FCT ADVANCED FUEL CELL TECHNOLOGY

Volume 15 Number 8 ISSN: 1095-1415 August 2011

BMW hydrogen storage and distribution center in Spartanburg, South Carolina. See story below.

AROUND THE INDUSTRY

BMW Launches $1 Million Hydrogen Venture

BMW Manufacturing has launched the first phase of an integrated program to validate the feasibility of converting methane collected from the Waste Management's Palmetto Landfill into hydrogen. The first phase of the million dollar, multi-phase project will be funded by SCRA (South Carolina Research Authority).

A collaboration of government energy agencies and other public and private sponsors will work together on future phases. The team will include BMW, Advanced Technology International (a subsidiary of SCRA), the Gas Technology Institute, Ameresco Inc., and the South Carolina Hydrogen and Fuel Cell Alliance.

In September 2010, BMW completed installation of a hydrogen storage and distribution area within the existing energy center at its manufacturing plant in Spartanburg. The company is using hydrogen fuel cells to power nearly 100 material handling vehicles in its new 1.2 million square-foot assembly facility. Success of this new project will allow BMW to transition from the pilot-scale system into a full-scale system capable of supporting one of the largest single-site deployments of fuel cell material handling equipment in the world.

G-TEC Promotes Natural Gas Boosters for R&D

G-TEC Natural Gas Systems (G-TEC) of Buffalo, New York, has received an award from the New York State Energy Research and Development Authority Clean Energy Business Growth and Development Program to promote its line of natural gas pressure booster systems for fuel cell research and development.

The company's pressure boosters elevate standard utility gas pressure as high as 10bar at flow rates up to 236lpm. The G-TEC systems are compact, are installed indoors in the area where high pressure will be used and are 50% less expensive than similar capacity units, requiring outdoor installation on a concrete pad. G-TEC's Pressure Boosters generally do not require complex permitting procedures and are approved by CSA International for reliability and performance.

G-TEC also designs and builds custom natural gas pressure booster systems featuring low parasitic power demand and small size that are incorporated as components in commercial stationary fuel cell products.

"Leading fuel cell companies have purchased G-TEC systems to provide high pressure natural gas for laboratory development," says David Reichard, G-TEC president. "We have designed and delivered custom pressure booster systems for commercial CHP fuel cell systems."

German Government Approves Funding for CFC

Ceramic Fuel Cells Ltd. of Australia, a leading developer of high efficiency and low emission power products for homes and buildings, reports that the German government has formally approved funding for an order of up to 200 ceramic fuel cells integrated power and heat generators from German energy service provider EWE.

The order from EWE is the largest CFC has received,

with total revenue of up to €4.9 million over two years. Part of the funding for the order is being provided by the German government's national hydrogen and fuel cell technology innovation program.

Ceramic Fuel Cells is supplying the core Gennex fuel cell module and related components to its local manufacturing partner, Gebrüder Bruns Heiztechnik GmbH, which is integrating the fuel cell module with a boiler into an integrated power and heating product for supply to EWE.

Nedstack Delivers 1MW PEM Fuel Cell to Belgium

Dutch fuel cell manufacturer Nedstack has transported its first 1MW fuel cell power plant to the Solvay chlorine plant in Lillo, Belgium. This PEM Power Plant – the largest of its type in the world – will convert hydrogen, a by-product in the chlorine industry, into electricity and heat. Chlorine and caustic soda production are highly energy-intensive industries, but the Nedstack PEM Power Plant will enable the SolVin chlor-alkali plant at Antwerp-Lillo to self-generate 20% of its total electricity consumption.

In addition to 1MW of electricity, the Power Plant also produces 1MW of heat, which can be reused in the production process for significant additional cost savings.

The Nedstack 1 MW fuel cell PEM Power Plant being loaded onto the low loader truck, ready to deliver to the Solvay chlorine plant in Lillo, near Antwerp in Belgium.

Nedstack commissioned MTSA Technopower in Arnhem to build the PEM Power Plant.

The Hydrogen Region project, coordinated by WaterstofNet, has an overall budget of €14 million to develop hydrogen knowledge and projects within the Flanders-South Netherlands region.

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AT&T Will Use Bloom Boxes in Data Centers

Telecommunications giant AT&T will install Bloom Energy fuel cells at 11 sites in California, including some of the companies' data centers and network facilities. The company will use Bloom Energy Servers – known as Bloom boxes – to supply 7.5MW at its properties. The Bloom units will be deployed later this year and be operational in early 2012.

The Bloom Box contains an array of fuel cells that can convert air and nearly any fuel source – ranging from natural gas to a wide range of biogases – into electricity via a clean electrochemical process, rather than dirty combustion. Even running on a fossil fuel, the systems are approximately 67% cleaner than a typical coal-fired power plant, according to Bloom.

Each Bloom Energy Server provides 100kW of power in roughly the footprint of a parking space. The company has deployed its units at a lineup of blue-chip customers, including Bank of America, Coca-Cola, eBay, FedEx, Staples and Wal-Mart.

Ceres Power Creates 170 New Jobs

Ceres Power's volume fuel cell manufacturing facility has officially opened in Horsham, Sussex, U.K. The company has created more than 170 highly skilled green collar jobs at the manufacturing facility in Horsham and technology center in Crawley.

As part of the group's plans for a mass market launch of the CHP product in the U.K., the manufacturing facility can be expanded to produce up to 30,000 fuel cell CHP products per year to create additional jobs. There are also further opportunities to export significant volumes of the CHP product globally.

The fuel cell module produced at the facility is integrated within a compact wall-mounted residential CHP product that replaces a conventional boiler and generates almost all of a typical home's electricity. The group has partnered with British Gas to sell, install, service and maintain the CHP product in U.K. homes, offering households a 25% saving on annual total energy costs and reducing CO_2 emissions.

Panasonic Opens European Fuel Cell R&D Center

Panasonic has launched the Panasonic Fuel Cell Development Office Europe (PFCOE) in Langen, Germany. The facility, situated in the company's European R&D center in Germany (PRDCG), will focus on developing residential fuel cells for the European market in close collaboration with European utility companies.

ADVANCED FUEL CELL TECHNOLOGY is published monthly by Seven Mountains Scientific, Inc., P.O. Box 650, 913 Tressler St., Boalsburg, PA 16827, USA; (814) 466-6559, Fax: (814) 466-2777, email: fct@7ms.com, Website: http://www.7ms.com

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Annual subscription rates including First Class or Air Mail postage are: USA, Canada and Mexico: US$120; all other countries: US$155. Pay by Visa, MasterCard, American Express or check written on a bank in the U.S. to: Seven Mountains Scientific, Inc.

Panasonic has been developing residential fuel cells since 1999 and launched the world's first system, the ENE FARM, in May 2009 in Japan. The center in Langen will focus on developing and adapting the fuel cells to reflect the different operational conditions between Europe and Japan. Since the operation of Panasonic's fuel cell depends on the composition of natural gas, it is necessary for the fuel cell to be adapted to European gas conditions.

In Japan, a house powered by an ENE FARM fuel cell can save about 1.5 tons of CO_2 emissions per year compared with a house powered by electricity from a thermal power station and a gas heating system.

Leo Motors Improves ZAFC Generator

Leo Motors of South Korea reports that it has further developed its Zinc Air Fuel Cell (ZAFC) generator with additional innovations which it believes can enhance its efficiency and reduce the size and weight.

First, Leo developed a new type of zinc ball by adding aluminum and magnesium. The new balls react to the air and electrolyte better than existing balls, and should generate electricity more efficiently and effectively.

Leo has also developed a plastic which reduces the generator's size and weight, and a new circulator, which enhances the contact between zinc balls and electrolyte. Thanks to an electrolyte density sensor and electrolyte injector, the new ZAFC generator uses less electrolyte, which accounts for more than 60% of its size and weight. Leo has applied for patents for the new ZAFC technologies.

Fuel Cell Lighting System Featured at Atlantis Launch

A hydrogen fuel cell-powered mobile lighting system was used at Kennedy Space Center as the Space Shuttle Atlantis launched into space last month, the 135th and final mission for the NASA Space Shuttle Program.

The lighting system, sponsored by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy in conjunction with Boeing Co. and developed by Sandia National Laboratories with several industry partners, was deployed to the site of the final space shuttle launch and observed by visitors, shuttle astronauts and members of the international media.

The unit provided lighting in the international press area, and its auxiliary power was used to recharge the camera battery packs for a number of photographers at the event. The NASA mission was one in a series of test sites where the system has been used.

The system features a fuel cell running on pure hydrogen, resulting in zero-emission electrical power. The cell produces electricity for an advanced, power-saving Light Emitting Plasma™ lighting system and additional auxiliary power up to 2.5kW.

Ceramic Fuel Cells MCS Accreditation Update

Ceramic Fuel Cells Ltd. of Noble Park, Victoria, Australia, reports that BRE Global, an independent, third-party approvals organization, has completed the technical assessment of Ceramic's BlueGen Microgeneration Heat and Power (mCHP) product to be certified under the U.K. Microgeneration Certification Scheme (MCS).

The company's submission met all of the requirements under MCS standard MCS015 and is now awaiting final certification from BRE Global.

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Official Gazette, Vol 1367 (June 2011)

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TECHNICAL ARTICLE

Sealing Fuel Cells for Peak Performance

By Sherwin Damdar,
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and
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Manager Business Development & Integration
Pikotek-PSI, Garlock family of companies

There are a number of different types of fuel cells, all of which are based on electrochemical reactions to convert chemical energy from a fuel into electricity. These technologies are frequently defined by the material used for the electrolyte separating the anode and cathode. Two of the most common types are solid-oxide (SOFC) and polymer electrolyte membrane (PEM) fuel cells.

SOFCs are designed primarily for stationary power applications which include distributed generation, providing primary or redundant power for office buildings, hospitals and other large facilities, giving them emergency backup and a degree of independence from the commercial power grid. They also are used as auxiliary power units in truck cabs, RVs and military vehicles and equipment, as well as for residential heat and power. PEMs, by contrast, are designed to provide portable power for automobiles, material handling and other mobile equipment.

The principal advantages of SOFCs are their high efficiency and ability to use a variety of fuels. Their biggest disadvantage is high operating temperatures (500℃-1,000℃; 1,200℉-1,800℉), which require long startup times and can cause corrosion and degradation of cell components. Operating at much lower temperatures (50℃-100℃; 120℉-212℉), PEM fuel cells provide quicker startup, but require costly catalysts and are sensitive to fuel impurities. In both types, individual power-generating modules are stacked to deliver the requisite power for their intended application.

Critical components in these devices are the gaskets used to seal these modules to prevent mixture or leakage of air and fuel, which can adversely affect efficiency. Connections to ancillary components such as burners, pre-heaters and condensers also must be sealed.

Critical Factors

Among the factors to be addressed in gasket selection are temperature, the effects of water vapor, gasket compression, deflection and sealing characteristics, expected service life and maintenance. Unfortunately there are no standards for sealing fuel cells.

Temperature is the first and perhaps most important consideration when evaluating gasket materials. As noted SOFCs have dramatically higher temperature requirements than PEM fuel cells. In addition some materials accommodate thermal cycling better than others.

Non-compressible glass and ceramic materials are commonly used to seal SOFCs. Glass offers the added advantage of being able to have its coefficient of thermal expansion controlled through crystallization. Both of these materials, however, are brittle, rigid and prone to cracking during movements induced by thermal cycling. Compressible seals are a better choice for SOFCs since they remain resilient even at extremely high temperatures (see Figure 1).

Fig. 1 Typical compressible gaskets (from left) mica-, talc- and vermiculite-based materials

Sealing conditions are not particularly challenging with PEM fuel cells as their lower operating temperatures open a wide range of potential options. An adequate level

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of sealing can be achieved using ethylene propylene diene monomer (EPDM), polyurethane or silicone seals. However special attention must be paid to material formulation to assure the gasket will not out-gas, leach into or extract from the cell fluids. These reactions will degrade the seal and compromise cell performance.

The media to be sealed is air and a combination of hydrogen, nitrogen, steam, carbon monoxide and carbon dioxide. Particularly critical gaskets are those that separate the air and fuel intakes, which are subject to long-term exposure to chemical oxidizing and reducing environments. In addition these gaskets must be able to withstand the deflective stresses from the expansion and contraction of cell components with different coefficients of thermal expansion.

Process Compatibility

When evaluating gasket materials for fuel cells, sensitivities to the electrochemical process and corrosion also must be taken into account. The gaskets must not only be compatible with the process, but provide electrical insulation to prevent the drain of current. The constituents of all the materials used in the construction of a fuel cell need to be assessed to determine if they are potentially corrosive to the metallurgy or could alter the fuel or electrolyte membranes. Most elastomeric gaskets, for example, contain sulfur which will form corrosive by-products such as dilute sulfuric acid when it combines with condensed water.

The required life expectancy for fuel cells is generally 40,000 hours, representing 4½ years of continuous service. This is acceptable for the present, but to be economically viable they will have last 8 to 10 years, which means the gasketing will have to last this long as well. In the case of SOFCs this poses a technological challenge due to extremely high operating temperatures.

The effectiveness of a seal is largely dependent on the design of the gasketed joint in which it is installed. Compared with industrial connections that exert stresses of 5,000 psi to 10,000 psi on a gasket, compressive loads on fuel cell joints can be as low as 5 psi. These low loads can make it difficult to seal SOFC joints. Because the gaskets usually contain very little elastomeric content, they require more compressive load to create a seal. Compressive load can be increased by modifying gasket geometry or using an alternate bolting scheme.

Connections should be designed to provide as much compressive load possible. There should be no metal-to-metal contact of the flanges, which can result in leaks if the gasket material creeps due to temperature and thermal cycling. Gasketing for SOFCs should be 20% to 35% compressible with 15% to 20% recovery. These values will facilitate a seal between thin flanges that may deflect when bolted together.

Fuel stack elements and joints to connect ancillary components may not be able to develop high compressive loads, since they do not have the same rigidity as standard pipe or equipment flanges. However internal pressures rarely exceed atmospheric conditions (see Figure 2).

Fig. 2 Typical gasket for auxiliary connection to a SOFC

Predicting Performance

The success of a gasket material for fuel cell applications is linked to the relationship of the compressive stress and the resulting seal tightness (Figure 3a). Stack height can be critical when planning for 30, 60 or more cells. If a gasket will not compress (deflect) within a defined range and maintain a seal, it will compromise cell performance.

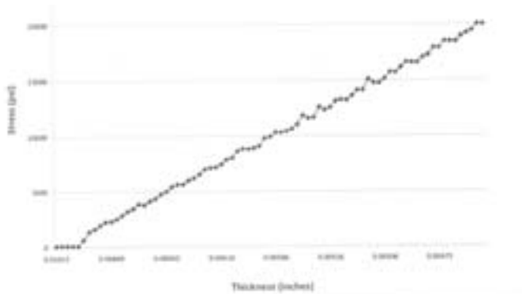

Fig. 3 Compressive load vs. thickness for a talc-based gasket

Fig. 3a Compressive load vs. leakage for a talc-based gasket

For each gasket thickness being evaluated, compression vs. deflection data should be compared. By combining compressive stress vs. seal tightness and deflection, expected performance can be assessed prior to validation in prototype or production units (see Figures 3 and 3a).

Maintenance of key joint components also needs to be considered. Ideally gaskets should not leave a residue on the connection faces, due to the difficulty of removing it in the confined spaces for which many fuel cell assemblies are designed. Even if a gasket is removed intact, it cannot be used again due to plastic deformation which decreases compressibility.

Gasket extracts can affect electrochemical processes or corrode the materials of which the cell is constructed. The constituents of all materials used in fuel cell construction need to be assessed to determine if they are potentially corrosive, or will alter fuel quality, electrolyte or membrane. This type of information is beyond the scope of a material safety data sheet. Rather it calls for the sealing manufacturer to disclose the components and elemental composition of the gasket. This may require a non-disclosure agreement to protect both parties' intellectual property.

A good starting point is for the cell manufacturer to identify the materials and their concentrations that are not desired in the system. For example, there are various grades of natural gas in terms of calorific value and purity. Lower grades and liquefied natural gas can contain high amounts of sulfur, which at elevated temperatures has detrimental long-term effects on metals. This concern is intensified by the fact that most fuel cells are designed to work with all the common grades of natural and liquefied gas.

As noted gasket materials with elastomeric binders may contain leachable sulfur and sulfates up to thousands of parts per million. Trace amounts of other potentially reactive materials in high-temperature fibers and fillers may be incompatible with the exotic custom alloys used in SOFCs or molten carbonate fuel cells (MCFC). In some cases these minute constituents will be published in a specification sheet, but are not the norm for a Material Safety Data Sheet (MSDS).

Moisture Effects

One of the by-products of fuel cell reactions is water vapor. Although seemingly benign, it can degrade gaskets and impair cell performance. That means using a hydrophobic gasket material that will not absorb moisture instead of a hydrophilic one that can even absorb humidity in the air stream. Steam vapor content of less than 5%, typical in high-temperature fuel cells, can be enough to degrade gaskets. If a condenser component fails, moisture levels could increase three to four times, magnifying the problem.

Application Variable	Failure Mode
Temperature excursions	Exceeding a material's temperature limit can oxidize or melt it causing the gasket to degrade, lose compressive load and ultimately fail resulting in high leakage.
Temperature cycling	Repeated thermo-mechanical expansion and contraction of flanges and gaskets can cause joints to loosen and leak.
Joint design	Designs incapable of providing sufficient compressive gasket stress to achieve and maintain a seal will result in leaks and failure.
Media	Not all sealing materials are compatible with hydrocarbon fuels, water, acids and bases. Chemical attack can weaken and dissolve gaskets or causing them to become brittle and crumble. Media that permeates a seal and selectively attacks a component of the material can cause leakage and collapse of the joint.
Pressure and pressure surges	Fuel cell pressures are usually low, but combined with the above factors a pressure surge could push a gasket out of the joint causing a catastrophic leak.

Gaskets can fail for a number of reasons, but the leading cause is insufficient compressive load due to the joint design or improper installation. Below is a summary of application variables and usual failure modes.

The demand for greater fuel cell efficiency and longevity will no doubt continue to increase as the demand for more environmentally friendly, alternative energy sources increases. Sealing these devices for peak performance will play a small but vital role in meeting these demands. Unfortunately gasket selection for fuel cell applications is sometimes an afterthought in the larger development process.

Yet the multiple variables summarized above, and their complex interactions with one another as well as various sealing materials call for a holistic approach to gasket selection.

This is best achieved through close collaboration with sealing manufacturers, even if that means sharing proprietary information that can impact both gasket and fuel cell performance.

References

Article: Chemical interaction between Crofer 22 APU and mica-based gaskets under simulated SOFC conditions, F. Wiener, M. Bram, H.-P. Buchkremer & D. Sebold

Article: Effect of sulfur-containing compounds on fuel cell performance, D. Imamura, E. Yamaguchi, Y. Hashimasa

Article: Sealing Glass-Ceramics for Planar Solid Oxide Fuel Cells, Alexander Fluegel

Article: Filled Glass Composites for Sealing of Solid Oxide Fuel Cells, Sandia Labs

RESEARCH AND DEVELOPMENT

AU Researcher Developing Nanopowder for Fuel Cells

Olivia Graeve, associate professor of materials science and engineering Kazuo Inamori School of Engineering at Alfred University of Alfred, New York, is working on development of a ceramic nanopowder that could lead to better solid-oxide fuel cells.

Solid Cell, Inc., which manufactures stationary and portable solid-oxide fuel cells for residential, commercial and military applications at its plant in Rochester, has kicked off a collaborative project with Graeve to "manufacture ceramic powders for Solid Cell's patent-pending SOFC interconnect."

The goal of the project is to demonstrate the feasibility of replacing traditional ceramic powder synthesis with a low-cost process. The proprietary technology will reduce the time, energy and handling requirements of synthesis, while producing a nanopowder with improved physical properties.

Preliminary results are expected before the end of the summer. Solid Cell says it anticipates that interconnect units fabricated from the nanopowders synthesized at Alfred University could be incorporated into prototype fuel cell units for durability testing before the end of the year.

Through the Center for Advanced Ceramic Technology, which is funded through the Empire State Development Corporation, companies gain access to Alfred University researchers and facilities.

ELECTRIC VEHICLES

Opel Announces 2015 Fuel Cell Vehicle

Recently, the Hungarian Prime Minister and EU Council Chairman Viktor Orbán visited Adam Opel AG in Rüsselsheim to learn about the company's strategy for sustainable mobility. During his visit, Orban met with the Opel management board, took a test drive in the Opel Ampera and visited the plant and the design center, where he viewed future Opel models.

Opel's sustainable mobility strategy is focused on downsized highly efficient combustion engines and the launch of an extended range EV this year. Fuel cell propelled EVs can be commercialized by a 2015/2016 time frame, but progress will depend upon development of a suitable refueling infrastructure.

The three new engine families that play an important role in Opel's model initiative will be built in a new plant in Szentgotthárd, Hungary from December 2012. These are a family of small gasoline engines, one of medium-sized gasoline engines and one of medium-sized diesel engines.

The new engines already fulfill the strict EURO 6 emissions standard of the future and have especially low CO_2 emissions.

Vision Delivers World's First Zero-Emission Truck

In July, Vision Industries Corp. of El Segundo, California, delivered the world's first zero-emission hydrogen fuel cell-electric Class 8 truck to Total Transportation Services Inc. (TTSI), a company that will put the vehicle in the ports of Los Angeles and Long Beach. The effort is part of the ports' Technology Advancement Program, designed to encourage the commercialization of clean goods-movement vehicles and equipment.

Total Transportation Services Inc. (TTSI) will operate the Vision truck under typical short-haul conditions at

the ports for the next 6 months. The vehicle is an electric truck with a battery recharged by a hydrogen fuel cell which generates electricity from a reaction of hydrogen and oxygen. There is no combustion and no air pollution. Pure water is the only by-product

Airbus Studies Fuel Cells for Independent Taxiing

In conjunction with the German Aerospace Centre (DLR), Airbus of Toulouse, France, is researching the efficacy of fuel cell technology for self-directed taxiing. The manufacturer believes the technology is so promising, in fact, that it utilized a fuel cell system to provide backup power for a civil transport aircraft in 2008.

Developing innovative aviation practices is all part of the Advisory Council for Aeronautics Research in Europe's ACARE 2020 initiative, which Airbus supports fully. Some of ACARE's top goals include finding sustainable ways to reduce CO_2 emissions and noise by 50% and decrease NOx emissions by 80%.

UPCOMING EVENTS

Call for Papers

Deadline: September 30

26th International Electric Vehicle Symposium and Exposition, June 3-7, Los Angeles Convention Center, Los Angeles, California.

Submit 750-word maximum abstract describing the proposed paper's main points, conclusion, title and contact information at www.evs26.org.

Contact www.electricdrive.org.

Deadline: October 15

IEEE International Electric Vehicle Conference, March 4-8, TD Conference Center and Clemson University International Center for Automotive Research, Greenville, South Carolina.

Submit brief abstract describing the proposed paper's main points, conclusion, title and contact information at http://electricvehicle.ieee.org/cfp.html.

Contact http://electricvehicle.ieee.org.

Deadline: December 9

19th World Hydrogen Energy Conference 2012, June 3-7, Sheraton Centre Toronto, Ontario, Canada.

Submit 200-word maximum abstract describing the proposed paper's main points, conclusion, title and contact information at http://www.whec2012.com/conference/ call-for-abstracts/.

Contact World Hydrogen Energy Conference 2012, JPdL Conference Secretariat, 1555 Peel St., Suite 500, Montreal, QC H3A 3L8 Canada, phone: (514) 287-1070 ext. 290, or visit www.whec2012.com.

Meetings and Symposia

September 7-8 – National Alliance for Advanced Technology Batteries Conference, Seelbach Hilton, Louisville, Kentucky.

Topics include reuse of electric vehicle batteries; economics of grid-connected, distributed energy storage; new developments in traction batteries and distributed storage systems; and export opportunities for U.S. battery manufacturers.

Info: Jim Greenberger, NAATBatt, phone: (312) 558-0477, email: jgreenberger@naatbatt.org or visit www.naatbatt.org.

September 13-16 – 14th Asian Battery Conference, Hyderabad International Convention Centre, Hyderabad, India.

Promotes a better understanding of the Asian battery industry, encourages mutual co-operation within the region, and provides a forum for the introduction of latest technology and equipment to Asian battery manufacturers.

Info: Visit www.conferenceworks.net/au/14abc/.

September 21-22 – EV Battery Tech USA, Detroit Marriott, Troy, Michigan.

Includes practical solutions from vehicle OEMs for driving down the cost of EV batteries, increasing energy density, range, life cycle and safety.

Info: Visit www.ev-battery-technology.com.

September 21-23 – 16th International Congress for Battery Recycling ICBR 2011, Grand Hotel Excelsior, Venice, Italy.

Includes battery legislation updates; the future of LEU, EHV, PEHV and EV battery systems; Li-Ion battery technology successes; safety issues and transportation regulations; recycling efficiency; the best battery recycling technologies; an exhibit area and recycling plant tours.

Info: Visit www.icm.ch.

October 9-14 – 220th Electrochemical Society Meeting, Westin Boston Waterfront, Boston, Massachusetts.

This international forum explores the latest scientific and technical developments in electrochemical and solid-state science and technology including batteries, fuel cells and energy conversion. Scientists, engineers, and researchers from academia, industry, and government laboratories discuss issues through oral presentations, poster sessions, panel discussions, and tutorial sessions.

Info: The Electrochemical Society, 65 S. Main St., Building D., Pennington, NJ 08534-2839, phone: (609) 737-1902, visit www.electrochem.org.

October 25-27 – The Battery Show, Surburban Collection Showplace, Novi, Michigan.

Focuses on advanced battery technology and provides an opportunity to meet with buyers, designers, scientists, technicians from automotive OEMs, electric utilities, portable electronics manufacturers, and government officials.

Info: Visit www.thebatteryshow.com.

October 31-November 3 – 2011 Fuel Cell Seminar and Exposition, Walt Disney World Swan and Dolphin, Orlando, Florida.

Now in it's 35th year, the seminar covers all aspects of fuel cell R&D, applications, and commercialization. Topics include high temperature research and development; fuel processing; low temperature research and development; hydrogen research and development; fuel cell testing; fuel cell modeling; demonstrations and end-user perspectives; commercialization; and global overviews.

Info: Fuel Cell Seminar & Exposition Headquarters, c/o South Carolina Hydrogen and Fuel Cell Alliance, PO Box 12302, Columbia, SC 29211, phone: (803) 737-8031, fax: (803) 737-0101, or visit www.fuelcellseminar.com.

November 7-8 – Lithium Battery Power, Paris Las Vegas Hotel & Casino, Las Vegas, Nevada.

Includes application-driven lithium development; new lithium chemistries for better electrodes; higher LIB performance; safety, reliability and performance; materials and components; design and integration; nanotechnology in improving power and energy density; and electrode technologies for higher power and energy density.

Info: The Knowledge Foundation, 18 Webster St., Brookline, MA 02446-4927, phone: (617) 232-7400, fax: (617) 232-9171, or visit www.knowledgefoundation.com.

November 9-10 – Battery Safety 2011, Paris Las Vegas Hotel & Casino, Las Vegas, Nevada.

Focuses on application specific battery safety issues affecting performance; degradation and reliability factors; battery management systems; commercial cells evaluation and failure analysis; testing technique and protocol advances; high throughput testing, automation and modeling for better safety; and regulatory issues.

Info: The Knowledge Foundation, 18 Webster St., Brookline, MA 02446-4927, phone: (617) 232-7400, fax: (617) 232-9171, or visit www.knowledgefoundation.com.

November 9-10 – Lithium Battery Power, Paris Las Vegas Hotel & Casino, Las Vegas, Nevada.

Includes application driven lithium battery development; new lithium chemistries for better electrodes and higher LIB performance; technologies for higher safety, reliability and performance; materials and components; system design and integration; nanotechnology in improving power and energy density; and electrode technologies for higher power and energy density.

Info: The Knowledge Foundation, 18 Webster St., Brookline, MA 02446-4927, phone: (617) 232-7400, fax: (617) 232-9171, or visit www.knowledgefoundation.com.

December 1-5 – Hydrogen and Fuel Cells Conference 2011, The Ocean Coral, Puerto Morelos, Mexico.

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 www.zingconferences.com/ index.cfm?page=conference&intConferenceID=79&type=conference.

December 14-16 – EFC11: European Fuel Cell Technology & Applications Piero Lunghi Conference and Exhibition, Fontana Di Trevi Conference Center, Rome, Italy.

Includes materials and fabrication processes; cell, stack system modeling; system and balance of plant design and optimization; lab and field tests and market or real-time applications; fuel processing and non-conventional fuels; and non-conventional fuel cells and niche applications.

Info: Visit www.europeanfuelcell.it.

2012

February 6-10 – 12th International Advanced Automotive Battery Conference and Symposia (AABC), Omni Orlando Resort at ChampionsGate, Orlando, Florida.

Automotive energy-storage experts discuss the technological progress and 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 4-8 – IEEE International Electric Vehicle Conference, TD Conference Center and Clemson University International Center for Automotive Research, Greenville, South Carolina.

Includes innovations in EV energy storage solutions such as battery chemistry, fuel cell, ultra capacitor or battery management systems.

Info: Visit http://electricvehicle.ieee.org.

March 12-15 – 29th 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 6-9 – 26th International Electric Vehicle Symposium and Exposition, Los Angeles Convention Center, Los Angeles, California.

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.

May 15-17 – Battcon, The Westin Diplomat Resort, Hollywood, 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.

June 3-7 – 19th World Hydrogen Energy Conference 2012, Sheraton Centre Toronto, Ontario, Canada.

Features hydrogen and fuel cell applications from companies and research institutions with 1,000 attendees including 300 presenters and 200 poster displays.**fo:** Visit. www.whec2012.com.

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