XI.0 Small Business Innovation Research (SBIR) Fuel Cell Technologies Office New Projects Awarded in FY 2014

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 $225,000 each for about nine months to explore the feasibility of innovative concepts. Phase II R&D efforts further demonstrate the technologies to move them into the marketplace, and these awards are up to $1,500,000 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 Phase I and Table 2 lists the STTR Phase II projects awarded in FY 2014 related to the Hydrogen and Fuel Cells Program. Brief descriptions of each project follow.

TABLE1. FY 2014 SBIR Phase I Projects Related to the Hydrogen and Fuel Cells Program

	Title	Company	City, State
XI.1	Ionomer Dispersion Impact on Advanced Fuel Cell and Electrolyzer Performance and Durability	Giner, Inc.	Newton, MA
XI.2	Demonstration of a Prototype Fuel Cell-Battery Electric Hybrid Truck for Waste Transportation	US Hybrid	Torrance, CA
XI.3	Demonstration of a Prototype Fuel Cell Electric Truck for Waste Transportation	Vision Motor Corp.	Long Beach, CA
XI.4	Flexible Barrier Coatings for Harsh Environments	GVD Corporation	Cambridge, MA
XI.5	New Approaches to Improved PEM Electrolyzer Ion Exchange Membranes	Tetramer Technologies LLC	Pendleton, SC
XI.6	High-Performance Proton Exchange Membranes for Electrolysis Cells	Amsen Technologies LLC	Tucson, AZ
XI.7	High-Temperature High-Efficiency PEM Electrolysis	Giner, Inc.	Newton, MA

TABLE 2. FY 2014 SBIR Phase II Projects Related to the Hydrogen and Fuel Cells Program

	Title	Company	City, State
XI.8	Optimizing the Cost and Performance of Composite Cylinders for H2 Storage using a Graded Construction	Composite Technology Development, Inc.	Lafayette, CO
XI.9	Novel Structured Metal Bipolar Plates for Low-Cost Manufacturing	Treadstone Technologies, Inc.	Princeton, NJ
XI.10	Cryogenically Flexible, Low Permeability Thoraeus Rubber Hydrogen Dispenser Hose	NanoSonic, Inc	Pembroke, VA

PHASE I PROJECTS

XI.1 Ionomer Dispersion Impact on Advanced Fuel Cell and Electrolyzer Performance and Durability

Giner, Inc.
89 Rumford Avenue
Newton, MA 02466-1311

The project will develop advanced membrane and electrode components that may significantly enhance the durability and performance of proton exchange membrane fuel cells. Enhanced durability and performance will lead to more cost reduction and public acceptance of hydrogen vehicles. The widespread deployment of hydrogen vehicles will relieve the nation's heavy dependence on imported oil and reduce air pollutants.

XI.2 Demonstration of a Prototype Fuel Cell-Battery Electric Hybrid Truck for Waste Transportation

US Hybrid
445 Maple Avenue
Torrance, CA 90503-3807

The fuel cell refuse truck has no emissions, saves 17,000 barrels of imported oil with $4.2M fuel savings over its operational life and has less than three years return on investment. It is cleaner, quieter and friendlier to operate with a fuel cell power plant enabling mobility via renewable energy.

XI.3 Demonstration of a Prototype Fuel Cell Electric Truck for Waste Transportation

Vision Motor Corp.
2230 E. Artesia Blvd.
Long Beach, CA 90805

This project will prototype a Class 8 hydrogen fuel cell electric refuse truck that will be placed in demonstration service with the Santa Monica Publics Works Division in the City of Santa Monica, California. This project aims to measure and demonstrate operational cost effectiveness, emission reduction, and commercial viability of a heavy-duty fuel cell electric vehicle in the refuse service.

XI.4 Flexible Barrier Coatings for Harsh Environments

GVD Corporation
45 Spinelli Place
Cambridge, MA 02138

The project will develop a barrier coating for o-rings and other high-pressure hydrogen seals to prevent hydrogen from permeating the seal even at 200°C and 700 bar. They are partnered with Green Tweed and the Massachusetts Institute of Technology. The new barrier coating will reduce permeability of the seals by 10x compared to the uncoated seal baseline performance.

XI.5 New Approaches to Improved PEM Electrolyzer Ion Exchange Membranes

Tetramer Technologies LLC
657 S. Mechanic Street
Pendleton, SC 29670

Tetramer Technologies, LLC, has developed a new membrane molecular architecture, which has demonstrated equivalent or better performance to the current Nafion® materials under automotive fuel cell conditions at 50% lower cost. These attributes directly address the DOE high electrolyzer cost and performance issues. Key attributes of Tetramer's technology vs. the current Nafion® electrolyzer membranes are improved physical performance properties, 50% lower hydrogen permeability and equal or higher conductivity. This technology will provide thinner membranes which can lower costs and increase performance directly through decreased ionic resistance, and indirectly through the reduction of the overall cell potential. Tetramer's membranes can also provide 50% less hydrogen crossover loss, thus improving the electrolyzer yield and lowering costs.

XI.6 High-Performance Proton Exchange Membranes for Electrolysis Cells

Amsen Technologies LLC
1684 S. Research Loop, Suite 518
Tucson, AZ 85710

This project aims to develop high-performance ion-exchange membranes for proton exchange membrane electrolyzers based on a ternary material system. Such membranes shall have lower hydrogen permeability and higher proton conductivity than the state-of-the-art commercial membranes. Additionally, the new membrane shall have good water transfer capability, high tensile strength, and high stability under high-pressure electrolyzer operating conditions.

XI.7 High-Temperature High-Efficiency PEM Electrolysis

Giner, Inc.
89 Rumford Ave.
Newton, MA 02466

This project is a combined Phase I and Phase II award that will examine different membrane chemistries and additives in an effort to increase electrolyzer efficiency through a novel membrane electrode assembly (MEA). This MEA will be operated at higher than usual temperature and will withstand operation at high differential pressure through the use of this company's proprietary technology. Phase I will consist of fabricating membranes of various chemistries with the goal of increasing high-pressure efficiency. These membranes will be extensively characterized; with the top performers identified by the end of Phase I. Phase II will encompass short-term durability and performance testing of the membranes as electrolysis MEAs in moderate-pressure cells, with tasks for further membrane improvement from data gathered. Phase II ends with long-term durability testing of the top MEAs in multi-cell stack configurations and full (5,000 psi) pressure.

PHASE II PROJECTS

XI.8 Optimizing the Cost and Performance of Composite Cylinders for H2 Storage using a Graded Construction

Composite Technology Development, Inc.
2600 Campus Drive, Suite D
Lafayette, CO 80026-3359

Composite Technology Development will perform detailed design iterations using laminate analysis and finite element analysis to optimize the cost of a 700-bar hydrogen storage vessel using a graded construction (T700 on inside and textile polyacrylonitrile on outside). They will develop a model that incorporates accurate hoop strains with decreased radial/tangential ratios (increased wall thicknesses). They predict a cost savings of at least 25% over the current cost of Type IV 700-bar tanks. Composite Technology Development will also tailor fiber sizing and epoxy matrices that can harness the maximum achievable properties of the low-cost carbon fibers from Oak Ridge National Laboratory. Over the past 5–10 years, Oak Ridge National Laboratory has developed low-cost, textile-polyacrylonitrile funded by the DOE that has been qualified at intermediate strength which is what will be used in this project.

XI.9 Novel Structured Metal Bipolar Plates for Low-Cost Manufacturing

Treadstone Technologies, Inc.
201 Washington Road
Princeton, NJ 08540

The focus of this SBIR project is to develop a low-cost novel structured metal bipolar plate technology for low-temperature proton exchange membrane fuel cells for transportation applications. The innovative metal bipolar plate technique is aimed to meet industry revised performance and cost requirements for metal bipolar plates. This project goes beyond TreadStone's current low-cost metal plate technology that uses a very small amount of gold for low-temperature proton exchange membrane fuel cell applications. It will develop a gold-free metal plate coating technology that meets the revised requirements from industry, including: (i) gold-free coating; (ii) lower electrical contact resistance, and (iii) roll-to-roll coating on stainless steel foil strips, before stamping. In Phase II of the project, TreadStone plans to scale up this technology to roll-to-roll fabrication scale, and demonstrate the technology in a full-size, short stack in automobile fuel cells at Ford Motor. The proposed project is built on three pillars: (1) robust experimental evidence demonstrating the feasibility of our technology, (2) a team that consists of industrial leaders in fuel cell stack application, design, and manufactures; and (3) a low-risk, significant-milestone driven project that proves the feasibility of meeting project objectives. The implementation of this project will reduce the fuel cell stack metal bipolar separator plate cost which accounts 15-21% of the overall stack cost. The gold-free solution will reduce the cost risk associated with the rapid raising gold price of current metal plate technologies. The roll-to-roll processing capability will reduce the capital investment for the corrosion-resistant plate fabrication. In combination, all these improved plate attributes will help the market penetration of in current early stage of fuel cell commercialization.

XI.10 Cryogenically Flexible, Low Permeability Thoraeus Rubber Hydrogen Dispenser Hose

NanoSonic, Inc
158 Wheatland Drive
Pembroke, VA 24136

During Phase II, NanoSonic Inc. will work on developing a safe, reliable, and cost-effective hose for use at hydrogen refueling stations. The hose needs to perform in high pressure and cryogenic temperature environments while maintaining durability and low hydrogen permeability. The proposed technology utilizes NanoSonic's Thoraeus Rubber technology, that is comprised of multifunctional, low-glass-transition-temperature copolymer resins that are modified with alternating layers of nanoparticles with high and low atomic numbers for radiation resistance and electrostatic discharge protection for the hoses. These cost-effective, grounded hoses offer a unique business case in terms of cost savings through reduced replacement and maintenance compared to currently available hose materials. NanoSonic has six partners on the project including the National Renewable Energy Laboratory, Swagelok, and manufacturing partner, New England Wire Technology Inc.