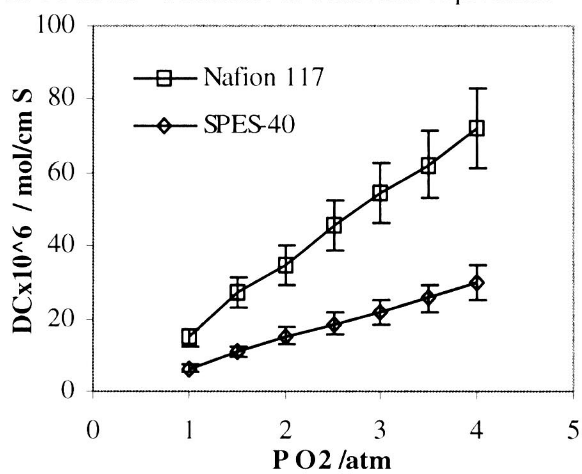

Figure 3. Comparing O_2 permeability of Nafion 117 and SPES-40 as a function of pressure.

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References

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