FESC
Florida Energy Systems Consortium

University of Central Florida

Insight into Membrane Degradation Mechanisms Through Verification of Chemical and Mechanical Degradation Test Capabilities

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Description: The objectives of the program were to gain insight into fuel cell membrane degradation mechanisms including both chemical and mechanical degradations. In order to achieve this objective, the Membrane Electrode Assembly Durability Test System, MEADS, was verified, after which chemical degradation tests were conducted. By performing post mechanical testing and analyzing the data, the impact of accelerated degradation tests on the cell performance decay, chemical decomposition and mechanical weakening of the membranes were evaluated.

Budget: $351,518
Universities: UCF/FSEC
External Collaborators: U. S. Department of Energy

Executive Summary

This project was essentially completed by fall 2010. However, it was determined that the ability to obtain publication quality transmission electron microscopy (TEM) images would be beneficial to a better understanding of membrane degradation. Additionally, this capability would enhance the ability to obtain future funding in this field. As a result, contract funding was used to purchase a Leica Trimmer and a Leica Microtome. The trimmer is employed for rough trimming of samples and then the microtome is used to prepare the samples, which must be thinner than 100 nm in order to obtain high quality TEM images. These two instruments were installed at the Material Characterization Facility at UCF, where the TEM resides and are available to all UCF researchers.

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In order to better determine the impact of fuel cell testing on membranes; it is necessary to examine cross-sections of the tested membranes using a transmission electron microscope (TEM). The Materials Characterization Facility (MCF) at UCF has an excellent TEM but it was determined that the existing microtome, used for preparing the cross-sections, was not adequate for this purpose. This instrument must be capable of preparing slices of the sample that are 80-100 nm thick in order for the TEM to obtain clear images of fuel cell membranes. With the MCF microtome, a diamond knife could not be used and as a result slices were either too thick or were shredded. It was therefore decided that a new microtome would be purchased. It was determined that the Leica EM UC7 possessed all of the required characteristics and so was purchased under this program. It was also determined that before the microtome could be used, a trimmer was required to perform the rough trimming of the samples. Leica carried this instrument and it was purchased to be used in conjunction with the microtome. The instruments, which were installed in the MCF facility for use by all UCF faculties, can be seen below.

Figure 1: Leica Trimmer

Figure 2: Leica EM UC7 installed at MCF

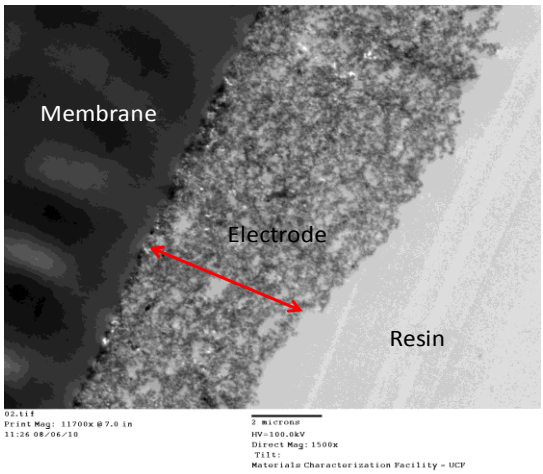

Figure 3: Partial cross-section image of an MEA

This Leica microtome provided samples that were far superior to any previously obtained with the old instrument. The capability to acquire publication quality TEM images has been greatly enhanced with the acquisition of both the trimmer and the microtome.

An example of the images obtained after sample preparation using the new instruments can be seen in Figure 3.

This project has been completed.