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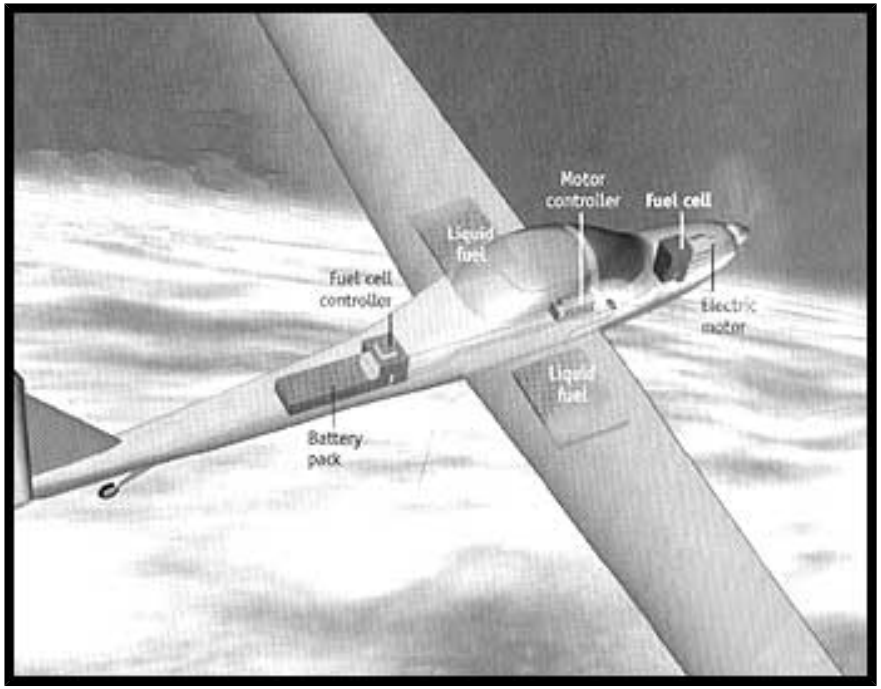

A Boeing-designed test plane may prove that fuel cells could replace gas turbines on jetliners. See story

AROUND THE INDUSTRY

Prototype Could Soon Replace Rechargeable Batteries

U.S. researchers from the Lawrence Livermore National Laboratory (LLNL) have demonstrated a prototype miniature fuel cell which they claim could soon replace rechargeable batteries in cell phones, personal digital assistants (PDAs), laptops, and other portable devices.

Fuel cells are electrochemical energy conversion devices that convert hydrogen and oxygen into electricity and heat. Like batteries, they can be recharged while power is being drawn from them but, instead of recharging using electricity, fuel cells use hydrogen and oxygen.

LLNL's Jeff Morse said that the fuel cell could be cheaper, smaller and contain more energy than any battery or alternative fuel cell technology. "The higher

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energy capacity of such a product will lead to further new classes of personal electronics, such as autonomous sensors and communication devices that are not currently possible with existing battery technologies," he said.

The laboratory's patented method for making thin film fuel cells combines microcircuit processes, microfluidic components and microelectricalmechanical systems (MEMS) technology to provide a lighter, longerlasting power source.

Morse said that the MEMS-based fuel cell power source will replace rechargeable batteries, such as lithiumion and lithiumion polymer, in cell phones, laptops and handheld devices.

LLNL predicted that the fuel cells could cut the use of batteries by 50%, with total savings of more than $2 billion per year.

Energy Visions Announces DMFC Breakthrough

Energy Visions Inc.'s (EVI) fuel cell division recently achieved a major breakthrough in its direct methanol fuel cell (DMFC) program. Experiments with a new electrode design developed in conjunction with Dr. Karl Kordesch at the Technical University of Graz, Austria, show significant improvements in both power and efficiency.

"The new electrode, when used in the advanced configuration of EVI's flowing electrolyte DMFC design, has produced a fuel cell that operates at a higher voltage than PEM-based DMFCs and has several times the power density than our earlier prototypes." says Dr. Douglas James, general manager of EVI's fuel cell division. "We plan to embed this new electrode design in the prototype stack that we expect to demonstrate for the military. We believe this breakthrough places us in the forefront with the very best PEM-based DMFC designs — and with significant headroom for improvement in both performance and cost." The DMFC program is a joint venture between Energy Visions Inc. and the Alberta Research Council, Inc., and is based in Calgary, Canada.

EVI has also completed start-up cycling tests of its pilot production line for the manufacture of its proprietary nickel zinc rechargeable battery system. As the company nears its intended nickel zinc product launch, several battery manufacturers and battery pack producers seeking product samples for evaluation purposes have approached the company. "The multi-billion dollar market for rechargeable batteries is continuing to grow, and we remain confident that our nickel zinc product offering will be able to win market share in the near future." says David J. Trudel, COO and president of EVI's battery division.

Hydrogenics to Supply EC Fuel Cell

The European Commission has chosen Hydrogenics Corp.'s test systems for a new fuel cell laboratory at Petten in the Netherlands, reports The Globe and Mail. The contract, with the EC's Institute for Energy of the Joint Research

Center, is valued at $740,000.

Hydrogenics, based in Mississauga, Ontario, Canada, produces commercial proton exchange membrane fuel cell systems for transportation and stationary and portable power applications.

Hydrogen Reformer Allows Refueling at Gas Station

Ztek Corporation of Woburn, Massachusetts, a leader in the development of solid oxide fuel cell (SOFC) technology, has successfully extracted hydrogen from regular unleaded gasoline using the company's reformer. This breakthrough could revolutionize the fuel cell industry by freeing vehicles from an expensive and heavy on-board reformer. By locating reformers at existing service stations, fuel cell vehicles would be refueled similar to current gasoline-powered cars, requiring little change in consumers' fueling or driving habits.

The reformer extracts hydrogen from gasoline or natural gas and will extract 85% of potential energy from the fuel — many times that of the well-known electrolysis process. The result is a significant reduction in fuel needed to produce the hydrogen. In addition, unlike other reformers, the Ztek reformer does not require any precious metals for its components, greatly reducing costs.

"There is national interest in hydrogen for fuel cells today,"said Dr. Michael Hsu, Ztek's founder and CEO. "This device should make hydrogen easily available to the public driving hydrogen-fueled vehicles. Ultimately, integrating the reformer with our SOFC system will offer station owners a complete power and energy solution."

Reforming methods in use today are incompatible with an increasingly "green" automobile. Electrolysis, a competing process for powering fuel cells, uses electricity to produce hydrogen, reducing, if not eliminating, any positive environmental impact. Other known reforming methods emit greenhouse gases, such as CO_2, directly into the atmosphere.

The reformer allows for separation and sequestration of the carbon dioxide byproduct. "This advance will extend the life of existing fuel resources and dramatically lessen the environmental impact of consuming those fuels," said Dr. S.H. Chan, former dean of the University of Wisconsin School of Engineering and current president of Yuan Ze University in Taiwan.

Ztek is now integrating the components needed to produce pure hydrogen for fueling. Its prepackaged, high-efficiency reformer will be available later this year.

Also, Ztek has been selected as a finalist by the Connecticut Clean Energy Fund to team with The Renewable Resources Group, LLC, of Newington, Connecticut, to receive funding for a demonstration of the company's 25kW (SOFC) system.

Under its proposal, Ztek will manufacture and supply a 25kW integrated SOFC and hydrogen reformer system for the DEP's facility at Dinosaur State Park in Rocky Hill, Connecticut. It will also participate in site preparation and be responsible for system installation, commissioning, and service. The proposal was one of only nine selected as finalists out of 31 submitted.

Professor Ernest B. Yeager Dies

Dr. Ernest B. Yeager, age 77, the Frank Hovorka Professor Emeritus of Chemistry at Case Western Reserve University, died March 8, 2002, in Cleveland, Ohio, after a long struggle with Parkinson's disease.

He was internationally known for his pioneering contributions to the fundamental understanding of electrochemical reactions and to the development of fuel cell and battery technology. During nearly 50 years on the Case Western Reserve faculty, he mentored 80 doctorate students and 45 postdoctoral fellows, authored 270 scientific papers, and edited and co-edited 20 books.

A native of Orange, New Jersey, Yeager considered a career in music and was a talented pianist but decided to pursue mathematics and the sciences. He graduated summa cum laude with his B.A. degree from Montclair State University in 1945. Upon completion of his Ph.D. in chemistry from Western Reserve University in 1948, he joined the faculty of the department of chemistry he served until his retirement in 1990.

In 1976 he founded what in 1994 was rededicated in his honor as the Yeager Center of Electrochemical Sciences, one of the largest university research groups working in electrochemistry in the United States.

In a 1976 Plain Dealer article, Dr. Yeager commented that electrochemistry would play a major role in meeting the nation's energy problems and helping to conserve natural resources. He believed that electric cars would become more common in years to come and that high performance fuel cells and storage batteries would be needed to power them. Much of his research focused on developing these advanced power systems.

During his career he served as president of the Electrochemical Society (1965-66) and the International Society of Electrochemistry (1969-71), and as vice president of the Acoustical Society of America. He also was a consultant to numerous companies, NASA, and the Navy, and won both the Acheson Medal and the Vittoria de Nora Medal from the Electrochemical Society.

Yeager is survived by his brother John F. of Ridgefield, Connecticut; a nephew and a niece; seven grand nieces and nephews; and an aunt and cousins who live in Switzerland.

Memorial contributions may be made to Movement Disorders Research,

Cleveland Clinic Foundation, to further research on Parkinson's disease or to the Ernest B. Yeager Center for Electrochemical Sciences, Case Western Reserve University.

Catalyst Breakthrough Eliminates Platinum

Medis Technologies Ltd.'s subsidiary, More Energy Ltd., has achieved an important breakthrough in developing a catalyst for use on the cathode in its direct liquid ethanol/methanol (DLE/M) fuel cell which no longer requires platinum or other noble metals as a component. This has significant implications for reducing the cost of a fuel cell since platinum is a very costly metal.

"We are pleased with this valuable step forward in the development of a commercially viable fuel cell," said Robert K. Lifton, chairman and CEO of Medis Technologies. "Platinum is already costing over $500 an ounce, and if large fuel cells for cars or power generation reach the market they can be expected to sharply increase the demand and, hence, further increase the price of platinum. We expect that eliminating the use of platinum as a component of the catalyst for the cathode would reduce the cost of making our fuel cell when it comes to market by an estimated 20%. More Energy's scientists are focusing on the elimination of platinum from the catalyst for the anode as well. Our aim is to lower the cost of our fuel cells to a level that makes our product very attractive both in price and performance compared with rechargeable batteries presently used in portable electronic devices."

Medis presented this information at the CIBC World Markets Annual Global Energy Conference in New York City on March 21. It will be archived on the company's website, www.medistechnologies.com, for 90 days.

Canada's Palcan Signs with Shanghai Firm

Palcan Fuel Cell Co.'s chairman, John Shen, reports that the company has signed a development contract with the Shanghai Yung-Qiang Technology Co., a subsidiary of Shanghai Marine Diesel Engine Research Institute ("Engine Co.").

The deal secures both financial and manufacturing support for Palcan and will aid in the development of various hydrogen and air fuel subsystem components. Engine Co. will invest rmb800,000 (approximately Cdn$150,000) to aid with development.

The new components focus on hydrogen storage and air fuel subsystems. Included is a new lightweight container for Palcan's low-pressure metal-hydride storage material and a new proprietary valve to better control the release of hydrogen. The canister will provide a low-cost and efficient means for a host of applications to utilize hydrogen without the cost and risk associated with high-pressure hydrogen storage.

The contract also calls for the development of air fuel pumps, another key component of Palcan's PalPac system requiring high efficiency and low manufacturing cost.

Neah Power Gets Funds for Direct Methanol Fuel Cell

The Seattle Times reports that Neah Power Systems of Bothell, Washington, has received $5 million in its second round of funding from Frazier Technology Ventures of Seattle and Alta Partners of San Francisco, California. The company, co-founded by Leroy Ohlsen (pictured below), is developing a battery-sized direct methanol fuel cell in hopes of replacing lithium-ion batteries in portable electronic devices, such as laptops, mobile phones, and PDAs.

Development began about two years ago with a small amount of Alliance of Angels funding. In February 2001, Neah Power received $1.3 million in its initial round of venture capital. This latest round should enable the company to build its senior management team and continue engineering a fuel cell prototype to show to customers.

Leroy Ohlsen

"It should give us about 12 to 18 months of runway," said Neah Chairman Dan Rosen, co-managing partner of Frazier Technology Ventures.

Along with the financial backing from Alta Partners, Alta's Peter Schwartz is expected to join Neah's board, Rosen said. Schwartz was a member of President Clinton's fuel-cell council.

Fuel cells rely on chemistry, not combustion, using silicon as a base for a methanol reaction that releases several times more energy than lithium batteries. Methanol has substantially more energy content, so fuel cells can last about five times as long, said co-founder Leroy Ohlsen.

"The advantage is, you can take a cartridge of methanol, pop it in, and it's instantly recharged," said Ohlsen, a 27-year-old chemistry graduate from the University of Washington, who leads the engineering work on the fuel cell. "Theoretically, you could see your laptop — which goes about three hours on batteries if you're lucky — go for 14 hours with a fuel cell."

The Bush administration endorsed a plan to support fuel-cell technology by offering tax credits to develop fuel cells. Such high-profile recognition, coupled with volatile fuel prices and recent global political events, have made fuel cells a hot prospect. "It brings more attention to the fuel cell revolution, and we're a part of that," Ohlsen said.

Fuel-cell technology is also considered more environmentally friendly than lithium batteries, said Neah CEO Steve Tallman. Methanol fuel cells emit only water and heat, whereas lithium batteries often end up in a landfill and can explode or catch fire when exposed to moisture.

Though the technology is still in its early stages, Neah Power has submitted worldwide patent applications for its cell and plans to release it on the market by early 2004. The company intends to market its technology to original equipment manufacturers, which include major computer firms, with the aim of giving the consumer the option to use either a fuel cell or a battery.

DuPont Invests $19 Million in Fuel Cell Research

DuPont Canada Inc. will begin developing components for the fuel cell industry and plans to expand its research center with the help of a $19 million investment from Ottawa's federal technology partnerships fund, says The Montreal Gazette.

The chemical and fibers company said that during its four-year research and development program its fuel cell research work force will grow from 27 to more than 80 in the eastern Ontario city of Kingston. If the program is successful, DuPont Canada said it could spend up to $45 million by 2009, with a possible 500 development and production jobs created.

The research will look to develop key components of fuel cells, the first of which is expected to be delivered to the industrial marketplace by this year's third quarter.

New Fuel Cell Company Formed

A new Pasadena, California-based company, Direct Methanol Fuel Cell Corporation (DMFCC), has been formed to commercialize the direct methanol fuel cell technology developed at the NASA/Caltech Jet Propulsion Laboratory (JPL) and the University of Southern California (USC).

DMFCC, Caltech, and USC have signed a letter of intent for DMFCC to acquire rights to 22 issued and 40 pending U.S. and foreign patents, including the original and fundamental patent for using methanol dissolved in water as the fuel. In exchange, Caltech and USC will become equity shareholders in DMFCC and receive a royalty on sales.

DMFCC's chief executive officer, Dr. Carl Kukkonen, was previously director of JPL's Center for Space Microelectronics Technology and Ford Motor Company's expert on hydrogen as an alternative automotive fuel. "Direct methanol has two significant advantages," reports Kukkonen. "First, methanol is a readily available liquid fuel, whereas hydrogen is a gas. Second, our fuel cell uses methanol directly as a liquid in a low temperature system without needing to reform it into hydrogen gas. Therefore, it is well suited to portable and mobile

applications."

Direct methanol fuel cells have been demonstrated at JPL in sizes ranging from 1 watt to 1.4 kilowatts. They replace batteries in some applications, generators in others, and can be the power source for electric vehicles. They are highly efficient, silent, non-polluting power generators that can be used to power a wide variety of devices, such as cell phones, laptops, leaf blowers, and automobiles.

The company is actively seeking investors and strategic partners for its activities. Visit info@dmfuelcell.com for more information.

UTC Signs Development Agreements with Nissan

UTC Fuel Cells, a unit of United Technologies Corp., has signed agreements with Nissan Motor Co. Ltd. to develop fuel cells and fuel cell components for vehicles. Renault, Nissan's alliance partner, is also participating in the projects.

In the first agreement, UTC Fuel Cells will provide fuel cell power plants to Nissan for evaluation, based on the company's proprietary ambient-pressure proton exchange membrane (PEM) fuel cell technology. In the second agreement, UTC Fuel Cells, Nissan, and Renault will work to develop components for fuel cell vehicles.

In addition to its other partnerships, UTC Fuel Cells has developed and produced 5kW fuel cell power plants which provide auxiliary electrical power for prototype Series 7 BMW automobiles. The company is also developing fuel cells for the bus market with partners Irisbus of Europe and Thor Industries of the United States. Prototype buses will be powered by UTC's 75kW ambient pressure power plants.

Synergy Produces Soot-Free Feed for Fuel Cells

Synergy Technologies Corp. of Calgary, Alberta, Canada has successfully reformed each of the five major fossil fuels into free hydrogen and other feeds commonly used as fuel for most types of fuel cells. Most significantly, the company obtained these results while achieving two industry milestones — eliminating the production of soot traditionally associated with heavy fossil fuels reforming, and reducing the power consumption of the reformer system to less than 5%.

In an experimental program recently completed, Synergy's SynGen reformer successfully converted natural gas, propane, gasoline, diesel, and toluene into the hydrogen and other feeds suitable to supply all major types of fuel cells, including the commonly used PEM (proton exchange membrane), SOFC (solid oxide fuel cell), and MCFC (molten carbonate fuel cell). At the same time SynGen eliminated soot production within the feeds, and reduced consumption of the electricity produced by the fuel cell to as low as 2%.

To date, fuel cells have been unable to use the soot-laden feeds created by traditional diesel and other heavy fossil fuels reforming processes. In addition, they have been hampered by a loss of power efficiency resulting from the reformer's partial consumption of the very electricity the fuel cell is producing.

SynGen's cold plasma technology, which reforms fossil fuels with less energy consumption than do competing reforming processes, eliminates soot production and allows for considerably improved power output by the fuel cell.

"We are very excited by these results," said Synergy CEO Barry J. Coffey. "We believe they bring us considerably closer to securing business and product development arrangements with manufacturers of each of the major types of fuel cells."

Synergy will first concentrate on securing such arrangements with fuel cell companies providing solutions for three major markets — the military, flared or vented natural gas fuels, and assorted stationary sites around the world, Coffey said. Initial commercialization of Synergy's SynGen reforming process for fuel cell use is expected to occur "in the near-term," he said.

Fuel Cells May Beat Batteries for Backup

A fuel cell technology by Carlsbad, California-based Metallic Power promises a more economical, space-saving approach to power. The company recently demonstrated a 2.5kW/3kVA backup power source based on a zinc-air fuel cell system.

This technology generates power from zinc pellets and then recovers the zinc internally within the power source for the next cycle of operation. The rack-mounted source operates quietly while producing no emissions. Zinc is nonflammable and benign to humans and the environment. The power source is significantly smaller and lighter than a conventional UPS equipped for similar run-times.

Prototypes have operated up to five hours with an eight-hour run-time expected in the final product. The company has proposed several variations of the power source with varying run-times, and output voltages as well as approximate numbers for size and weight.

The fuel cell's implementation is unique. Using zinc pellets, rather than zinc plates, permits scaling of fuel tanks so power and energy can be scaled independently. One fuel cell design can be the basis for several power sources with different run-times. Zinc pellets are critical for fuel regeneration within the power source and provide a form of zinc that's readily circulated through the fuel cell stack and through the regenerator for conversion from the zinc-oxide byproduct back to zinc.

Compared to lead acid batteries in conventional uninterruptible power supplies

(UPSs), zinc-air fuel cell sources can be made smaller and lighter because the cells offer up to ten times the energy density per kilogram and up to three times the energy per liter.

Susan Connell, marketing communications manager at Metallic Power, says a 3kVA UPS with eight hours of battery backup could occupy 65 inches of rack space and weigh 2,800 pounds. An equivalent fuel cell backup source would require roughly 20 inches of rack space and weigh about 300 pounds.

Metallic Power is seeking testing partners to determine the power sources's optimum configuration. Field testing of the prototypes began early this year, with product introductions expected in 2003.

For more information, contact Barry Eisenberg, (760) 476-8000, or Barry.Eisenberg@MetallicPower.com.

SOFC Power System in Swedish Residences

Fuel Cell Technologies Ltd., subsidiary of Fuel Cell Technologies Corp. of Kingston, Ontario, Canada, has won an international competition to supply and install three SOFC power systems in a progressive residential development project in Stockholm, Sweden, that is focusing on environmental concerns. This represents the company's first sales into the European market of its 5kW SOFC power system.

The installation will be part of a new district in Stockholm where up to 8,000 housing units, largely powered by renewable energies, will include the power systems fueled by biogas. This new district will function as a prototype and as a source of inspiration for ecologically planned construction and living.

The Local Investment Programme (LIP) Council administers the residential fuel cell procurement program for building developers in the City of Stockholm. The aim of the project is for LIP to evaluate pilot installations and, following a short period of operation, issue a contract for commercial installations with the winning supplier(s).

Fuel Cell Technologies' 5kW power systems co-generate electricity and heat for hot water and space heating. They operate with high efficiencies up to 90%, and have low carbon-dioxide emissions and no sulphur emissions. Those operating on biogas in Stockholm will be environmentally friendly and will not produce the polluting air contaminants created by typical combustion generators.

Autotest's Fuel Cell Test Development Expansion

Autotest Company of San Antonio, Texas, is expanding its development of fuel cell testing and measurement applications. Autotest's president and CTO Robert Cox says, "Our systems already offer the ability to test and evaluate the critical

power outputs and QC requirements of fuel cells. We are currently working with automotive industry leaders to develop application-specific systems for the automotive industry."

"Recent developments and emphasis in higher output (150kW to 10kW) fuel cell technology coupled with additional customer interest in our fuel cell business development strategies has encouraged us to accelerate our efforts in the fuel cell industry," adds Michael McGregor, vice president for sales and marketing.

For more information visit www.autotest.com.

Ballard and Ford to Develop Engine Generators

Ballard Power Systems' Electric Drives and Power Conversion Division and Ford Power Products, a subsidiary of Ford Motor Company, have agreed to jointly develop commercial power generation products driven by spark-ignited combustion engines for the generator market.

The main application for the powertrain is generation sets which are often used when power is not available from the electrical distribution grid. This new alternative in power generation has many advantages to the end user, including increased power, lower cost per kilowatt, and reduced emissions. These products will have a considerably lower environmental impact than diesel-powered generators and the same power output at a lower cost. Opportunities also exist for on-road hybrid applications, such as commercial trucks and buses, where the powertrain provides power to electric drive motors, batteries, and other equipment.

Initial products from this joint agreement are expected by the end of this year and will serve the prime power, standby power, and emergency power markets.

Hyperion Catalysis Opens Plastics Technical Center

Hyperion Catalysis International, the world's only tonnage producer of carbon nanotubes, has opened a new plastics technical center at its Cambridge, Massachusetts, headquarters. The company produces multi-walled nanotubes sold under the trade name FIBRIL™.

With the new center, Hyperion can quickly provide development lots of master batches and compounds to better respond to customer requests. The center also will be used to research new polymer compounds and to qualify innovative customer applications. Its resources include compounding and testing equipment, and a staff of scientists and technicians skilled in plastics compounding and electrical/electrostatic materials.

Carbon nanotubes are 10-12nm in diameter — more than 5,000 times thinner than human hair — and 10-15 microns (FM) long. Due to their unusually high aspect ratio (1:1,000+), these submicroscopic tubes provide a highly effective,

electrically conductive network when compounded with non-conductive materials, such as thermoplastics, even at low loadings. Typical usage levels of FIBRIL nanotubes range from 1-5% vs 8-12% for chopped or milled carbon fiber, nickel-coated graphite, or metal fibers, and 8-20% for carbon black.

Hyperion Catalysis has sales offices in Massachusetts, Michigan, California, and Tokyo. Its European sales and marketing office is slated to open in the first half of 2002.

For details, call (617) 354-9678 ext. 2344, fax: (617) 354-9691 or visit www.HyperionCatalysis.com.

Toshiba and Hitachi Develop Mini Fuel Cells

Toshiba Corp. and Hitachi Ltd. have separately developed tiny fuel cells reports, The Nikkei Weekly. Both firms hope to commercialize their product by the end of 2003.

Toshiba's 25mm-thick fuel cell is for use in personal digital assistants, with an output of 8 watts and weighing 500 grams. Using methanol as fuel, it allows 40 hours of operation, five times longer than standard rechargeable lithium-ion batteries. The company is also working on a 5mm-thick cell that could be affixed to the back of a PDA.

Hitachi's fuel cell has been developed for notebook computers and features a continuous operating life of more than ten hours. The company plans to sell cartridges of methanol, the fuel used in the cell, for use in a variety of digital devices.

Both fuel cells directly remove hydrogen by passing methanol through a special membrane, unlike conventional technologies using different tools to remove hydrogen, which makes it difficult to shrink the cells for portability.

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