

**WEDNESDAY, AUGUST 24, 2005, P.M.**

**SESSION 42A: INTERNATIONAL SYMPOSIUM ON FUEL CELL AND HYDROGEN TECHNOLOGIES**

**PEMFC PROTON CONDUCTING MATERIALS**

Sponsor(s): Materials Science and Engineering Section, The Metallurgical Society of CIM

Room: Imperial Ballroom 5

Chairmen: T. NAVESSIN, NRC Institute for Fuel Cell Innovation, Canada and  
D.P. WILKINSON, University of British Columbia, Canada

**PAPER 42A.1 — 14:00**

**OXYGEN KINETIC AND MASS TRANSPORT PROPERTIES IN NOVEL POLYMER ELECTROLYTE MEMBRANES FOR USE IN PEMFCs.**

T. ASTILL, NRC Institute for Fuel Cell Innovation, Canada

B. EASTON and S. HOLDCROFT, Simon Fraser University, Canada

Fuel cell technology is an important sector in today's global research and energy generation. Fuel cells can promote energy diversity and the transition to renewable energy sources. The characteristic that PEM fuel cells deliver high power density makes them ideal power sources for vehicular, stationary, and microelectronic applications.

Characterization of the electrolyte membrane plays a vital role in determining the suitability for fuel cell applications. Oxygen reduction kinetics and mass transport within polymer electrolytes is of critical importance since oxygen reduction at the cathode is the rate limiting process in fuel cells. For an electrochemical charge transfer to be successful only the dissolved reactant moieties are relevant, therefore efficient transport of reactant species, such as oxygen, within the electrolyte is crucial. This efficient reactant transport or permeation comprises two important components, the solubility ( $c_b$ ), and diffusion coefficient (D). The kinetics and mass transport properties can be determined by Pt-microelectrode technique, apparatus shown in Figure 1. Both the temperature and oxygen pressure can be controlled at one hundred percent humidity to mimic the environment found inside PEM fuel cells.

**PAPER 42A.2 — 14:20**

**SELF-ASSEMBLY OF SURFACE-CHARGED LATEX PARTICLES INTO PROTON-CONDUCTIVE MEMBRANES.**

J. GAO, D. LEE, Y. YANG, S. HOLDCROFT, and B.J. FRISKEN, Simon Fraser University, Canada

We present results from our investigation of the concept and practice of using surface-charged latex nanoparticles as building blocks for conductive membranes. Nanoparticles were synthesized by free-radical co-polymerization of two hydrophobic monomers, butyl acrylate (BA) and methyl methacrylate (MMA), a crosslinker, N, N'-methylenebisacrylamide (BIS), and a charged monomer, sulfonate styrene sodium salt (NaSS), in water. The resultant nanospheres were characterized with static and dynamic laser light scattering. Thin films were cast from concentrated particle dispersions, followed by incubation at  $\sim 110^\circ\text{C}$ . Conductivity, water uptake and final charge content were measured. The membranes have higher conductivities than both amorphous films cast from sulfonated BA-MMA-Styrene copolymer chains and BA-BIS-MMA-NaSS gel films. TEM images and neutron scattering spectra confirm the particulate structure of the membranes.

**PAPER 42A.3 — 14:40**

**DEVELOPMENTAL AND EVALUATION OF PROTON CONDUCTING MATERIALS FOR PEMFC.**

T. NAVESSIN, K. SHI, Z. XIE, NRC Institute for Fuel Cell Research, Canada

S. HOLDCROFT, Simon Fraser University, Canada

Recent research activities in proton exchange membrane fuel cell (PEMFC) have significantly improved the performance per unit cost and its lifetime. These activities narrow the technology gaps, and thus, enable commercialization in some applications. One particular focus is in the development and understanding of proton conducting membrane materials. Many novel membranes are being developed which provide control and systematic understanding of complex relationships between chemical structure, morphology, physicochemical properties, and electrochemical kinetics. In this study, different classes of proton conducting membranes suitable for portable and automotive applications were evaluated in an operating PEMFC at the Institute for Fuel Cell Innovation, National Research Council. Analysis of these results may provide constructive feedbacks to the material researchers.

**PAPER 42A.4 — 15:00**

**PREPARATION AND PROPERTIES OF PROTON CONDUCTING BLENDING POLYMERS WITH FLUOROUS BLOCK COPOLYMERS AS COMPATIBILIZERS.**

K. SHI, J. MURPHY, N. SIEB, NRC Institute for Fuel Cell Innovation, Canada and

S. HOLDCROFT, Simon Fraser University, Canada

Three series of membranes were prepared by blending poly(vinylidene difluoride) (PVDF) or poly(vinylidene difluoride-co-hexafluoropropylene) [P(VDF/HFP)] with sulfonated poly(ether ether ketone) (S-PEEK), sulfonated polysulfone (SPU), or sulfonated polystyrene, in order to develop novel PEM membranes suitable for melt processing. By means of incorporating fluorine-containing block copolymer into the blended system, acceptable proton conductivity and low water containing PEM materials were prepared. The effect of sulfonated poly([vinylidene difluoride-co-hexafluoropropylene]-b-styrene) block copolymers as compatibilizers was investigated: conductivity was enhanced for S-PEEK/fluoropolymer blends. Microstructures for the blends were examined by transmission electron microscope (TEM) and scanning electron microscope (SEM).

COFFEE BREAK — 15:20 – 15:40