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Fuel Cells Get Ready for Prime Time Devices for portable applications look the most promising

Lawrence D. Maloney -- *Design News*, March 7, 2005

High energy prices are providing a fresh impetus for development of fuel cells to power everything from cars to laptops to the family home.

Trial versions of fuel cells for notebook computers are going into the field this year, and ABI Research (Oyster, NY) predicts that 13.5 percent of laptops will run on fuel cells by 2012.

In transportation, the Department of Energy has dispensed the first \$350 million of what will be a \$1.2 billion initiative to determine the commercial viability of hydrogen fuel cells for cars by 2015.

And in the worldwide technology race, utility companies in Japan this year are kicking off a widespread program in which citizens—including Prime Minister Koizumi—will rely on fuel cells for the first kilowatt of power in their homes.

Meanwhile, the field has spawned a flurry of start-up companies, as well as new industry alliances to accelerate the movement of research to market. "Technology has advanced to the point that real products are entering the commercialization phase," says Scott Pearson, CEO of Protonex, a fuel cell developer in Southboro, MA.

Portables lead the way



New Partnership: Protonex has teamed up with Parker Hannifin to develop prototypes of 150 and 500W portable generators.

Protonex, for example, is working with the U.S. military on field tests of its hydrogen-air cell. This proton exchange membrane system provides high-performance portable power for GPS equipment, military radios, night-vision goggles, and other military gear. The company notes that a soldier on a three-day mission would have to carry more than 20 lbs of batteries to equal the power of one 5-lb Protonex fuel cell.

In addition, Protonex in 2004 signed a strategic partnership with Parker-Hannifin for joint development of fuel cell. Protonex will supply the fuel cells, while Parker will provide pumps, valves, seals, and manifolds to complete the system. In November, the companies showed the first prototypes from their partnership—150 and 500W portable generators.

Another Massachusetts company—Giner Electromechanical Systems—is supporting General Motors' efforts to develop hydrogen fuel cells for cars, as well as developing its own prototype direct methanol fuel cells (DMFCs). One 150W unit, about the size of a shoe box, can serve either as a battery recharger or a direct power source for such applications as boats and recreational vehicles. The military is also evaluating it. "Activity is heating up in fuel cells," says Lawrence Gestaut, Giner's VP of Technology. "There is an extraordinarily good focus on solving the hurdles to get us over the top."

MTI Micro (Albany, NY) claims to be the first company to commercialize a fuel cell (see *Design News* 01/10/05, <http://rbi.ims.ca/4388-511>). In December, the company began shipping its direct methanol fuel cell (DMFC) as an integrated component within a portable RFID reader manufactured by Intermecc Technologies (Everett, WA). The power pack, which measures just 3 x 3 inches, continuously charges a lithium ion battery. Result: a fivefold increase in running time versus a device powered only by battery.

William Acker, MTI Micro's president, attributes the cell's ability to achieve higher energy density in a compact package to the simplified water management system in its Mobion™ power packs. The system feeds 100 percent methanol directly into the anode side of the cell. This design eliminates the need for micro pumps that carry water from the cathode to the anode in typical DMFCs.

MTI Micro has also developed a smaller 40-cc prototype for smart phones and other consumer electronics. And like Protonex, the company has established strategic alliances with prominent companies. DuPont will supply membrane materials for the cell. Gillette Duracell will handle fuel refills for consumer products, and Flextronics will manufacture the cells.

As Acker sees it, fuel cells will gain an ever increasing share of the market for powering portable electronic devices, which is expected to grow from \$7 billion now to \$10 billion by the end of the decade. Says Acker: "As OEMs add more and more features to cameras, phones, and other devices, the power draw is becoming too great for traditional batteries."

David Kurzman, an analyst with Needham & Co. in New York, agrees that the portable power market, rather than transportation or stationary applications, offers the best opportunities for near-term fuel cell use.

Obstacles to growth

Even with these positive signs, however, the industry faces tough challenges. Carl Pinto, director of product development for Toshiba notebooks, points out that commercial use of fuel cells in laptops hinges on approval of new standards and regulations that would allow the new power sources on passenger planes. The United Nations is already taking up this issue. Still, it could be a long path to approval with the Air Transport Association and the Federal Aviation Administration also needing to pass judgment. On the plus side: CSA America and



Commercial Launch: MTI Micro claims to be the first to market with a methanol cell that continuously charges a lithium-ion battery for an RFID reader. MTI's technology eliminates the pumps found in most DMFC cells and feeds methanol directly into the anode side of the cell.

Underwriters Laboratory announced in December that they will jointly develop and publish a new standard that will set requirements for micro fuel cell systems and cartridges.



Tiny Package: Toshiba has developed an 8.5-gm DMFC for devices as small as digital audio players and headsets for mobile phones.

Meanwhile, Toshiba is pushing ahead in developing fuel cells for consumer electronics. In its Top 50 Awards for 2004, Scientific American named Toshiba and MTI Micro as the business leaders in the energy sector. Among the Toshiba prototypes now in field test is a direct methanol cell that acts as a docking station for a laptop, providing auxiliary power and extending the life of a lithium battery to 10 hrs.

Still another Toshiba prototype, a passive DMFC system with no pumps, weighs only 8.5 gm and is small enough to power an MP3 music player for as long as 20 hrs on a single 2-cc charge of methanol.

Pinto notes that portable fuel cells must still overcome significant obstacles, such as reducing the size of pumps in active DMFC systems by at least 50 percent. The industry must also set up a network of refueling stations for cells. Even so, Pinto believes that lithium ion has very limited potential for advancement and that fuel cells are the next-generation technology.

Outlook for cars and homes

Progress is slower in fuel cells for transportation, but here, too, there are positive signs. Cellex (Vancouver, Canada) has developed a compressed hydrogen system to replace lead-acid batteries in forklifts. The fuel cells run up to twice as long as batteries and require just 7 min of off-floor time for refueling versus a half hour for batteries. Wal-Mart is among the companies doing field tests of the system in its distribution centers.

In automotive, the Department of Energy last year named the companies that will receive the initial round of \$350 million in funds for hydrogen and fuel cell development. Among the companies considered the leaders in transportation: United Technologies, General Motors, and Ballard Systems of Canada.

Mike Rosenberg, treasurer of Ballard, told *Design News* that half of the vehicles in the DOE program will be powered by Ballard cells. The company already has demonstration programs with hydrogen-powered Mercedes-Benz Citaro buses in several European cities, as well as Australia, China, and California. In the next 18 months, Ford and Daimler-Chrysler will add 90 more vehicles to its test fleet, which operate with Ballard hydrogen cells.

Still, hydrogen for transportation faces tremendous challenges, ranging from technical hurdles, such as poor energy density, to establishment of fueling infrastructure. Most experts agree that for propulsion applications to be viable, the industry needs to hit a target of \$50/kW-hr. "We're now about 100 times that," says Gestaut of Giner.

Rosenberg believes, however, that as the industry produces hydrogen cars in high volumes—at least 250,000—this cost target can be met as we near the government's 2015 milestone for demonstrating the viability of hydrogen. He adds, too, that manufacturers will realize substantial energy-efficiency gains from hydrogen, once cars are designed from the ground up for these systems.

The outlook for stationary fuel cell systems is more optimistic. Early in 2005, three utilities in Japan will launch a major program to provide up to 60 percent of the energy needs in a typical home with a 1 kW hydrogen cogeneration system from Ballard. Price per unit is \$10,000 with the government subsidizing half the amount.

With stationary cells seen as an increasingly attractive source of primary or backup power for hotels and college buildings, sales of stationary fuel cells are expected to increase from less than \$200 million now to \$11.4 billion in 2009, according to the Research and Markets organization.

Regardless of the application, fuel cell researchers are confident that continuing high prices for traditional energy sources will make their technologies more viable with every passing year.

Web Resources

//For more information on fuel cells, check out the links below//

Protonex hydrogen PEM fuel cells:
<http://rbi.ims.ca/4388-512>

Giner Electrochemical Systems hydrogen direct methanol fuel cells:
<http://rbi.ims.ca/4388-513>

MTI Micro DMFC technology: <http://rbi.ims.ca/4388-514>

Toshiba DMFC technology: <http://rbi.ims.ca/4388-515>

Cellex hydrogen fuel cells: <http://rbi.ims.ca/4388-516>

Ballard Systems hydrogen fuel cells:
<http://rbi.ims.ca/4388-517>

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