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Colorado State University Students design and build a zero-emissions vehicle.

AROUND THE INDUSTRY

CSU Students Design, Build Zero-Emission Vehicle

Students on Colorado State University's Vehicle Innovation Team (CSU VIT) are designing, testing and assembling a vehicle that could change the future of the automotive industry – and fuel consumption across the planet. The vehicle, a fuel cell plug-in hybrid electric vehicle operates on a combination of compressed hydrogen gas and electricity.

The team, consisting of 40 Colorado State University faculty and undergraduate and graduate students, is designing and building the car as part of EcoCAR 2. Sponsored by General Motors and the U.S. DoE, EcoCAR 2 requires students to explore a variety of powertrain architectures focusing on electric drive vehicle technology.

"The US Department of Energy, General Motors and CSU have made great investments in these students and it is beginning to really pay off," says Thomas Bradley, faculty advisor for the team. "The innovative designs, outstanding teamwork, and hard work that these students are demonstrating are what make this project an educational and technical success."

Intelligent Energy Reports Highest Power Densities

U.K.-based Intelligent Energy's proprietary fuel cell technology is providing leading levels of power output and performance for a number of its automotive customers, with the company's fuel cell stacks demonstrating continuous volumetric and gravimetric power densities of 3.7kW/L and 2.5kW/kg, respectively.

"We believe that our fuel cell stack technology has achieved industry leading power density performance," says Intelligent Energy's motive division managing director, James Batchelor. "We deliver these benchmark performance levels using our own patented technology which has been designed for high volume, low-cost manufacturing. We provide our technology to existing

clients as they progress towards series production and continue to work with new automotive customers and OEMs under a variety of commercial arrangements."

Intelligent Energy is a global leader in fuel cell design and development, with a range of high performance, compact, cost-effective and scalable technology focused on its target market sectors. In 2012, the company formed a joint venture in Japan with the Suzuki Motor Corp. to manufacture fuel cells for a range of automotive and other sectors. In February of this year, within 12 months of its incorporation, the joint venture, SMILE FC System, announced the completion of the first ready-to-scale production line.

Japan's First Public Hydrogen Refueling Station

Japan's first hydrogen refueling station set up in a non-industrial area for use by the general public opened on April 19 in Ebina, Kanagawa Prefecture.

A joint project of JX Nippon Oil & Energy Corp. and the government-affiliated New Energy and Industrial Technology Development Organization, the hydrogen station was opened next to a conventional gasoline station.

Previously, hydrogen stations were only allowed in industrial areas where there are few private residences. The central government revised related laws last year to allow hydrogen stations in residential areas or places next to conventional gas stations to spread the use of environmentally friendly fuel cell vehicles.

"We want to set up hydrogen stations in at least 40 places by 2015," says Seiichi Isshiki, president of JX Nippon Oil & Energy.

To help reduce costs, the government's regulation reform council plans to relax regulations so that it will become easier to set up liquid-hydrogen stations, which are suitable for transporting and storing large amounts of hydrogen.

Nuvera, Toyota Launch Fuel-Cell Vehicle Program

Nuvera Fuel Cells of Billerica, Massachusetts, has begun a program with Toyota Motor Sales USA Inc. in which Nuvera will operate and maintain two Toyota advanced fuel cell hybrid vehicles at its headquarters.

The two-year program is designed to help build awareness of fuel-cell technology, as well as the benefits of hydrogen as a clean fuel, and the development of hydrogen infrastructure in the Northeast. Nuvera officials say they will use the program to engage with government officials, policy-makers and the general public about the importance of hydrogen-powered cars and of supporting hydrogen infrastructure as a catalyst for economic growth and for meeting the region's zero-emissions vehicle mandates.

The cars will be refueled using Nuvera's PowerTap hydrogen generation and refueling equipment. The company says its PowerTap units are already deployed in industrial settings by material-handling professionals to produce hydrogen for fueling fuel-cell forklift fleets.

Installation of Fuel Cell on Isolated Site in Belgium

Air Liquide recently started up the first hydrogen fuel cell system on an isolated site in Belgium. This solution is an alternative power supply for telecom antennas that

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are located in isolated regions or which are difficult to connect to the power grid. It also allows the reduction of CO_2 emissions.

Since the end of January 2013, the site of the telecoms firm Belgacom, located in Wemmel, in Belgium, has been powered by a fuel cell system developed by Axane (a subsidiary of Air Liquide Group) and distributed in Belgium by Locquet Motors. This solution in Wemmel supplies electricity (230VAC) to a 3G antenna with an average power of 500VA.

To offer its users optimal coverage throughout Belgium, Belgacom sets up antennas in sites that are isolated from the power grid. Awaiting connection to the power grid, these antennas are temporarily powered by generators. Belgacom is now testing fuel cell technology as a way to develop antennas powered by a silent, reliable and high-performance energy supply that could replace these generators.

FUEL CELL PATENTS

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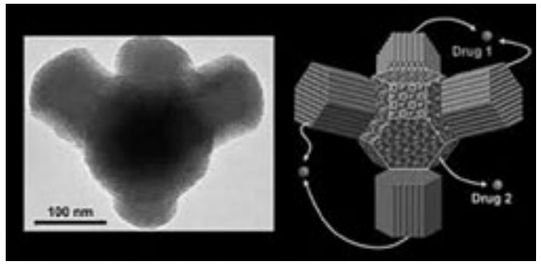
RESEARCH AND DEVELOPMENT

Nano Compartments May Aid Fuel Cell Design

Cornell researchers have created compartment nanoparticles that may carry two or more different drugs to the same target. Meanwhile, the same technology gets applied to fuel cells, where catalysts may be formed into porous structures to expose more surface area.

Ulrich Wiesner, the Spencer T. Olin Professor of Materials Science and Engineering, has tweaked "sol-gel" chemistry used to self-assemble porous silica



The image (left) depicts the core lattice, where catalysts can be placed in compartment pores for targeting in a structure. In the hexagon-shaped cylinder branches, other substances may be place for delivery.

particles, making it shift gears partway through a reaction, and creating what amounts to two or more different nanoparticles joined together.

The starter for the process is a mixture of organosilanes, complex molecules built around carbon and silicon atoms. They assemble a three-dimensional lattice that grows to form particles a couple of hundred nanometers in diameter, filled with pores one or two nanometers in size that could be filled with other material. The shape of the pores depends, among other things, on the pH, or acidity, of the solution.

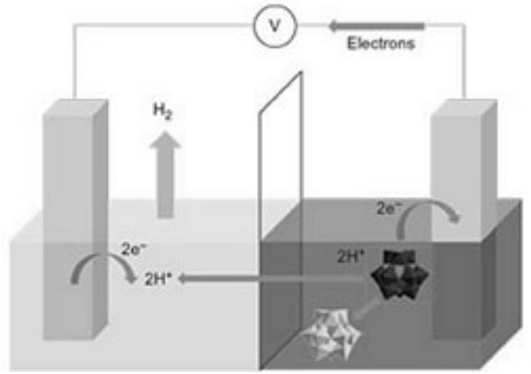
The researchers added ethyl acetate, a chemical that breaks down in water, in the process making the solution more acidic. At first the organisilanes form a lattice of tiny cubes that join into somewhat cubical particles, with rounded corners. As acidity increases, the lattice becomes hexagonal, building a rough cylinder, and hexagon-based cylinders begin to grow out of the faces of the cubes. The number of cylinders and their length can be controlled by the timing of the process and the concentration of ethyl acetate.

Water Splitting Raises Green Hydrogen Hopes

U.K. scientists report that they have developed the first widely-useable electrolysis system that splits water and releases hydrogen and oxygen in separate stages. Lee Cronin and Mark Symes from the University of Glasgow in Scotland used a phosphomolybdate anion buffer to store protons and electrons generated when oxidizing water to oxygen. Instead of directly producing hydrogen, as electrolysis normally does, the buffer lets the scientists choose where and when they do the second step. That could aid efforts to store renewable energy as hydrogen fuel made by water electrolysis.

"Simultaneous hydrogen and oxygen production is a kind of elephant in the room for water splitting," Cronin tells *Chemistry World*. The gases can pass through and degrade expensive Nafion polymer membranes meant to separate them in existing electrolysers, with potentially explosive consequences.

Though electrolysis usually produces oxygen and hydrogen together, two interlinked half-reactions actually generate the gases. The first oxidises water into oxygen, protons and electrons. In the second, electrons reduce the protons to give hydrogen. To separate the reactions, Cronin and Symes sought chemicals that could be reduced and protonated, but could later release those electrons and protons again. They reasoned that the necessary electron-coupled-proton buffer (ECPB) properties might lie within the transition metal and oxygen-containing networks of polyoxometalate anions.



The polyoxometalate can release the protons and electrons later to produce hydrogen on demand © NPG.

"Doing tests where you oxidize water, but make absolutely no hydrogen would seem like failure to most people," Cronin says. "But this was exactly what we were after, as when you reverse the process you get pure hydrogen and no oxygen."

Startup Brings Fuel Cells to the Developing World

A startup company spun off technology developed at Lawrence Berkeley National Laboratory has created a simple, inexpensive way to provide electricity to the 2.5 billion people in the world who don't get it reliably.

Point Source Power's innovative device is based on a solid oxide fuel cell that is powered by burning charcoal, wood or other types of biomass – even cow dung – the types of fuel that many in the developing world use for cooking. The fuel cell sits in the fire and is attached to circuitry in a handle that is charged as the fuel cell heats

Craig Jacobson in the test labs of Point Source Power. (Photo by Julie Chao/Berkeley Lab).

up to temperatures of 700ºC to 800ºC. The handle, which contains an LED bulb, can then be detached and used for lighting or to charge a phone.

Jacobson co-invented the fuel cell in his 13 years as a materials scientist at Berkeley Lab. Working with Steve Visco and Lutgard DeJonghe, both still affiliated with the Lab, their breakthrough was in finding a way to replace most of the ceramics in the fuel cell with stainless steel, a far cheaper and more durable material.

The light bulb in Point Source Power's device, which it calls VOTO, provides longer and better quality light than the kerosene lamps commonly found in developing nations.

PRODUCT NEWS

SFC Energy Generators Available in North America

SFC Energy now offers the EFOY COMFORT series of fuel cell generators for recreational applications to consumers in those countries. EFOY COMFORT is available in three performance classes (80Ah, 140Ah or 210Ah charge capacity per day), with a 15% performance increase over previous generations.

The new EFOY COMFORT series is quieter than its predecessors, thanks to the intelligent use of vibration-absorbing attenuators from the automotive industry. Ease of handling has been further improved with intuitive operation via user-friendly menu navigation, a larger display for greater reading ease, and an expert mode for easy configuration of individual settings such as threshold levels.

In Europe EFOY COMFORT has consistently won top rankings in reader surveys of big motor home publications. Customer satisfaction surveys conducted by SFC Energy show that 93% of their customers would purchase their EFOY devices again.

Visit www.efoy-comfort.com or www.sfc.com.

The Need for Hydrogen-Powered Vehicles

Hydrogen Storage Technology – Materials and Applications provides a sense of urgency about the need to get zero-emission hydrogen fuel cell vehicles on the road and other hydrogen-based power equipment into the marketplace.

Sandia National Laboratories researcher Lennie Klebanoff, the book's editor, co-wrote half the chapters. He was director of the Metal Hydride Center of Excellence, one of three U.S. Department of Energy (DOE) Hydrogen Storage Centers of Excellence dedicated to solving the problem of storing hydrogen on automobiles. The center included 21 partners from industry, academia, and national laboratories from 2005 through 2010. Klebanoff also led a successful effort to develop a fuel cell mobile lighting system.

Technical issues such as the chemistry of hydrogen storage materials, codes and standards, pressure vessels and engineered hydrogen storage systems are addressed in the book. A chapter led by Johnson reviews a recent General Motors/Sandia project that developed the first engineered hydrogen storage bed that could satisfy the fuel demands of real automotive drive cycles. Klebanoff says storage isn't the technical hurdle some believe it to be.

For more information, visit the CRC Press website at http://www.crcpress.com/product/isbn/9781439841075.

ELECTRIC VEHICLES

Toyota 2015 Fuel Cell Vehicle to Cost $50-100K

Chris Hostetter, group vice president of strategic planning for Toyota Motor Sales U.S.A., said that prototype fuel cell vehicles cost about $1 million each when they were developed several years ago. But the cost factor for salable vehicles arriving in 2015 will be in the neighborhood of $50,000, he said.

That likely should place the sticker price of the vehicle under $100,000, Hostetter said at the Fortune Brainstorm Green conference.

Toyota's current fleet of 100 fuel cell beta-test prototypes is based on the Highlander crossover and carry a real-world range of 440 miles. However, the 2015 production vehicle will have a Prius-like silhouette and size, similar to that of the FCV-R concept hatchback unveiled at the 2011 Tokyo Motor Show, Hostetter said.

Hydrogen-Powered Passenger Boat in U.K.

In the U.K., commissioned for the city council's Green Capital initiative, Hydrogenesis is operating 45-minute trips between the Arnolfini and the ss Great Britain.

Keith Dunstan, director of Bristol Hydrogen Boats, says the vessel is the U.K.'s first hydrogen fuel-celled boat. The 36-foot, 12-seat vessel, which cost £225,000 and produces no emissions, is starting a six-month trial in the city docks. It was designed and built by Bristol Hydrogen Boats, a consortium of local ferry operators and Auriga Energy Ltd. "We've been running for a while, trialling it and making sure things are running properly. But I think it's finally ready to go, so we're going to keep our fingers crossed."

Dunstan says a specially commissioned fuel station had been built to create hydrogen to power the ferry. If the scheme is financially viable, he hopes it can be extended with the long-term aim to produce its own hydrogen.

UPCOMING EVENTS

Call for Papers

Deadline: January 15, 2014

Battcon, May 5-7, Boca Raton Resort and Club, Boca Raton, Florida.

Submit a brief abstract describing the proposed paper's main points, conclusion, title and contact information with a biography as a Word file attachment to Michael Salokar at michael.salokar@alber.com.

Contact Michael Salokar, Albercorp, 3103 N. Andrews Ave. Ext., Pompano Beach, FL 33064, (954) 623-6660, or visit www.battcon.com.

Meetings and Symposia

May 6-8 – Battcon, Disney's Contemporary Resort, Lake Buena Vista, Florida.

Noncommercial, technical event for storage battery users from the power, telecom, UPS and other industries. End-users, engineers, battery and battery test equipment manufacturers, installers, and standards and safety experts gather to discuss storage battery innovations and solutions for existing systems; everyday applications; technical advances; and industry concerns. A trade show features storage power related vendors.

Info: Jennifer Stryker, Albercorp, 3103 N. Andrews Ave. Ext., Pompano Beach, FL 33064, (954) 623-6660 ext 23806, or visit www.battcon.com.

May 29-30 – 3rd Israeli Power Sources, Batteries, Fuel Cells, Smart-Grid & EV Conference, Daniel Hotel, Herzelia, Israel.

Brings together participants from leading private and

public companies, start-ups, investors, academics and businesses to discuss batteries, fuel cells, power sources, smart-grid and EVs.

Info: Visit http://www.sdle.co.il.

June 10-12 – Electric Drive Transportation Association Conference and Annual Meeting, Washington Marriott Wardman Park, Washington, DC.

Provides in-depth, leading-edge information to promote the discussion and development of electric drive technology and power sustainable transportation. Includes electric, extended range electric, plug-in hybrids, hybrids and fuel cell vehicles. Ideal for academic, government, and industry leaders interested in the technical, policy and market challenges. Hundreds of exhibits are anticipated. Ride, drive and charge the latest battery, plug-in hybrid, and fuel cell electric drive vehicles, bikes and scooters.

Info: Visit www.electricdrive.org.

June 26-27 – IFBF: The International Flow Battery Forum, O'Callaghan Alexander Hotel, Dublin, Ireland.

Promotes the latest developments in flow battery science, technology, and deployment; and flow batteries as a modern and effective electrical energy source.

Info: Visit www.flowbatteryforum.com.

July 12-15 – Hydrogen and Fuel Cells Conference 2013, Silverado Resort and Spa, Napa Valley, California.

Includes hydrogen production and materials; materials for hydrogen storage; fuel cell research and development; hydrogen and fuel cell applications; and hydrogen safety engineering.

Info: Visit http://www.zingconferences.com/ index.cfm ?page=conference&intConferenceID=109&fSignup=1&CFID =2267227&CFTOKEN=97972260.

September 1-4 – 4th International Microbial Fuel Cell Conference, Cairns, Queensland, Australia.

Organized by Pennsylvania State University (USA), Gwangju Institute of Science and Technology (Korea), and Wageningen University/WETSUS (The Netherlands) and includes all microbial electrochemical technologies.

Info: Visit www.mfc4.com.au.

September 10-13 – 15th Asian Battery Conference, Shangri-La Hotel, Singapore, China.

Industry C-Level executives, marketers, technical staff and sales teams discuss new and emerging technologies, understand future directions, meet new suppliers, conduct business and network with industry peers.

Info: Visit www.conferenceworks.com/au/15abc/.

November 17-20 – EVS27, Gran Via, Barcelona, Spain.

Includes planetary sessions, oral sessions in parallels, poster sessions, exhibition, Ride&Drive, and projects dissemination. See the latest battery, hybrid and fuel cell electric vehicles available on the market, prototypes and infrastructures for the electric vehicles as well as all types of components.

Info: Visit www.evs27.org.

2014

February 3-7 – 14th International Advanced Automotive Battery Conference and Symposia (AABC), Hyatt Regency, Atlanta, Georgia.

Automotive energy-storage scenarios for the development of the market. The LLIBTA Symposium includes advances in materials, cell and pack designs, and analyzes battery performance, durability and safety in new applications.

Info: Carol Chambers, Advanced Automotive Batteries, phone: (530) 692-0140; fax: (530) 692-0142, or visit www.advancedautobat.com.

March 10-13 – 31st International Battery Seminar & Exhibit, Broward County Convention Center, Ft. Lauderdale, Florida.

Ideal for battery and small fuel cell manufacturers, users, OEMs, product designers, component, equipment and material suppliers, applications engineers, marketing analysts, patent attorneys, investors and those interested in the battery and small fuel cell industries.

Info: Thomas M. Devita, Seminar Coordinator, Florida Educational Seminars Inc., 2300 Glades Road, Suite 260W, Boca Raton, FL 33431, phone: (561) 367-0193, fax: (561) 367-8429, or visit www.powersources.net.

May 5-7 – Battcon, Boca Raton Resort and Club, Boca Raton, Florida.

Technical event for storage battery users from various industries. End-users, engineers, battery and battery test equipment manufacturers, installers and safety experts discuss storage battery innovations for existing systems; everyday applications and technical advances.

Info: Jennifer Stryker, Albercorp, 3103 N. Andrews Ave. Ext., Pompano Beach, FL 33064, (954) 623-6660 ext 23806, or visit www.battcon.com.

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