Published on ***Hawaii Natural Energy Institute*** (http://www.hnei.hawaii.edu)

Home > Printer-friendly PDF

Fuel Cell Fabrication

HNEI has established a membrane electrode assembly (MEA) fabrication laboratory giving us the ability to produce MEAs. The chosen fabrication technology for MEA production at HNEI was developed at Los Alamos National Laboratory (LANL) [1]-[3]

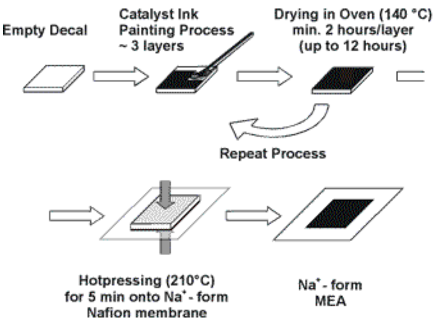

Figure 1: Schematic of MEA fabrication method.

This technology entails the creation of a catalyst ink mixture. Standard ink composition used at HNEI for polymer electrolyte membrane fuel cell (PEMFC) applications contains 20% platinum on carbon (Pt/C) and 5% Nafion solution (1100 EW) in a weight ratio of 5:2, and tetrabutylammonium hydroxide (TBA-OH). Figure 1 shows a schematic of the fabrication process. The catalyst ink mixture is coated on a hot press transfer substrate, which is an intermediate carrier material referred to as a 'decal.' Presently, HNEI applies the catalyst layers by hand painting. This coating technique allows for minimal material waste, flexible choice of electrode size and shape, and the application of a very broad range of adjustable catalyst loadings. The target catalyst ink loading of this technology can be adjusted over a wide range from approximately 0.05 0.80 mg Pt/cm^2 when using standard ink. The desired loading is reached by stepwise manual application of the ink with subsequent drying and weighing of the catalyst material. A successive hot pressing step permanently transfers the created electrode layer on a Nafion membrane. See Figure 2 for a view of the MEA formed after hot pressing. Final steps in this production process include a proton exchange step of the MEA in sulfuric acid of low molarity, and a MEA drying step on a vacuum hotplate.

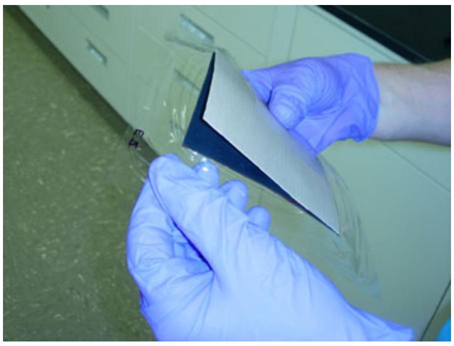

Figure 2. During the hot pressing step, the catalyst layer is transferred to the membrane, forming an MEA. The decal material is then carefully removed from the assembly of electrodes and membrane.

The HNEI MEA laboratory possesses equipment and material to produce MEAs for PEMFC applications ranging from 1 - 600 cm^2. Production of 50 and 100 cm^2 cells have been successfully demonstrated in the laboratory. In the following months, these cells will be tested and analyzed using the capacities at HNEI's Hawaii Fuel Cell Test Facility (HFCTF). A joint study with LANL is anticipated in order to compare the achieved results at HNEI with standard MEAs created and operated at LANL. This cooperation may involve the exchange of MEAs to establish a common baseline. Furthermore, HNEI intends to expand the currently established MEA fabrication technique by implementation of a semi-automated catalyst ink coating setup. This knife-spreading apparatus will be designed and built in house. It increases the speed of the coating process for an MEA to less than 2.5 hours, while allowing for loading deviations of less than 4%, and very high catalyst homogeneities [4]. This semi-automated technique is useful for highly reproducible MEA production of repetitive cell sizes and loadings which are important in successful research and develo

References

- [1] M.S. Wilson, S. Gottesfeld, 'Thin-film catalyst layers for polymer electrolyte fuel cell electrodes', Journal of Applied Electrochemistry, 22 (1), 1 7, (1992).
- [2] M.S. Wilson, S. Gottesfeld, 'High performance catalyzed membranes of ultra-low Pt loadings for polymer electrolyte fuel cells', Journal of the Electrochemical Society, 39 (2), L28-L30, (1992).
- [3] M.S. Wilson, J.A. Valerio, S. Gottesfeld, 'Low Platinum Loading Electrodes For Polymer Electrolyte Fuel-Cells Fabricated Using Thermoplastic Ionomers', Electrochimica Acta, 40 (3), 355 363, (1995).
- [4] G. Bender, T.A. Zawodzinski, A.P. Saab, 'Fabrication of High Precision PEFC Membrane Electrode Assemblies', Journal of Power Sources, 124, 114 117, (2003).

Segmented Cell System

To improve cell diagnostics, with and without impurity injection, a segmented cell system was designed and built in-house. This diagnostic system consists of segmented cell hardware, an in-house custom built current transducer system, and a National Instrument PXI data acquisition instrument.

iThe segmented cell hardware is based on the existing HNEI 100 cm^2 cell design, which consists of a multiple channel serpentine flow-field, offering three different heating options: (i) heating pads, (ii) heating cartridge, and (iii) heating/cooling liquid. The segmented flow-field consists of ten cell segments following consecutively the path of the six channel serpentine flow-field. Each segment has an area of 7.6 cm^2 and consists of its own distinct current collection, and, if desired, a distinct GDL and catalyst area. The cell hardware and electrode segmentation can be applied to either the anode or the cathode.

The data acquisition system allows interrogation of up to 32 current and 32 voltage channels and is not limited to the existing HNEI 100 cm^2 cell hardware. The limitation of the individual current sensor for each segment, i.e., 15 A, can be increased by using a countercurrent option. This allows for flexibility in cell design and higher accuracy during AC impedance experiments. 1 shows the current distribution of an Ion Power MEA, operated at HNEI standard conditions of 80 °C temperature, 7/7 psig backpressure, 2/2 stoicheometry, and 100/50% relative humidity. The cell performs strongest at the cell inlet and shows continuously decreasing performance along the flow-field.

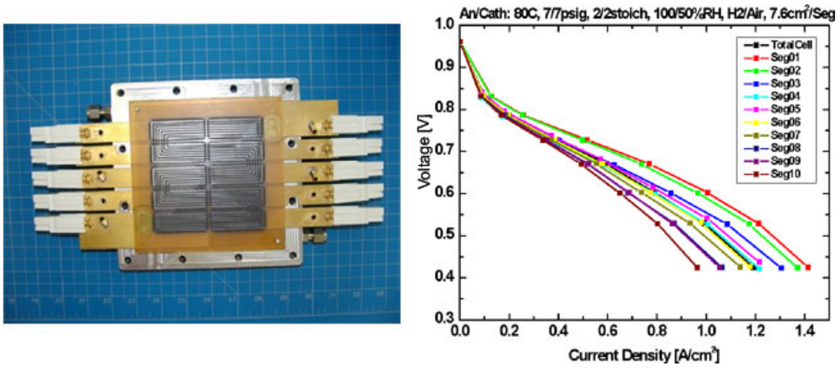

Figure 3: Left: HNEI's segmented cell hardware. Right: Current distribution of the segmented cell.

Last Updated: Sunday, July 11, 2010

[Hawaii Natural Energy Institute](http://www.hnei.hawaii.edu) ? 1680 East West Road, POST 109 ? Honolulu, HI 96822 ? Ph: (808) 956-8890 ? Fax: (808) 956-2336 ? Email:Contact ?
