V.G.5 Component Benchmarking Subtask Reported: Single Cell Testing Second Round Update and Technical Assistance to Industrial and University Partners

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Start Date: FY 2002
Projected End Date: Project continuation and direction determined annually by DOE

Objectives

- Collaborate with industry, universities and other government agencies involved with the United States Fuel Cell Council (USFCC)
- Establish a standardize test procedure for single cell proton exchange membrane (PEM) fuel cells
- Conduct fuel cell 'break-in' for second round-robin tests using the "standardized test protocol"
- Identify and correct issues regarding the procedure
- Expand the protocol to include longevity and durability testing
- Provide assistance to fuel cell community in establishing standardized testing protocols (i.e., single cell and durability)
- Provide technical assistance to developers to accelerate fuel cell commercialization

Technical Barriers

This project addresses the following technical barriers from the Fuel Cells section (3.4.4.2) of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

(A) Durability
(B) Cost
(C) Electrode Performance

Approach

- Conduct frequent meetings with the USFCC
- Assemble test cells according to the agreed procedure
- Collect and prepare break-in results
- Conduct blind-tests using the protocol at different test sites
- Compare and analyze results
- Assist the fuel cell community in MEA fabrication and fuel cell testing as necessary
- Provide DOE-directed assistance to developers

Accomplishments

- Held regular productive meetings with members of the USFCC
- Modified standard test procedure for single cell PEM fuel cells
- Completed second round of testing
- Provided technical assistance to several collaborators from industry, universities, and government affiliates

Future Directions

- Utilize lessons learned to further improve the existing protocol and finalize
- Contribute to the longevity and durability testing protocol
- Review the data from the USFCC protocol's 2nd round robin results
- Continue to assist developers as directed by DOE

Introduction

The work described herein is a collaborative effort among members of the USFCC, Materials and Components Working Group, Single Cell Task Force reflecting results from using an agreed upon testing protocol that was subsequently modified to incorporate lessons learned. Completion of a first round robin series of tests led to the suggested improvements. This work will allow us to establish testing protocols that are globally accepted for their accuracy, ability to promote

and quantify scientific advancement and, ultimately, facilitate the commercialization of fuel cells [1]. In addition, testing methods similar to the above mentioned protocol were used to provide technical assistance to fuel cell developers.

Approach

The Single Cell Testing Protocol has been developed such that laboratories can publish test results for a new material or component in a consistent, verifiable manner. The protocol consists of several stages; cell assembly, gross leak testing, electrochemical H_2 crossover measurement, initial break-in, conditioning, and polarization curve [1]. Cell assembly, pressure testing, and initial break-in were performed at LANL [2]. Polarization curves are to be generated at the other test sites.

In addition, throughout the year we trained several collaborators from industry, universities, and other government institutions on MEA fabricating, testing, and analysis. This hands-on procedure allowed each collaborator to personally participate in each step of the process. (i.e., catalyst ink preparation, electrode painting, hot pressing, cell assembly, and fuel cell testing). These processes are described in detail elsewhere [3].

Results

LANL served as the initial test site. Cell assembly, leak test, hydrogen cross-over measurements and break-in were conducted. Data were recorded. Figures 1 and 2 show results from a single test cell break-in. LANL will review the polarization curves from the test sites. LANL is also participating in the development of a durability protocol.

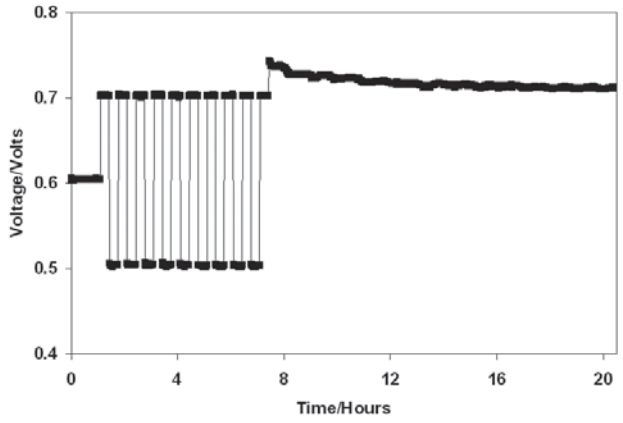

FIGURE 1. Voltage versus Time During the Break-In

Beyond component benchmarking, this task has a significant component in providing technical assistance to developers. While the data generated are generally considered proprietary, collaborators have indicated that they value the training of LANL's in-house procedures as well as the opportunity to develop specific test conditions and procedures for their own product. Figure 3 shows the results of a 5 cm^2 PEM fuel cell operating on hydrogen/air at 80°C obtained during a recent collaboration. The platinum loading at each electrode was 0.2 mg Pt/cm^2 (20% Pt/C, ETEK).

Conclusions

- The initial testing requirements have been fulfilled, the results are shown and test hardware has been shipped to the subsequent test site
- Thorough training in LANL's procedure has allowed other's technology to advance

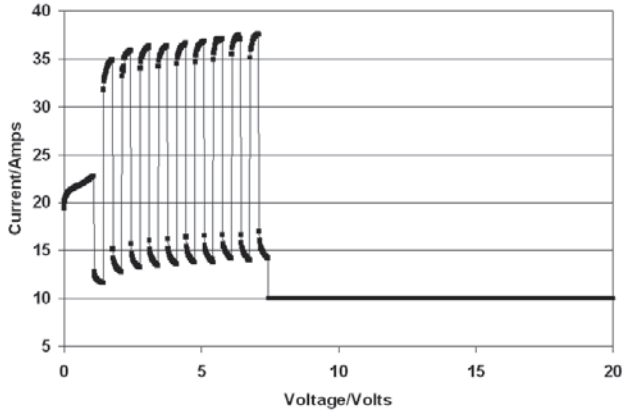

FIGURE 2. Current versus Time for the Break-In

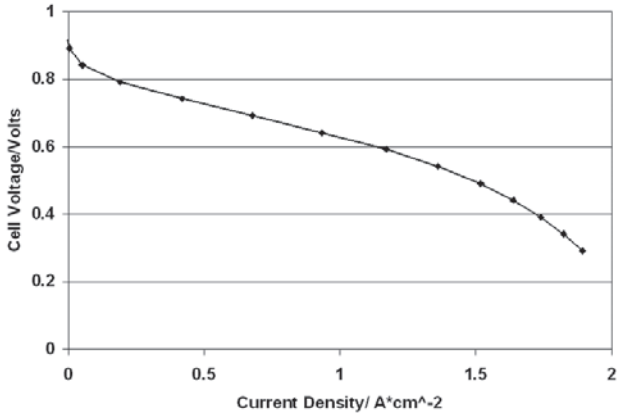

FIGURE 3. A Fully Humidified Hydrogen/Air VI-Curve Taken at 80°C and 30 psig Back Pressure with 0.2 mg Pt/cm^2 at each Electrode

References

1. Component Benchmarking, 2005 DOE Hydrogen Program Report.

2. Single Cell Test Protocol, USFCC Document No. 05-014 (www.usfcc.com).

3. Davey et al., Overview of Fuel Cell Membrane Electrode Assemblies (MEAs) at Los Alamos National Laboratory (LANL), 1st Symposium on MEA Manufacturing, Dayton 2005.

FY 2005 Publications/Presentations

1. Davey et al., Overview of Fuel Cell Membrane Electrode Assemblies (MEAs) at Los Alamos National Laboratory (LANL), 1st Symposium on MEA Manufacturing, Dayton 2005.

2. Proprietary letter reports to DOE and developer on DOE-directed Technical Assistance to Developers under parent task.

3. LANL Testing Matrix, WG12 Meeting, San Ramon, CA.

4. Impurities Testing Update, FreedomCAR Tech Team Mtg. Detroit, MI.