

Minutes of the High Temperature Membrane Working Group Meeting Wednesday, October 10, 2007

The fall meeting was conducted as a joint session of the HTMWG and CARISMA (Coordination Action for Research on Intermediate and high temperature Specialized Membrane electrode Assemblies) and held at the Hilton Hotel, in conjunction with the Electrochemical Society Meeting. Forty-eight people attended. Nancy Garland began the meeting with a brief welcome and an acknowledgement that several visitors “from across the pond” had made the trip to make it a joint meeting with CARISMA.

Dr. Garland was followed by Dr. James Fenton from the University of Central Florida. Dr. Fenton gave a brief overview for the meeting and then introduced Dr. Jin Wang from Argonne National Lab.

Dr. Wang began his talk by showing a photo of the Advanced Photon Source at Argonne National Lab. This 3rd generation synchrotron x-ray facility, built by US DoE for basic and applied research, has over 3,000 users/year. He went on to describe opportunities for membrane research with surface sensitive x-ray techniques. Some of the x-ray techniques that can be applied include reflectivity and standing waves, x-ray photon correlation spectroscopy and GISAXS using x-ray wave-guides. Some of the advantages to these techniques are that they are nonintrusive, *in situ* capabilities and are sensitive for thin films.

Questions for Dr. Wang included relating the techniques to fuel cell membrane analysis. He assured the audience that this was no problem, that experiments could be constructed.

The next speaker was Deborah Jones from the National Scientific Research Council. Ms Jones outlined membrane development in Europe. She said that the European Commission has provided funding under six framework programs for the last 20 years. Funding has increased but so have the requests for the money. Under Framework Program 7, energy is included with other topics and an implementation plan will be initiated under this FP. Current projects are running under FP6 and CARISMA is one of these projects. CARISMA coordinates a number of projects, referred to as work packages.

Specific work that is being conducted in the area of membranes includes modification of PFSA and SPEEK to be used at high temperatures. Additional work includes decreasing the temperature for PBI and an investigation of intrinsic proton conductors.

After detailing some of the specific work being done, Ms Jones concluded with a list of perspectives and challenges yet to be solved.

Following Ms. Jones, Lorenz Gubler of the Electrochemistry Laboratory, Paul Scherrer Institute in Switzerland, presented “A Strategy for Aging Test of Fuel Cell Membranes.” He began with a discussion of the merits of graft co-polymerization, which include the

tailoring of the membrane composition to the required application and potential cost effectiveness. He then went on to discuss the membrane “health state” and ways to monitor it. Questions to ask include how do the functionalities change as a function of time; is the degradation rate constant, increasing, decreasing with time, or discontinuous; and does the degradation of one functionality affect the other? Ways to monitor the condition of the membrane are by observing the ohmic resistance, measuring the open circuit voltage and the gas permeation rate.

Aging tests take a long time but accelerated aging tests can be done. Increasing the stress factor(s) will accelerate degradation and yield shorter time to failure. The mechanisms for degradation are mechanical, radical and thermal. To accelerate testing, mechanical or chemical degradation or a combination of the two can be used.

Dr. Gubler said that it is important to understand the process of aging of membranes. This can be done through post mortem analysis, in-situ accelerated testing, in-situ real time testing, and ex-situ materials testing.

Following Dr. Gubler’s presentation, Jim McGrath presented a number of slides that showed different structures and the resulting morphologies. He said that block copolymers have better conductivity than do random copolymers.

Dr. Fenton then showed a graph of conductance dependence on relative humidity at 120 °C. He followed this by giving a brief overview of the requirements for the samples that the HTMWG members are to furnish to UCF for conductivity testing under the program.

The meeting concluded with members being encouraged to submit any items on morphology or anything else that they are willing to share so that they can be posted on the website.