The Fossil Report

Oak Ridge National Laboratory Fossil Energy Program

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Energy Technology for the Future...and for the World

New Project to Explore Low-Cost Manufacturing of Ceramic Fuel Cell Components

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Oak Ridge National Laboratory has initiated a new project to develop multilayer ceramic manufacturing processes, which are suited to low-cost, high-volume production of ceramic fuel cell components.

Fuel cells generate power by extracting the chemical energy of natural gas or other hydrocarbon fuels without combustion. Advantages include high efficiency and very low release of pollutants into the atmosphere.

Recent work at the DOE National Energy Technology Laboratory resulted in a concept for potential increases of efficiencies of SOFC systems to greater than 80 percent. This approach, call the Ultra Fuel Cell, is based on staged SOFCs, whereby spent (but not completely combusted) fuel exiting a first SOFC stack operating at low-temperature (700°C) is fed into a second SOFC stack

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Infrared Heating—A New Tool for Materials Processing

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Heating is a required step in many materials processes. Commonly used heating methods include: (1) gas-fired, (2) induction, (3) resistance, and (4) microwave. Each method has its own heating characteristics and associated benefits and costs.

A new heating method known as infrared has recently been developed at the Oak Ridge National Laboratory.

This method uses tungsten halogen lamps, and the heating systems using these lamps can be fabricated into a variety of furnace shapes.

The simplest shapes include single panels that can be used for unidirectional heating of surfaces. Panels can also be fitted with lamps for bidirectional heating. The lamps can be formed into tube or box furnaces, and can also be used for the fabrication of systems for inner-diameter heating.

Infrared heating has many advantages over commonly used heating techniques. Infrared heating provides: (1) an inherently clean non-contact heating method; (2) high heat fluxes which are materials dependent, due to the fact that only the sample is heated to the desired temperature; (3) heating only to the part ; (4) fast cooling rates due to the cold-wall nature of the process in which only the sample is heated; (5) high heat fluxes, which can be delivered unidirectionally over large areas; (6) con-

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trolled temperature gradients through thick-section material; and (7) a precise process, which is essentially shape independent, utilizing proper furnace designs.

Advances in lamp design and furnace designs at Oak Ridge National Laboratory have enabled heat fluxes as high as 236 W/cm to be delivered, utilizing conventional tungsten-based lamps and as high as 3500 W/cm^2, utilizing a plasma-based infrared system.

Continuous heat flux furnaces have been developed that can readily deliver 43 W/cm^2. These furnaces have been shown to be robust enough to heat treat, temper unidirectionally, a 682-kg die block with a 88-kW infrared furnace and austenitize one ton of steel per hour for a 500-kW circular infrared furnace.

Five different infrared systems of various types are available at ORNL. The infrared heating systems can be used for a variety of materials processing applications including: surface heating of forging dies, gradient hardening of dies, on-line annealing of sheets and wire, heating of billets for forging, brazing of dissimilar metals, heat treating of metals and alloys, high-temperature sintering of powder metallurgy components, and many more.

Proof-of-concept for many of the applications has already been demonstrated at ORNL.

An infrared-based systems manufacturing company, Infrared Technologies LLC, has started at the East Tennessee Technology Park in Oak Ridge, Tennessee.

For more information, contact **Craig Blue**.

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operating at high temperature (800°C).

Materials technology for high-temperature SOFC stacks has been developed. The focus of this new project is the development of materials and manufacturing technology to improve performance and reduce the cost of SOFC stacks that can operate efficiently at low temperature (500 to 800°C).

There are two methods to decrease the operating temperature of solid oxide fuel cells: (1) develop new electrolytes with improved oxygen ion conductivity at low temperatures, and (2) decrease the thickness of the electrolyte. In the near term, however, only decreasing the thickness can make a major impact on the operating temperature.

The development of cost-effective fabrication methods typically relies on deposition of multiple layers followed by co-sintering (densification of all the layers in a single heat treatment). Co-sintering methods for the fabrication of thin electrolyte films supported on porous electrodes have been demonstrated.

These processes generally involve deposition of a green electrolyte film from a suspension of electrode powder onto a highly porous electrode substrate. The green bilayer structure is then sintered to densify the electrolyte film while only partially densifying the electrode substrate. Subsequent deposition and annealing of the opposite electrode completes the SOFC structure.

In this program, low-cost fabrication methods for both anode-support and cathode-supported thin-film cells will be developed.

For more information on this and other ORNL Fossil Energy Program fuel cell activities, contact **Tim Armstrong**.

Work sponsored by the DOE Office of Fossil Energy, DOE National Energy Technology Laboratory.

New Fuel Cell Runs on Conventional Hydrocarbons

CNN Environmental New Network

Work at the University of Pennsylvania has resulted in a fuel cell that operates to produce electricity using only conventional forms of hydrocarbons, such as methane and butane. Hydrogen is the more common fuel for a fuel cell.

The researchers point to this new type of fuel cell as an important step toward the ultimate goal of cheap, efficient, and clean energy.

Earlier attempts to operate solid oxide fuel cells with conventional hydrocarbon fuels failed due to the buildup of carbon resulting from the electrochemical process.

The new fuel cell uses a material which, after four days of testing, did not reveal any fouling. It is hoped that additional testing will demonstrate that the fuel cell will remain stable for much longer periods of time.

Additional information on the University of Pennsylvania work can be found in the March 16 issue of *Nature*.

FY 2001 Budget Resolution Approved

On April 13, the House and Senate separately approved the FY 2001 budget resolution. The resolution represents the congressional response to the President's proposed FY 2001 budget and does not need to be signed into law.

The budget resolution establishes congressional priorities for FY 2001 through FY 2005.

The major outcome of the resolution is that spending targets have been established. All federally-support R&D would be affected by the spending targets.

Although many non-defense areas will realize increases in FY 2001, future allocations are projected to be inadequate to maintain pace with inflation.