arpa·e
CHANGING WHAT'S POSSIBLE

www.arpa-e.energy.gov

Materials & Systems Research, Inc. (MSRI)

Intermediate-Temperature Electrogenerative Cells for Flexible Cogeneration of Power and Liquid Fuel

Program: REBELS
ARPA-E Award: $2,799,978
Location: Salt Lake City, UT
Project Term: 11/01/2014 to 10/31/2017
Project Status: ACTIVE
Website: www.msrihome.com
Technical Categories: Stationary Generation

Critical Need:

Centralized power generation systems offer excellent economy of scale but often require long transmission distances between supply and distribution points, leading to efficiency losses throughout the grid. Additionally, it can be challenging to integrate energy from renewable energy sources into centralized systems. Fuel cells--or devices that convert the chemical energy of a fuel source into electrical energy--are optimal for distributed power generation systems, which generate power close to where it is used. Distributed generation systems offer an alternative to the large, centralized power generation facilities or power plants that are currently commonplace. There is also a need for small, modular technologies that convert natural gas to liquid fuels and other products for easier transport. Such processes are currently limited to very large installations with high capital expenses. Today's fuel cell research generally focuses on technologies that either operate at high temperatures for grid-scale applications or at low temperatures for vehicle technologies. There is a critical need for intermediate-temperature fuel cells that offer low-cost, distributed generation both at the system and device levels.

Project Innovation + Advantages:

MSRI is developing an intermediate-temperature fuel cell capable of electrochemically converting natural gas into electricity or liquid fuel in a single step. Existing solid-oxide fuel cells (SOFCs) convert the chemical energy of hydrocarbons--such as hydrogen or methane--into electricity at higher efficiencies than traditional power generators, but are expensive to manufacture and operate at extremely high temperatures, introducing durability and cost concerns over time. Existing processes for converting methane to liquid transportation fuels are also capital intensive. MSRI's technology would convert natural gas into liquid fuel using efficient catalysts and a cost-effective fabrication process that can be readily scaled up for mass production. MSRI's technology will provide low-cost power or liquid fuel while operating in a temperature range of 400-500?C, enabling better durability than today's high-temperature fuel cells.

Impact Summary:

If successful, MSRI's fuel cell will provide affordable generation of power or small, modular production of methanol directly from natural gas at an intermediate temperature of 400-500°C.

Security:
Enabling more efficient use of natural gas for power generation provides a reliable alternative to other fuel sources--a broader fuel portfolio means more energy security.

Environment:
Flaring and venting of natural gas results in significant greenhouse gas emissions. Converting stranded natural gas to a liquid fuel simulatneously reduces greehhouse gas emissions and produces valuable products.

Economy:
Distributed generation technologies would reduce costs associated with power losses compared to centralized power stations and provide lower operating costs due to peak shaving.

Contacts

ARPA-E Program Director: Dr. John Lemmon ARPA-E-Comms@hq.doe.gov
Project Contact: Dr. Greg Tao gtao@msrihome.com

Partners

Bio2Electric, LLC
North Carolina State University
West Virginia University Research Corporation