XI.0 Small Business Innovation Research (SBIR) Hydrogen Program New Projects Awarded in FY 2008

The Small Business Innovation Research (SBIR) program provides small businesses with opportunities to participate in DOE research activities by exploring new and innovative approaches to achieve research and development (R&D) objectives. The funds set aside for SBIR projects are used to support an annual competition for Phase I awards of up to $100,000 each for about nine months to explore the feasibility of innovative concepts. Phase II is the principal research or R&D effort, and these awards are up to $750,000 over a two-year period. Small Business Technology Transfer (STTR) projects include substantial (at least 30%) cooperative research collaboration between the small business and a non-profit research institution.

Table 1 lists the SBIR projects awarded in Fiscal Year 2008 related to the Hydrogen Program. On the following pages are brief descriptions of each.

TABLE 1. FY 2008 SBIR Projects Related to the Hydrogen Program

	Title	Company	City, State
XI.1	Aqueous Phase Base-Facilitated-Reforming of Renewable Fuel (Phase I Project)	Directed Technologies, Inc.	Arlington, VA
XI.2	Faradayic ElectroEtching of Stainless Steel Bipolar Plates (Phase I Project)	Faraday Technology, Inc.	Clayton, OH
XI.3	Anode Concepts for SO_2 Crossover Reduction in the HyS Electrolyzer (Phase I Project)	Giner Electrochemical Systems, LLC	Newton, MA
XI.4	Power Generation from an Integrated Biofuel Reformer and Solid Oxide Fuel Cell (Phase I Project)	InnovaTek, Inc.	Richland, WA
XI.5	Utilizing Metal Injection Molding to Meet High Volume, Cost Effective Manufacturing of Bipolar Plates (Phase I Project)	Precision Energy and Technology, LLC	Kettering, OH
XI.6	Sulfur-Resistant, Ultrathin Dense Membrane for Production of High Purity Hydrogen (Phase I STTR Project)	T3 Scientific, LLC	Arden Hills, MN
XI.7	Development of Highly Efficient Solid State Electrochemical Hydrogen Compressor (Phase II Project)	FuelCell Energy, Inc.	Danbury, CT
XI.8	Advanced Sealing Technology for Hydrogen Compressors (Phase II Project)	Mohawk Innovative Technology, Inc.	Albany, NY
XI.9	Photoelectrochemical System for Hydrogen Generation (Phase II Project)	Physical Optics Corporation	Torrance, CA
XI.10	Nanotube Array Photoelectrochemical Hydrogen Production (Phase II Project)	Synkera Technologies, Inc.	Longmont, CO
XI.11	Perovskite Adsorbents for Warm-Gas Removal of Sulfur (Phase II Project)	Eltron Research & Development, Inc.	Boulder, CO
XI.12	Nanofiber Paper for Fuel Cells and Catalyst Supports (Phase II Project)	Inorganic Specialists, Inc.	Miamisburg, OH

PHASE I PROJECTS

XI.1 Aqueous Phase Base-Facilitated-Reforming of Renewable Fuel

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DOE Grant No. DE-FG 02-08ER85111

The primary industrial hydrogen production method today is steam methane reforming (SMR) of natural gas (NG) at medium centralized facilities. This method has several shortcomings: (1) the NG feedstock is not renewable, (2) carbon emissions require costly mitigation systems to be compliant with U.S. Environmental Protection Agency regulations, (3) reformation results in a dilute hydrogen gas stream that requires extensive purification to obtain pure hydrogen, and (4) elevated processing temperatures, input energy requirements, and process inefficiencies induce high capital and operating costs. This project will investigate a base-facilitated-reforming (BFR) process for the economical production of hydrogen. BFR addresses the four drawbacks of the NG SMR process and offers the following key advantages: conversion of renewable fuels, liquid phase reformation, low-temperature operation, elimination of water-gas shift, pure hydrogen gas creation and carbon dioxide at any scale.

XI.2 Faradayic ElectroEtching of Stainless Steel Bipolar Plates

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DOE Grant No. DE-FG 02-08ER85112

Commercialization of proton exchange membrane fuel cells requires low-cost components, materials, and manufacturing processes. Specifically, the manufacture of the fuel cell's bipolar plates utilizes methods that are slow, expensive, and inappropriate for some advanced flow field designs. It is desirable that new manufacturing technologies be developed that enable advanced designs at high volume and low cost. This project will develop and demonstrate an electrochemical etching process that will enable the through-mask etching of stainless steel bipolar plates at high volume and low cost. This technique will enable advanced flow channel designs, not easily attainable using current manufacturing technologies. Phase I will include process development/optimization, equipment design and build, and flow field design.

XI.3 Anode Concepts for SO_2 Crossover Reduction in the HyS Electrolyzer

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Newton, MA 02466
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DOE Grant No. DE-FG 02-08ER85113

The idea of a hydrogen-fueled future is positive on many levels (better air quality, increased energy efficiency), but its realization depends critically on finding a non-carbon, or at least renewable, source of hydrogen. Thermochemical cycles, such as the Hybrid Sulfur (HyS) process, have the potential of providing hydrogen from nuclear energy at high efficiency with minimal environmental impact. This project will develop an innovative, HyS electrolyzer design to correct the SO_2 crossover problem inherent to current HyS electrolyzers. This approach, which involves the regulation of SO_2 gas delivery to the HyS electrolyzer anode, will help to minimize the activity of SO_2 at the anode-membrane interface, thereby diminishing the driving force for diffusion of SO_2 to the electrolyzer cathode. Phase I will focus on reducing SO_2 crossover by at least 50% while maintaining high electrochemical performance. Phase II will demonstrate the scaling up of this technology to a hydrogen production rate of 1.6 lbs H_2/day

XI.4 Power Generation from an Integrated Biofuel Reformer and Solid Oxide Fuel Cell

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DOE Grant No. DE-FG 02-08ER85115

Alternative energy sources must be sought to meet the energy demands of our growing economy and to improve energy security while reducing environmental impacts. The conversion of bio-oil from non-food-based biomass to hydrogen for fuel cells would allow significant increases in the use of renewable feedstocks for energy production. This project will develop a non-food, biomass-based power plant, in which the bio-oil is made from agricultural and forestry residuals (such as wood saw dust) through the fast pyrolysis process. In this approach, a proprietary steam reforming process and catalysts are combined with a solid oxide fuel cell for distributed power generation in the range from 3 to 30 kW.

XI.5 Utilizing Metal Injection Molding to Meet High Volume, Cost Effective Manufacturing of Bipolar Plates

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Precision Energy and Technology, LLC
2000 Composite Drive
Kettering, OH 45420
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DOE Grant No. DE-FG 02-08ER85131

With the rise in energy costs, an economical means is needed to move our country to a hydrogen economy. This can be accomplished by means of proton exchange membrane fuel cells. These fuel cells offers a solution to power generation and battery replacement for a wide variety applications including automotive, appliances, generators, and recreational uses for decades to come. In order to drive this transition, cheap components are needed. One such component is the bipolar plate. This versatile component carries the power between cell, dissipates heat, and supplies the fuel to the heart of the cell. A more economical method is needed to produce these plates from metals and alleviate the more costly graphite plate from fuel cell design. Manufacturing technology needs to be applied to reach the goal of less than $5 per kilowatt of power. This project's intent is to reach that goal, reduce components and improve reliability.

XI.6 Sulfur-Resistant, Ultrathin Dense Membrane for Production of High Purity Hydrogen (STTR Project)

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DOE Grant No. DE-FG02-08ER86364

Research Institution: Sandia National Laboratories

The use of coal, a secure and economical energy source, to produce a clean hydrogen fuel with near-zero emission would support the domestic and global green economy. A membrane is the most economical approach to meet the challenges of this process. This project will develop a defect free membrane that has high flux, high selectivity, and high resistance to contaminants, is able to handle high pressure and temperature, and is durable and economical. The approach is to carefully choose materials that meet most of these criteria, and then employ coating and assembly techniques to achieve the rest. Various operational conditions will be evaluated in Phase I to determine feasibility. This will be followed by a prototype demonstration for hydrogen purification in Phase II.

PHASE II PROJECTS

XI.7 Development of Highly Efficient Solid State Electrochemical Hydrogen Compressor

FuelCell Energy, Inc.
3 Great Pasture Rd.
Danbury, CT 06813

This project focuses on the development of a dual-use highly-efficient, solid-state electrochemical hydrogen compressor to produce high-pressure, high-purity hydrogen for near-term industrial applications and to meet future hydrogen refueling infrastructure needs.

XI.8 Advanced Sealing Technology for Hydrogen Compressors

Mohawk Innovative Technology, Inc.
1037 Watervliet-Shaker Rd.
Albany, NY 12205-2033

For the hydrogen economy and energy independence to become a reality, efficient and reliable large-scale compressors are needed to move hydrogen gas from production sites to end user locations. Oil-free, non-contacting seal and bearing technologies are critical to the successful development of these new compressors. These technologies will also have a positive impact on the operating efficiency and life of existing and new pipeline compressor and aircraft gas turbine engine systems.

XI.9 Photoelectrochemical System for Hydrogen Generation

Physical Optics Corporation
20600 Gramercy Place, Bldg. 100
Torrance, CA 90501

This project is for an innovative system that will produce hydrogen for fuel cells and other energy applications by splitting water using photoelectric conversion of solar energy.

XI.10 Nanotube Array Photoelectrochemical Hydrogen Production

Synkera Technologies, Inc.
2021 Miller Drive, Suite B
Longmont, CO 80501

This project is focused on developing, validating, and commercializing next-generation nanomaterials that will enable the essentially limitless production of the world's mostperfect energy source–hydrogen–by splitting water via sunlight. Success in this project will represent a key enabling step on the nation's critical path toward achieving a "hydrogen economy."

XI.11 Perovskite Adsorbents for Warm-Gas Removal of Sulfur

Eltron Research & Development, Inc.
4600 Nautilus Court South
Boulder, CO 80301-3241

To utilize coal in non-polluting electric power plants and to produce hydrogen and synthetic fuels, impurities from coal must be reduced to the lowest levels. Scientifically designed sorbents are being developed to enable use of membranes for ultimate purification of hydrogen and for sequestration of carbon dioxide.

XI.12 Nanofiber Paper for Fuel Cells and Catalyst Supports

Inorganic Specialists, Inc.
965 Capstone Dr., Suite 327
Miamisburg, OH 45343

The high cost of fuel cell catalysts like platinum is a major problem for the fuel cell industry. This project will demonstrate how existing commercial fuel cell products can use far less catalyst if they are first modified with a thin layer of inexpensive carbon nanofibers, using a simple process.