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Practical Fuel Cells for Electronics

A novel design could allow laptops to run 5 to 10 times longer.

By Kevin Bullis

A new scheme for creating a compact device that efficiently converts methanol into hydrogen could make it practical to incorporate fuel cells into laptop computers and other portable electronics. Such a device could allow a laptop to run for 50 hours and be recharged instantly by swapping in a small fuel pack.

Fuel cells powered by methanol or another liquid fuel have long been held up as a solution to the ever-growing energy demands of portable electronics. But fuel cells that convert methanol directly into electricity are bulky. Fuel cells that run on hydrogen gas are much more compact, but the hydrogen, unlike liquid fuel, takes up too much space.

An ideal compromise would be a system that uses a hydrogen fuel cell but stores the hydrogen in liquid form as methanol until just before it's needed. The hydrogen would be freed in a series of steps in a fuel processor that include heating the fuel to vaporize it, heating water for steam reforming, and further reactions for removing carbon monoxide. But the challenge has been to make them both small and efficient.

At last week's American Chemical Society meeting in Boston, Ronald Besser, a professor of chemical engineering at Stevens Institute of Technology, in Hoboken, NJ, described a new system that could solve the problem.

Unlike in previous designs, in which the different processing steps are built into successive flat layers, Besser proposes a cylindrical design in which the layers form concentric tubes. In such a design, heat spreads in all directions from a combustor at the center, facilitating the necessary reactions. To keep each layer at the optimal temperature, he would incorporate aerogels, a relatively new type of insulation. To decrease costs, he's proposing to use advanced plastics for several of the layers.

The fuel processor for generating the 20 watts of power needed for a laptop or a large radio would be 4.8 centimeters in diameter and 10 centimeters long. Adding the fuel cell and fuel storage could mean another 20 centimeters of length, Besser estimates, but the processor would still be small enough to fit in a laptop. Considering the whole package, the system would store about 1,000 watt hours per kilogram; the very best batteries reach only 300 watt hours per kilogram, and laptop batteries can be about half of this. Besser says that such a system could potentially provide 5 to 10 times the amount of energy as a battery.

Jamie Holladay, a research scientist at the Pacific Northwest Laboratory, is optimistic

that the system can work. However, he says that his own research suggests that incorporating a plastic layer may not be possible, since it could deteriorate over time. Instead, it might be possible to use a metal or ceramic outer layer.

A number of research groups at companies and in academic and government labs have developed components for fuel cells that could soon be ready to incorporate into products, although Holladay doesn't expect to see them on the market for at least another two years. (See "Better Fuel Cells for Laptops.") There are still issues to be resolved with the hydrogen fuel cells. For example, such fuel cells produce water as they make electricity, and finding a way to get rid of that water without affecting the surrounding electronics in a laptop is a challenge, he says. What's more, the fuel cells are still expensive. If a fuel-cell system costs three or four times more than a battery, Holladay asks, why not just buy extra batteries for long trips?

And many experts believe that fuel cells will never appear widely in consumer electronics. They doubt that regulators, for instance, will allow passengers to bring flammable liquids on an airplane, even in small amounts and carefully packaged inside the system.

Still, advocates of the technology point to numerous practical applications. Emergency workers with powerful 20-watt radios need energy sources that can work for days or weeks on end without ready access to grid electricity. (See "Printing Fuel Cells.") The military could also be a major customer, using the technology replace batteries.