V.G.16 Development of a 5 kW Prototype Coal-based Fuel Cell*

Steven S. C. Chuang
The University of Akron
200 E. Buchtel Common, Whitby Hall
Akron, OH 44325-3906
Phone: (330) 972-6993; Fax: (330) 972-5856
E-mail: schuang@uakron.edu

DOE Technology Development Manager:
Amy Manheim
Phone: (202) 586-1507; Fax: (202) 586-9811
E-mail: Amy.Manheim@ee.doe.gov

DOE Project Officer: Reg Tyler
Phone: (303) 275-4929; Fax: (303) 275-4753
E-mail: Reginald.Tyler@go.doe.gov

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Objectives

- Improve the anode catalyst structure and the interface between electrode and membrane.
- Refine the techniques for fabrication of the fuel cell assembly.
- Select and test interconnect materials for the coal-based fuel cell.
- Investigate the design factors for the coal injection and flyash removal systems.
- Design and fabricate a 5 kW prototype coal fuel cell.

Technical Barriers

This project addresses the following technical barriers for the development of a 5 kW prototype coal-based fuel cell.

- Cracking and delaminating of the fuel cell assembly during calcinations and operations.
- Durability of the anode catalysts.
- Durability of the seals for the fuel cell stack.
- Durability of the interconnects for the fuel cell stack.

Technical Targets

- Energy density: 160 mA/cm^2 at 0.4 V

Approach

A key innovation of the coal fuel cell technology is the development of a highly active catalyst for the electrochemical oxidation of the solid carbon in coal. The use of the solid carbon as the fuel distinguishes this coal fuel cell technology from conventional solid oxide fuel cells which uses H_2 or syngas as the feed. A novel design of the anode structure composition is required to obtain the optimum performance of the anode for the coal fuel cell.

This project will focus on the refinement of the anode catalyst and the design/fabrication of a coal fuel cell stack. The anode catalyst structure and composition for optimum performance will be fine-tuned through a series of experimental testing: (i) varying compositions, calcination temperature, and reduction temperature, (ii) determining the anode impedance, (iii) evaluating the long term durability, and (iv) characterizing the anode structure.

The fuel cell stack will be designed on the basis of the results of investigation of fly-ash/coal particle distribution. The thermal management will be built on the basis of the results of the heat transfer analysis and energy balance of the fuel cell system. The results of this study will be used to evaluate the technical feasibility of scaling up the C-fuel cell.

Accomplishments

Our preliminary study has demonstrated that the electrochemical oxidation of solid carbon and coal is technically feasible on mixed metal/metal oxide anode catalysts at 750–950°C. Fly-ash produced from coal does not adhere to the anode surface. Our previous study has established the scientific and technical basis for the development of a 5 kW prototype coal-based fuel cell.