V.K.4 Martin County Hydrogen Fuel Cell Development*

Elizabeth Rehbock
Microcell Corporation
6003 Chapel Hill Road, Suite 153
Raleigh, NC 27607
Phone: (919) 858-8500; Fax: (919) 858-8615
E-mail: beth.rehbock@microcellcorp.com

DOE Technology Development Manager:
Donna Ho
Phone: (202) 586-8000; Fax: (202) 586-9811
E-mail: Donna.Ho@ee.doe.gov

DOE Project Officer: Greg Kleen
Phone: (303) 275-4875; Fax: (303) 275-4788
E-mail: Greg.Kleen@go.doe.gov

Contract Number: DE-FG36-08GO88107

Project Start Date: March 1, 2008
Project End Date: March 31, 2009

*Congressionally directed project

Objectives

- Transfer extrusion manufacturing process from research and development to the manufacturing floor while maintaining performance and quality within anticipated specifications.
- Modify Unicell process equipment by fine tuning parameters to increase and optimize throughput while maintaining performance and quality within anticipated specifications.
- Reduction of balance-of-plant components to allow for lower cost fuel cell fabrication and simplified operation.

Technical Barriers

This project addresses the following technical barriers from the Fuel Cell Manufacturing section (3.5.5) of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

(A) Lack of High-Volume Membrane Electrode Assembly (MEA) Processes

(D) Manual Stack Assembly

(E) Lack of Manufacturing Processes for Balance of Plant Components for PEM Fuel Cell Systems

Technical Targets

- Power Output: 7-10 Watts (Unicell)

Approach

A low-cost, high-speed manufacturing process for microfiber fuel cells was transferred from a research and development level to a manufacturing environment. The microfiber manufacturing technology comprises an extrusion process in which all the components of a single fuel cell, i.e., the electrocatalyst of cathode and anode, the polymer electrolyte membrane, and the current collectors, are extruded into a single microfiber ranging in size from 400-1,000 microns (see Figure 1). To create a fuel cell "stack" these microfibers are bundled into a "Unicell" structure (see Figure 2).

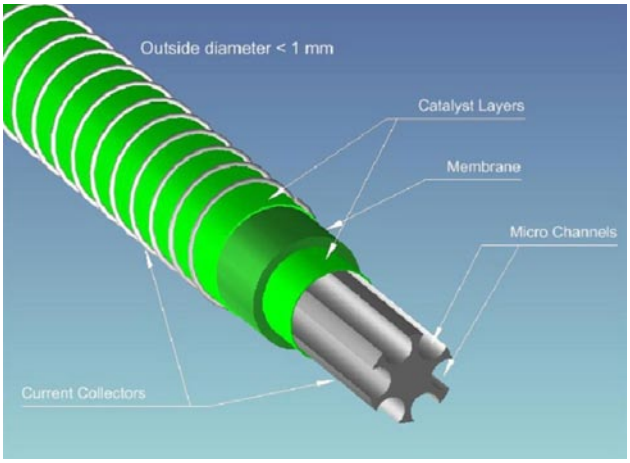

FIGURE 1. Microfiber Fuel Cell

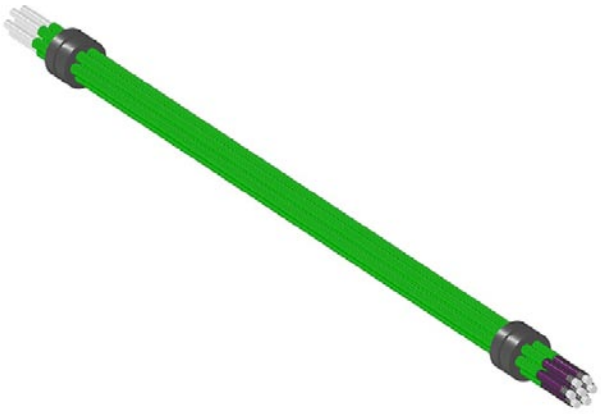

FIGURE 2. Unicell

Various parameters including production speed and product quality were analyzed to prove the viability of these processes at the manufacturing level.

Process equipment for extrusion of microfibrous fuel cells was designed and constructed based on prior designs at the research and development level. This equipment was installed at a manufacturing facility and extruded cells were tested according to strict protocols. It was anticipated that these production runs would verify that extrusion line production can be reliably duplicated at the manufacturing level. For the next step in the process, Unicell production, the process equipment was evaluated and optimized to handle increased throughput while maintaining quality and performance. Research and development was conducted concerning the design and simplification of the fuel cell system (see Figure 3) for increased assembly speed. This was done by reducing the balance-of-plant components resulting in lower cost fabrication and simplified operation. Effects on quality and performance were evaluated.

FIGURE 3. Fuel Cell System

Accomplishments (see Figure 4)

- Extrusion manufacturing equipment designed and installed. Viability of extrusion process for continuous manufacturing confirmed.
- Unicell manufacturing equipment designed and installed. Viability of automated "stack" assembly confirmed.
- System design changes were identified which resulted in elimination of temperature controllers, valves and excessive humidification equipment resulting in significant system cost reductions and enhanced performance.

FY 2009 Publications/Presentations

1. A poster presentation was made at the DOE Annual Review (May 2009).

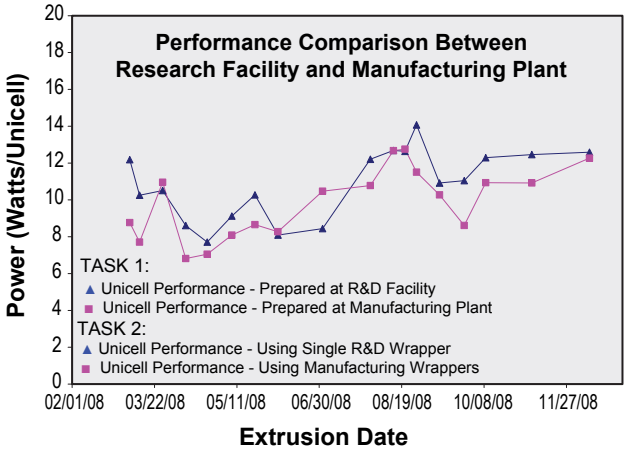

FIGURE 4. Performance Comparison between Research Facility and Manufacturing Plant