VI.0 Manufacturing R&D Sub-Program Overview

Introduction

The Manufacturing R&D sub-program supports research, development, and demonstration (RD&D) needed to reduce the manufacturing cost of hydrogen and fuel cell technologies and to develop a domestic supplier base. In support of the President's Manufacturing Initiative, as well as the Hydrogen Fuel Initiative and the Advanced Energy Initiative, the manufacturing research and development (R&D) effort will enable the mass production of both supply and end-use technologies (in parallel with technology development) and will foster a strong domestic supplier capability. Activities will address the challenges of moving today's laboratory-produced technologies to high-volume, pre-commercial manufacturing in order to drive down the cost of hydrogen and fuel cell systems. Research will be conducted in coordination with the Department of Commerce and the White House Office of Science and Technology Policy's Interagency Working Group on Manufacturing R&D. An RD&D technology roadmap has been developed with industry to identify critical technology development needs for high-volume manufacturing of hydrogen production, delivery, storage, and fuel cell systems.

In Fiscal Year 2008, six new industry cost-shared manufacturing projects from a 2007 solicitation were initiated in the following areas: novel electrode deposition processes for membrane electrode assembly (MEA) fabrication, high-volume fuel cell leak-test processes, novel assembly processes for low-cost MEAs and stacks, gas diffusion layer cost reductions, and fabrication technologies for high-pressure composite storage tanks.

Goal

Research, develop and demonstrate technologies and processes that reduce the manufacturing cost of hydrogen production, delivery, storage, and polymer electrolyte membrane (PEM) fuel cell systems.

Objectives

- Fuel Cells - Presently, automotive fuel cell stacks are fabricated at low volume and the costs of these stacks is approximately $3,000 per kW. This is 50 times the projected cost of $60 per kW[1] for the same stack technology (2006) at high volume (500,000 units). The projected high-volume cost includes labor, materials, and capital expenditures, but does not account for manufacturing R&D investment. The objective of manufacturing R&D is to enable this factor of 50 cost reduction in automotive fuel cell stacks.
- Hydrogen Storage - The objective of manufacturing R&D is to reduce the cost of making high-pressure carbon composite storage tanks by a factor of nine from 2005 costs.
- Hydrogen Production - The program's target is to reduce capital equipment costs to $580,000 for a daily capacity of 1,500 gallons of gasoline equivalent by 2015. For distributed electrolysis, the program's target for capital equipment cost is $125/kW by 2017. The objective of manufacturing R&D is to reduce the cost of making components and subsystems for distributed electrolysis systems by a factor of seven from 2006 costs.

FY 2008 Technology Status

This sub-program focuses on the manufacture of hydrogen storage and fuel cell technologies that will be needed in the early stages commercialization. Research investments are focused on reducing the cost of components currently used (or planned for use) in existing technologies, as well as reducing the cycle times of the processes being developed. Progress toward attaining the R&D manufacturing goals is measured in terms of the ability of funded research to reduce the cost of producing hydrogen PEM fuel cell technologies, and to increase manufacturing processing rates and annual manufacturing capacity.

---

[1] 2006 TIAX estimate for 80 kW automotive fuel cell systems.

The Multi-Year Research, Development and Demonstration Plan was updated in April, 2007, with estimated status costs for hydrogen production, storage, and PEM fuel cell technologies. The current costs for these technologies are $900/kW in capital costs for distributed electrolysis production, $250/kWh – $350/kWh for a 700 bar gaseous hydrogen storage system, and $3,000/kW for PEM fuel cell stacks fabricated at low volume.

FY 2008 Accomplishments

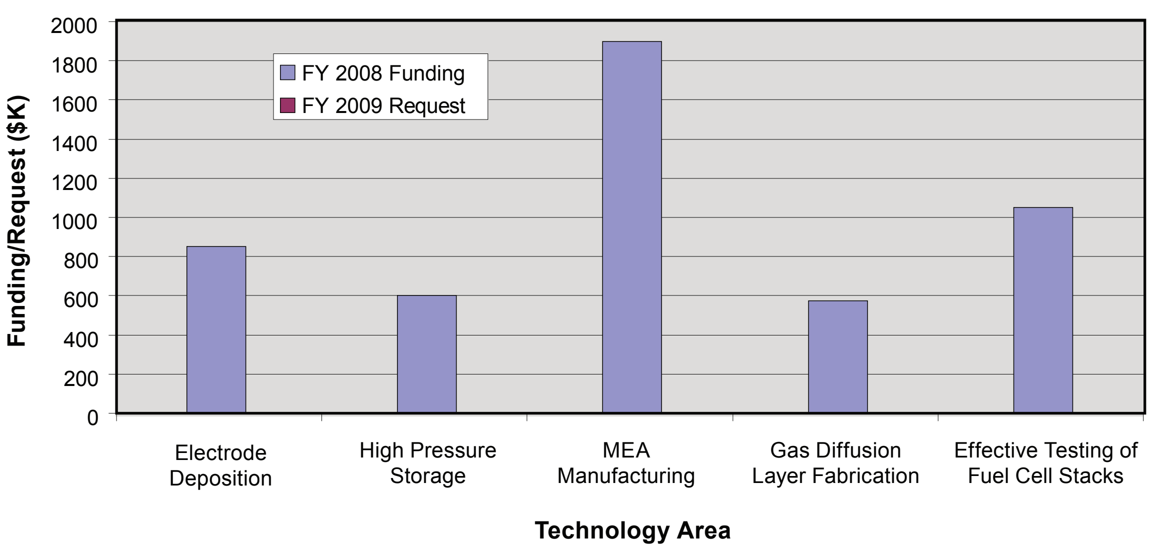
FY 2008 saw a number of advancements in manufacturing for hydrogen storage tanks, fuel cell stacks, and quality assurance. Profile Composites has demonstrated a cycle time reduction for high-rate manufacture of 350 bar carbon composite hydrogen storage cylinders from 7-9 hours to about 30 minutes. Profile Composites achieved this reduction by focusing on fiber and liner design and developing a novel methodology to control fiber wrap. In addition, Profile Composites has demonstrated a path to achieving a 20-minute cycle time.

In addition to Profile Composite's progress in reducing manufacturing process times for hydrogen storage tanks, Protonex Technology Corporation achieved a four-time reduction in fuel cell stack build times. This improvement was made possible by Protonex's development of an adhesion molded stack design coupled with a modular balance-of-plant, which supports injection molding. Protonex has demonstrated the new processes in over 250 stacks and over 30 systems.

While manufacturing process improvements are necessary to achieve the cost gains required, these process improvements must be coupled with lower-cost quality assurance methods. To this end, ASME Standards Technology investigated non-destructive evaluation methods for identifying failures in composite pressure vessels. The most promising technique was modal acoustic emission, which was able to detect defects in the steel liner of a 40-foot, 40-inch diameter composite over-wrapped steel-lined pressure vessel.

Budget

The President's FY 2009 EERE Hydrogen Delivery budget request was $0 to allow for focused efforts on the critical path technologies, i.e. on-board storage and fuel cells.



2009 Plans

New competitively awarded research projects have been allowed to reach a logical decision point in development while R&D focus is shifted to technology development for on-board hydrogen storage and fuel cells.

Peter Devlin
Manufacturing Team Lead
Department of Energy
Hydrogen, Fuel Cells & Infrastructure Technologies
EE-2H, 1000 Independence Ave., SW
Washington, D.C. 20585-0121
Office: (202) 586-4905
E-mail: Peter.Devlin@ee.doe.gov