V.L.3 Light-Weight, Low-Cost PEM Fuel Cell Stacks

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Endura Plastics Inc.
Kirtland, OH

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Objectives

- Demonstrate edge collected stack design capable of >1 kW/kg (system level).
- Develop low-cost, injection molded stack components.
- Verify stack performance under adiabatic conditions.
- Develop direct humidification scheme based on printed 2D microfluidics.
- Develop optimized printable current collectors for edge collection.
- Accelerate stack development by incorporation of multiple cell level sensors within the stack coupled with computational fluid dynamics (CFD) modeling.

Technical Barriers

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

(B) Cost

(C) Performance

Technical Targets

TABLE 1. Relevant Technical Targets for Fuel Cell Stacks and Systems Operating on Direct Hydrogen

Metric	Units	2010 target
System Specific Power	W/kg	650
Stack Efficiency at Rated Power	%	55
Stack Cost	$/kW$_e$	25

The first estimate of the project's status towards achieving these targets will be available after fabrication and testing of sub-stack modules. The project plan calls for sub-stack testing to be completed by the end of the first year of the project.

Approach

A light-weight, low-cost proton exchange membrane (PEM) stack design will be developed that is responsive to DOE performance and cost goals and that is substantially simpler in design and construction than conventional stacks. An edge-collected design is being pursued using gas diffusion layers/current collectors that are fabricated by a printing process that provides an intimate contact between the various components, eliminating the need for compressive forces currently used to ensure low resistance contacts. As a result, numerous components of conventional stacks including bi-polar plates, tie-rods and cell-level seals are eliminated, greatly reducing the parts count, weight, and assembly complexity. Low-cost, light-weight housings will be fabricated by injection molding to enclose the fuel cell components and to provide reactant manifolding. Adiabatic operation with very low pressure drop will allow for extremely low parasitic power losses due to the elimination of the compressor and substantially simpler humidification requirements.

Accomplishments

- Demonstrated printed current collector/thru-membrane via with a total resistance of 9 mΩ-cm. This resistance would result in less than 10 mV iR loss per cell at our target current density of 0.4 A/cm^2.

- A pressure drop of less than 13" H_2O has been demonstrated in a sub-stack mock-up with an air flow of 5 slpm. This air flow is equivalent to the sub-stack operating at 0.4 A/cm^2 and 3X stoichiometry.

FY 2007 Publications/Presentations

1. Presentations were made at the 2007 DOE Fuel Cell kickoff meeting (Feb. 2007) and at the DOE Annual Review (May 2007).