international association for hydrogen energy
Clean and Abundant Energy for Sustainability

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Breakthrough Energy Coalition is developing new tools to power the world

On November 29, 2015, U.S. President Barack Obama, along with other top global leaders, announced the Mission Initiative, created to dramatically accelerate public and private global clean energy innovation to address global climate change and provide affordable clean energy technologies to consumers including the developing world. Through the initiative, 20 countries are committing to double their respective clean energy research and development investment over five years. The large scale penetration of clean air technologies require investments from governments as well as the private-sector. This led to the creation of the parallel initiative called Breakthrough Energy Coalition (BEC), which was spearheaded by Microsoft founder Bill Gates, and includes over 28 significant private capital investors including some well-known business figures such as Facebook CEO Mark Zuckerburg, Amazon CEO Jeff Bezos, Reliance Industries Limited chairman Mukesh Ambani, and Dangote Group CEO Aliko Dangote.

BEC's mission is rooted in accelerating the development of technology in order to make energy more affordable, reliable and to reduce on carbon use. These goals would help to deter global climate change, galvanize energy independence and help improve the quality of life in impoverished countries.

The need for this coalition in the broader context of the economics that drive technology development is addressed in a statement by the BEC, "The existing system of basic research, clean energy investment, regulatory frameworks, and subsidies fails to sufficiently mobilize investment in truly transformative energy solutions for the future. We can't wait for the system to change through normal cycles."

The primary investment principle of the BEC is to invest early, in order to de-risk progressive technologies that are developed in research labs. This will help to bridge the gap between high-risk research and development stage with traditional capital investments in later stages of the development of novel technologies.

The scope of the sectors the group plans to invest in is very broad, as it is unclear at this point which sector stands to make the most significant gains. Different sectors that are planned for investing include: electricity generation and storage, transportation, industrial use, agriculture, and energy system efficiency.

In a short paper written by Gates coinciding with the formation of the Breakthrough Energy Coalition, he outlined a few promising research opportunities which included flow batteries, solar paint, and solar chemical technology. The solar chemical technology that he reported involves a novel silicon wire array photocathode for an economical water splitting device that is being researched at the California Institute of Technology. Such a device, which uses earth-abundant metals, could make hydrogen generation more economical and a more competitive energy source.

Over the next year the group plans to develop strategies for investing, create a means to facilitate their investments and to expand their community of investors.

Sources:
http://www.breakthroughenergycoalition.com/

https://www.gatesnotes.com/~/media/Files/Energy/Energy_Innovation_Nov_30_2015.pdf?la=en

-By Cyrus Daugherty

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IAHE Objective

The **objective** of the IAHE is to advance the day when hydrogen energy will become the principal means by which the world will achieve its long-sought goal of abundant clean energy for mankind. Toward this end, the IAHE stimulates the exchange of information in the hydrogen energy field through its publications and sponsorship of international workshops, short courses, symposia, and conferences. In addition, the IAHE endeavors to inform the general public of the important role of hydrogen energy in the planning of an inexhaustible and clean energy system.

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Hydrogen Vehicle News

Honda rolls our fuel cell in Japan, to lease 200 first year

Honda Motor Co. President and Chief Executive Takahiro Hachigo speaks during a press conference in the media preview of the Clarity Fuel Cell at the automaker's headquarters in Tokyo, Thursday, March 10, 2016.

Honda has rolled out a new fuel cell vehicle, the first of its kind to be a five-seater. The zero-emissions Clarity may not sell in big numbers, however, given its price tag of 7.66 million yen ($67,000).

Honda Motor Co. said Thursday that its Japan sales target for the first year is just 200 vehicles, all through leasing to government organizations, such as the Environment Ministry, and businesses. Honda declined to identify the businesses.

Tokyo-based Honda says the Clarity will go on sale in California later this year for about $60,000, and will lease for under $500 a month.

In Japan, the monthly leasing cost will vary according to the contract but will likely be about 100,000 yen ($880). Government green subsidies are expected to help defray the cost.

All the world's major automakers are working on fuel cells, which are being used to a limited extent in Japan, mainly through leasing.

They are super-clean, running on the energy created when hydrogen, stored as fuel, combines with oxygen in the air and so emits only water.

Honda, which also makes the Civic sedan, Odyssey minivan and Asimo robot, is a pioneer in fuel cell technology.

Its fuel cell became the first certified by the U.S. Environmental Protection Agency and the California Air Resources Board in 2002.

The new model has a cruise range of 750 kilometers (470 miles) on a full tank, which is at the top for a sedan, according to the Japanese automaker.

Honda has been able to make its new fuel cell more powerful, and reduce its size, allowing for five passengers, instead of the previous four.

Last month, Honda's president said two-thirds of the company's sales will be zero-emissions, including fuel cells and electric vehicles, hybrids and plug-ins by 2030.

Japanese rival Toyota Motor Corp. started selling its first fuel cell vehicle last year. Volkswagen AG, Hyundai Motor Co., General Motors Co. and Mazda Motor Corp. also have fuel cells in their lineups.

Source: http://phys.org/news/2016-03-honda-fuel-cell-japan-lease.html#jCp

Hyundai delivers first fuel cell vehicle in Ontario

After becoming the first automotive brand in Canada to deliver zero-emissions, hydrogen-powered Tucson Fuel Cell Electric Vehicles (FCEV) to British Columbia families in 2015, Hyundai Auto Canada Corp. extended its leadership with this advanced technology by handing over the keys to a customer in Ontario. On March 10, Joseph Cargnelli, Chief Technology Officer and Co-Founder at Mississauga-based Hydrogenics Corporation, took delivery of his 2015 Tucson Fuel Cell vehicle. The transaction was managed by two Hyundai dealership representatives from Don Valley North Hyundai: Arthur Leung, General Manager, and Ashkan Mavandadi, Sales Consultant.

"I am extremely proud to be Hyundai's first customer in Ontario to [receive] a fuel cell vehicle," said Cargnelli. "Hydrogen-powered fuel cell technology has the incredible potential to revolutionize our world by delivering clean energy to meet our every need; this is especially true when it comes to transportation. By offering the Tucson Fuel Cell [vehicle] to customers, Hyundai is taking a

significant step toward a brighter and cleaner automotive future; I have been eagerly awaiting the opportunity to drive my new fuel cell vehicle and showcase this technology every day."

"Everyone at Don Valley North Hyundai was honored to have the responsibility of delivering the first Tucson Fuel Cell [vehicle] to a customer in Ontario," said Leung. "The Tucson Fuel Cell is the ultimate expression of Hyundai's deep expertise in developing advanced technology through its substantial investment in research and development. By making this next-generation powertrain available to customers, Hyundai is furthering its role as a leader in the eco vehicle space."

In November, 2014, Hyundai Auto Canada announced it would become the first Canadian automotive company to offer its Tucson FCEV to actual, real-world customers. Since the first vehicle delivery took place in February, 2015, six Tucson FCEVs have been delivering thousands of zero-emissions kilometers on the roads of British Columbia. With the expansion to Ontario, the company is further demonstrating the capabilities of FCEV technology and calling for investment in infrastructure development.

"There is no doubt in my mind that fuel cell powertrains are ready for prime-time. We have proven that time and again," said Don Romano, President and CEO of Hyundai Auto Canada. "The Tucson Fuel Cell is exceeding expectations with its versatility, range, ease-of-use, and features. We believe that fuel cells are the future for the automotive industry and Hyundai has shown the technology has matured. The next step facing governments at all levels is investing in a network of hydrogen fueling stations so more customers can enjoy zero-emissions driving."

Hyundai's advanced fuel cell technology effectively replaces the battery pack used in an electric vehicle by generating electricity from an electrochemical process that involves stored hydrogen and oxygen from the atmosphere. The process does not involve hydrogen combustion, and there are no moving parts within the fuel cell stack. The only by-product is pure water vapor, making the Tucson FCEV a zero-emissions electric vehicle. Further, unlike battery electric vehicles, the Tucson FCEV takes less than five minutes to refuel with hydrogen gas and can deliver an estimated 426 km of emissions-free driving.

For more information about the Tucson FCEV, visit www.hyundaihydrogen.ca.

Source: http://www.cbs8.com/story/31447096/hyundai-delivers-first-fuel-cell-vehicle-in-ontario

Hyundai achieves 1 million emissions-free fuel cell vehicle miles in California

Hyundai Tucson Fuel Cell drivers are proving the viability of fuel cell technology by accumulating more than 1,000,000 miles on the roads and highways of Southern California while emitting only clean water and replacing approximately 385 tons of CO2 emissions that would have been emitted from vehicles of similar size.

Mike O'Brien, Vice President, Corporate and Product Planning for Hyundai Motor America said that "breaking the seven-figure consumer mileage barrier gives us new vision into the unlimited zero-emissions potential for Hyundai's fuel cell vehicles." With one eye on the future, O'Brien added "with our growing fleet of hydrogen-powered Tucson fuel cell vehicles accumulating one million miles this quickly, one can only imagine the unlimited potential for a zero-emissions hydrogen vehicle future."

Almost 100 California residents are now driving the Hyundai Tucson (ix-35) Fuel Cell vehicles.

The Hyundai Tucson Fuel Cell SUV uses energy-rich hydrogen fuel to provide a typical driving range of 265 miles between fill-ups. Fuel cell driving range and vehicle performance are minimally affected by either extreme hot or cold ambient temperatures, and can be refilled with hydrogen in less than five minutes, about the same time as a typical petrol or diesel vehicle.

The zero-emission miles are adding up—check out the Hyundai USA 'Hydrogen Milometer' showing how the drivers of the Tucson Fuel Cell are already doing their part to make our world a better place, day after day, mile after zero-emission mile.

Source: http://www.hydrogenlondon.org/news/hyundai-acheives-1-million-emissions-free-fuel-cell-vehicle-miles-in-california/

Hydrogen vs. electric: Which is actually more efficient?

You'd think it would be obvious. If ever an automaker was born to produce an electric car, it should be Toyota. Creator of the original electrified "green" car, the democratizer of the hybrid movement, it would seem a simple hop, skip and jump from Prius to plug-in.

Instead, the world's leading automaker is betting big on hydrogen. Oh, there may yet be a battery-powered vehicle in Toyota's future, but, more than any other manufacturer, it is putting its considerable engineering might behind the hydrogen-powered fuel-cell vehicle (FCV). Pressing the company's commitment to the lighter-than-air fuel, Bob Carter, senior vice-president at Toyota USA, told attendees at this year's Consumer Electronics Show in Las Vegas, "We believe hydrogen can help us contribute to the next 100 years of the automobile."

But with battery-powered electric cars enjoying so much media hype, one has to wonder why Toyota, normally so conservative, would deliberately take such a contrary position. After all, while FCVs are still as rare as hen's teeth, electric vehicles — from the diminutive Mitsubishi i-MiEV to Tesla's tire-squealing Model S — are now part of the automotive mainstream. What does Toyota see that Elon Musk — who famously labelled FCVs "fool cells" — does not?

The issue, of course, is range. Or, more accurately, the reason that consumers — other than hardcore Hollywood environmentalists — are not buying EVs in any sizable number is "range anxiety," the worry one will be stranded miles from home without a way to easily — or at least quickly — recharge the battery. As Toyota vice-chairman (and "father" of the Prius) Takeshi Uchiyamada says, "Because of its shortcomings — driving range, cost and recharging time — the electric vehicle is not a viable replacement for most conventional cars."

What's confusing is that a FCV is, in fact, an electric vehicle. It has an electric motor, its controllers are similar and it emits the same amount of greenhouse gases (none) as an electric car. The difference is that, while an EV is powered by a chemical battery, the FCV uses a replenishable fuel cell as its source of electrons. So, while the battery of a Tesla P85 Model S weighs close to 400 kilograms and needs about 10 hours of charging at home to cover 400 kilometers, the hydrogen fuel tank in Toyota's new Mirai weighs just 88 kilograms and refuels in about the same three minutes it takes to gas up a conventional car.

There are challenges, of course, most notably creating a new refueling infrastructure. Unlike battery-powered EVs, fuel cells can't be recharged at home; they require an infrastructure similar to the one that currently serves our gasoline-fueled mobility. At present, very few stations exist, and even California — one of the strongest proponents of zero-emission vehicles — has only about 15 hydrogen refueling stations.

Even fuel-cell protagonists admit that building a coast-to-coast infrastructure will take time and money, estimates varying from the billions to the many billions. That — if you listen to Mr. Musk — is a much bigger investment than battery-powered vehicles require.

Or is it?

In a simple pump-to-charging-cord comparison, hydrogen loses. Adding a single hydrogen pump to an existing gas station can cost as much as $1.5 million, much more than the $20,000 or so a basic high-output DC charger might cost. In a simple pump-to-cord comparison, hydrogen looks very expensive.

But when you look at how much it's going to cost to produce the kind of infrastructure required to fuel enough zero-emission vehicles to replace our entire fleet of internally combusting automobiles, the equation changes dramatically. According to Colin Armstrong, president and CEO of HTEC (Hydrogen Technology & Energy Corporation), a Vancouver company specializing in hydrogen refueling stations, a roadside station with 12 pumps would cost about $6 million. Meanwhile, Bloomberg Business reports that a Tesla Supercharging station capable of recharging five Model S's at a time costs about $250,000.

But — and this will be a big "but" if we ever do manage to rid ourselves completely of the internal combustion engine — a FCV needs only three minutes at the pump. EVs, even Tesla's vaunted Model S, require 20 or 30 minutes; that means an electric refueling station may require eight to 10 times more superchargers to service the same amount of traffic. Do the math again and, if you're looking

at the cost of a superhighway refueling station, the fuel cell looks like a viable alternative.

As for running costs, experts estimate that 500 km of hydrogen-fueled motoring will cost about US$30, about the same — at current prices — as the same trip in a gasoline-fueled subcompact. That is still, as Tesla owners loudly proclaim, more than the $10 of electricity a modern EV requires for the same trip. More importantly, it's probable that electricity will always be cheaper than hydrogen. Indeed, in the long run, I suspect the battle between battery- and fuel cell-powered vehicles may come down to a simple case of efficiency (EVs) versus convenience (FCVs).

Whatever the obstacles to a hydrogen-fueled future, however, it's impossible to discount the impact of Toyota's commitment. With apologies to Hyundai, General Motors, Mercedes-Benz and others that have all, either past or present, dabbled in hydrogen, this is the company that literally invented the green-car market. Toyota's success in promoting environmentally friendly motoring is simply staggering. Of the nine million hybrids that have been sold since the Prius first hit the market in 1997, more than eight million were built by Toyota, the Prius alone outselling all other EVs, hybrids and plug-ins combined by a factor of three to one. So, when Toyota says it will sell 30,000 hydrogen-powered cars a year by 2020, it's time the entire automotive industry started taking hydrogen seriously.

In 1997, naysayers scoffed — as Mr. Musk and others do today — at Toyota's ambitious plans for its then-revolutionary gas-electric hybrid. Three and a half million Priuses later, no one's scoffing.

Source: http://driving.ca/toyota/mirai/auto-news/news/hydrogen-vs-electric-which-is-actually-more-efficient

Next Hyundai fuel-cell vehicle to be another SUV

The current Hyundai Tucson Fuel Cell was the first of the modern crop of hydrogen fuel cell vehicles to go on sale, and it's also the only one with a crossover utility vehicle body.

As the name suggests, it's a (previous-generation) Tucson fitted with a fuel-cell powertrain.

Now it seems that Hyundai may make its next fuel-cell vehicle a crossover as well, although perhaps on a dedicated platform this time.

Plans for this second-generation model are already in place, and the Tucson Fuel Cell replacement may arrive before the end of the decade, according to British car magazine *Autocar*.

The new model will reportedly target individual consumers more aggressively than the current Tucson Fuel Cell.

Called the ix35 Fuel Cell outside the U.S., most deliveries of Hyundai's hydrogen crossover are to fleets, something that will need to change if fuel-cell vehicles are to gain a meaningful presence in the market.

The second-generation model will reportedly be a similar size to the current Tucson/ix35, but with significant weight reductions.

Back in December, Hyundai and Kia fuel-cell research boss Sae-Hoon Kim said the company's next fuel-cell vehicle would use a dedicated platform.

This would not only make weight reduction easier, but it could also allow for efficiency improvements in other areas by designing the platform around the fuel-cell powertrain.

Kim also said that Hyundai was aiming for a 500-mile range, which probably translates to around 400 miles on the U.S. EPA testing cycle.

That would be a big boost over the estimated 265-mile range of the Tucson Fuel Cell, as well as the EPA-rated 312-mile range of the Toyota Mirai sedan.

Hyundai's Tucson Fuel Cell replacement could also spawn a Kia sister model, which would be that brand's first production fuel-cell vehicle.

Both models are part of the joined Korean carmakers' ambitious green-car expansion plans, which cover not only fuel-cell vehicles but also hybrids, plug-in hybrids, and battery-electric cars.

They encompass continued sales of the Kia Soul EV, and Hyundai Sonata Hybrid and Plug-In Hybrid, as well as the 2017 Kia Optima Hybrid and Plug-In Hybrid.

Then there's the 2017 Hyundai Ioniq hatchback, which will be offered in hybrid, plug-in hybrid, and battery-electric versions.

Last year, the company delivered 54 Hyundai Tucson Fuel Cell vehicles, all in Southern California.

Source: http://www.greencarreports.com/news/1103100_next-hyundai-fuel-cell-vehicle-to-be-another-suv

GM partners with Honda to develop hydrogen fuel cell vehicles

When it comes to innovation, General Motors has tried hard to keep up with the times: it recently purchased Cruise Automation to help with developing its own driverless technology, it is expanding the reach of its OnStar in-vehicle tech, its current plug-in hybrid is winning all kinds of awards, and it is well on the way to delivering the new 2017 Bolt, an affordable long-range battery-powered EV.

One thing that GM hasn't released, though, is a hydrogen fuel cell vehicle. According to GM's Charlie Freese (Executive Director of Global Fuel-Cell Activities), this is basically because fuel cell technology is advancing so quickly that by the time GM got one fuel cell car on the market, it would already be obsolete.

GM doesn't want to give up on FCEVs, though—when Freese made his remarks back in February, GM had taken out more fuel-cell patents since 2002 than any other automaker.

So, you have all of this research and development, but not the ability to produce a fuel-cell car of your own in a timely manner—what do you do?

Well, if you are GM, you partner up with Honda. Honda is currently in the process of starting sales of its Clarity Fuel Cell sedan in Japan, with the highest range among zero-emissions vehicles at 466 miles, and plans to bring the Clarity to California and Europe before the end of the year.

By working together, the two companies aim to lower the cost of producing fuel cell cars to the same level as hybrids over the course of the next nine years. Hopefully for these automakers, the largest obstacle to hydrogen fuel cell vehicles—sparse refueling infrastructure—will be solved (especially since Toyota and Hyundai are also pushing for the EV of the future to get its power from hydrogen).

Source: http://thenewswheel.com/gm-partners-with-honda-to-develop-hydrogen-fuel-cell-vehicles/

Toyota Mirai FCV declared 2016 World Green Car

The Mirai hydrogen fuel cell vehicle from Toyota was named 2016 World Green Car at the New York International Auto Show.

Although the U.S. market Mirai is only available at this juncture in California, and has sold very few, and has detractors saying plug-in cars are the most green, those considerations were not part of the judging.

Rather, the Mirai was culled from eight global vehicles and got the nod after factoring tailpipe emissions, fuel consumption, and use of a major advanced power plant technology (beyond engine componentry) intended to increase the vehicle's environmental friendliness.

Now in its 12th year, the World Car Awards program has previously named the 2010 Toyota Prius "Top Three in the World" for both the World Green Car and the overall World Car of the Year categories.

"Just as Prius changed the world nearly 20 years ago, the hydrogen-powered Mirai is ready to make history," said Bill Fay, group vice president and general manager, Toyota Division. "With a range of over 300 miles per tank, a refueling time of under five minutes, and emissions that consist only of water vapor, Mirai is leading the world forward toward a more sustainable future."

Source: http://www.hybridcars.com/toyota-mirai-fcv-declared-2016-world-green-car/

Hydrogen News of Interest

Carbon leads the way in clean energy: New method uses cheap carbon-based catalyst to deliver energy using hydrogen

Professor Xiangdong Yao and his team from Griffith's Queensland Micro- and Nanotechnology Centre have successfully managed to use the element to produce hydrogen from water as a replacement for the much more costly platinum.

"Hydrogen production through an electrochemical process is at the heart of key renewable energy technologies including water splitting and hydrogen fuel cells," says Professor Yao.

"Despite tremendous efforts, exploring cheap, efficient and durable electro catalysts for hydrogen evolution still remains a great challenge.

"Platinum is the most active and stable electro catalyst for this purpose, however its low abundance and consequent high cost severely limits its large-scale commercial applications.

"We have now developed this carbon-based catalyst, which only contains a very small amount of nickel and can completely replace the platinum for efficient and cost-effective hydrogen production from water.

"In our research, we synthesize a nickel-carbon-based catalyst, from carbonization of metal-organic frameworks, to replace currently best-known platinum-based materials for electro catalytic hydrogen evolution.

"This nickel-carbon-based catalyst can be activated to obtain isolated nickel atoms on the graphitic carbon support when applying electrochemical potential, exhibiting highly efficient hydrogen evolution performance and impressive durability."

Proponents of a hydrogen economy advocate hydrogen as a potential fuel for motive power including cars and boats and on-board auxiliary power, stationary power generation (e.g., for the energy needs of buildings), and as an energy storage medium (e.g., for interconversion from excess electric power generated off-peak).

Professor Yao says that this work may enable new opportunities for designing and tuning properties of electro catalysts at atomic scale for large-scale water electrolysis.

Source: http://www.sciencedaily.com/releases/2016/03/160322080534.htm

Netherlands Green Deal Shares Hydrogen Through Natural Gas Pipeline

For the first time ever, companies have agreed to share hydrogen through an existing natural gas pipeline. Companies *Dow Benelux*, *Yara* and *ICL IP* have agreed to share H_2 through the Netherlands Green Deal Regional Hydrogen program.

According to GasUnie, "*Dow Benelux*, *Yara* and *ICL IP* are planning to exchange hydrogen for industrial applications via the national gas transport network of Gasunie Transport Services.

"The underground transportation via this network provides a sustainable, efficient and safe method to transport hydrogen. To ratify their intentions, Minister Kamp of Economic Affairs and the parties involved signed the Green Deal 'Regional Hydrogen' today."

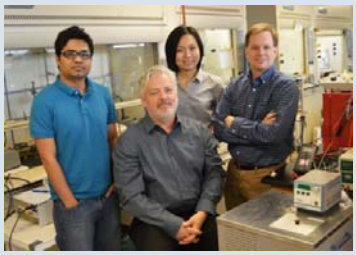
The exchange of hydrogen gas using this method will save 20,000 to 40,000 tons of CO_2, which corresponds to the natural gas consumption of around 3,000 households. The transport of hydrogen via roads and streets is reduced 70 to 80-percent.

The Netherlands is showing the world that transporting hydrogen this way is not only possible and feasible, but practical as well especially if we all wish to work for a greener and cleaner future.

Source: http://www.hydrogencarsnow.com/index.php/hydrogen-fuel-distribution/netherlands-green-deal-shares-hydrogen-through-natural-gas-pipeline/

Hydrogen News of Interest

Proven one-step process to convert CO_2 and water directly into liquid hydrocarbon fuel



A team of University of Texas at Arlington chemists and engineers have proven that concentrated light, heat and high pressures can drive the one-step conversion of carbon dioxide and water directly into useable liquid hydrocarbon fuels.

This simple and inexpensive new sustainable fuels technology could potentially help limit global warming by removing carbon dioxide from the atmosphere to make fuel. The process also reverts oxygen back into the system as a byproduct of the reaction, with a clear positive environmental impact, researchers said.

"Our process also has an important advantage over battery or gaseous-hydrogen powered vehicle technologies as many of the hydrocarbon products from our reaction are exactly what we use in cars, trucks and planes, so there would be no need to change the current fuel distribution system," said Frederick MacDonnell, UTA interim chair of chemistry and biochemistry and co-principal investigator of the project.

In an article published in the Proceedings of the National Academy of Sciences titled "Solar photothermochemical alkane reverse combustion," the researchers demonstrate that the one-step conversion of carbon dioxide and water into liquid hydrocarbons and oxygen can be achieved in a photothermochemical flow reactor operating at 180 to 200^{o} C and pressures up to 6 atmospheres.

The research was supported by grants from the National Science Foundation and the Robert A. Welch Foundation. Wilaiwan Chanmanee, postdoctoral research associate in mechanical and aerospace engineering, and Mohammad Fakrul Islam, graduate research assistant and Ph.D. candidate in the department of Chemistry and Biochemistry at UTA, also participated in the project.

Source: http://www.sciencedaily.com/releases/2016/02/160222220828.htm

Researcher develop miniaturized fuel cell that makes drones fly more than 1 hour

Drones are used for various applications such as aero picturing, disaster recovery, and delivering. Despite attracting attention as a new growth area, the biggest problem with drones is their small battery capacity and limited flight time of less than an hour. A fuel cell developed by Prof. Gyeong Man Choi (Dept. of Materials Science and Engineering) and his research team at POSTECH can solve this problem.

Prof. Choi and his Ph.D. student Kun Joong Kim have developed a miniaturized solid oxide fuel cell (SOFC) to replace lithium-ion batteries in smartphones, laptops, drones, and other small electronic devices. Their results were published in the March edition of *Scientific Reports*, the sister journal of *Nature*.

Their achievement has been highly evaluated because it can be utilized, not only for a small fuel cell, but also for a large-capacity fuel cell that can be used for a vehicle.

The SOFC, referred to as a third-generation fuel cell, has been intensively studied since it has a simple structure and no problems with corrosion or loss of the electrolyte. This fuel cell converts hydrogen into electricity by oxygen-ion migration to fuel electrode through an oxide electrolyte. Typically, silicon has been used after lithography and etching as a supporting component of small oxide fuel cells. This design, however, has shown rapid degradation or poor durability due to thermal-expansion mismatch with the electrolyte, and thus, it cannot be used in actual devices that require fast On/Off.

The research team developed, for the first time in the world, a new technology that combines porous stainless steel, which is thermally and mechanically strong and highly stable to oxidation/reduction reactions, with thin-film electrolyte and electrodes of minimal heat capacity. Performance and durability were increased simultaneously. In addition, the fuel cells are made by a combination of tape casting-lamination-cofiring (TLC) techniques that are commercially viable for large scale SOFC.

The fuel cells exhibited a high power density of ~ 560 mW cm^2 at 550 ^{o}C. The research team expects this fuel cell

may be suitable for portable electronic devices such as smartphones, laptops, and drones that require high power-density and quick on/off. They also expect to develop large and inexpensive fuel cells for a power source of next-generation automotive.

With this fuel cell, drones can fly more than one hour, and the team expects to have smartphones that charge only once a week.

Source: http://www.sciencecodex.com/researchers_develop_miniaturized_fuel_cell_that_makes_drones_fly_more_than_1_hour-177340

Laboratories team to find a replacement for platinum in fuel cells

Researchers from the Argonne National Laboratory and the Los Alamos National Laboratory have begun working together in order to develop less expensive fuel cells. The two organizations are working through the Electrocatalysis Consortium, which was formed by the Department of Energy. The initiative is meant to find alternatives to the platinum used to make fuel cell catalysts. These catalysts are required to ensure that fuel cells operate effectively, allowing electrolysis to take form within a fuel cell energy system.

Automakers want fuel cells to become less expensive

Finding ways to make fuel cells less expensive has become a major priority for those interested in clean transportation. The auto industry has become heavily involved in the fuel cell sector, with several companies having already developed hydrogen fuel cells to power a new generation of clean vehicles. Automakers have found that fuel cells are quite capable of powering vehicles in an effective manner. The problem, however, is that these energy systems are quite expensive due to their use of platinum. This has an effect on the overall price of fuel cell vehicles, making them less attractive to consumers in general.

Platinum makes for very costly fuel cell systems

Approximately half of the total cost associated with automotive fuel cell systems comes from their use of platinum. Researchers from the Argonne National Laboratory and the Los Alamos National Laboratory will work together to find a replacement for platinum, in the near future. Research efforts in other parts of the world have made progress in finding alternatives to platinum, such as nickel and cobalt. These materials are both inexpensive and function in a similar way to platinum, if they are used correctly.

Finding alternatives to platinum has become a priority

Replacing platinum is expected to make hydrogen fuel cells more attractive to those interested in renewable energy. These energy systems are not only being used in the auto industry, of course, and they have been providing electrical power to various industries over the past several years. As they become less expensive, they may see more use in emerging sectors.

Source: http://www.hydrogenfuelnews.com/researchers-aim-to-cut-down-the-cost-of-hydrogen-fuel-cells/8527774/

London Hydrogen Network to showcase fuel cell range in M25 marathon

The London Hydrogen Network Expansion program (LHNE) is set to showcase the benefits and range of fuel cell vehicles with a five day and night marathon around the M25.

The partners of the government-backed London Hydrogen Network Expansion project (LHNE) will attempt to set new records for the longest journey on one tank of hydrogen (existing record 435 miles) and the longest continuous FCEV journey (6,024 miles).

The record attempts, which began on Monday, March 14, are part of the project's efforts to increase awareness of the benefits of hydrogen-fueled cars and their environmental credentials. Hydrogen FCEVs produce no harmful tailpipe emissions with water being the only by-product. With range and refueling times similar to those of petrol or diesel cars, they can be seen as direct replacements for conventional vehicles.

A series of drivers, including members of the media, will take the wheel of a Hyundai ix35 Fuel Cell vehicle which will complete approximately 50 clockwise laps of the M25

between Monday and Friday next week.

LHNE, co-funded by Innovate UK, was set up in 2012 to create the UK's first hydrogen-powered transport system across London and the South East. It has delivered a new publicly-accessible, state-of-the-art fast-fill Smart-Fuel hydrogen refueling station and upgraded a second to the requisite 700 bar pressure status.

Hyundai Motor's ix35 Fuel Cell car has been commercially available since 2014 and, last year, Toyota introduced its Mirai FCEV to the market. Honda, Mercedes, BMW, Volkswagen and Audi are among several manufacturers known to be developing FCEVs to be launched in the coming years.

The LHNE partners are now keen for the adoption of hydrogen fuel cell technology to accelerate in the UK but one of the main challenges is the limited coverage of refueling stations to support the vehicles. There are currently six stations in the UK, including the two public Air Products SmartFuel stations in London and funding is in place for at least 12 to be operational in England and Scotland within the next 12 months.

Diana Raine, European business manager - hydrogen energy systems at Air Products, which has led the LHNE project, said: "The LHNE project is part of a range of hydrogen transport initiatives; many companies, organizations and bodies have been working for several years to establish the foundations of a hydrogen transport system in the UK.

"Although much progress has been made, limited refueling station coverage is one of the main issues restricting further uptake of FCEVs in the UK. A further public-private sector push will be required to move the sector to the next level."

Source: http://www.fleetnews.co.uk/news/environment/2016/03/07/london-hydrogen-network-to-showcase-fuel-cell-range-in-m25-marathon

Linde will be the exclusive provider of hydrogen for upcoming clean transportation event

The Linde Group has announced that it will be the sole supplier of hydrogen fuel for the 2016 Shell Ec0-Marathon. The event is meant to challenge groups of students to develop clean vehicles, pitting them against one another in a race to determine which team has produced the most efficient and environmentally friendly car. Many of these vehicles are likely to be equipped with fuel cells, which have powered efficient cars participating in the event for several years.

Fuel cells are gaining ground in the auto industry

Fuel cells have become quite popular in the transportation space. On the industry-level, automakers are using these energy systems to develop a new generation of cars that produce no harmful emissions. Fuel cell vehicles have yet to attain any degree of commercial success, but automakers are hopeful that these vehicles will eventually beat out their battery-powered counterparts in the near future. In order for this to happen, however, fuel cell technology must be made less expensive and more efficient. Events like the Shell Eco-Marathon are meant to spur innovation.

Linde will manage and show off its hydrogen technology at the Shell Eco-Marathon.

Linde will be managing the hydrogen fuel logistics and provide technical support an infrastructure system that will be used at the event. The company will also be providing advice to teams interested in using fuel cell technology. The event may serve as an occasion for Linde to show off its own hydrogen-based technology and how this technology can be used in the transportation space to make vehicles more environmentally friendly.

Linde Group continues to aid in the development of a hydrogen infrastructure

The Linde Group has played a major role in establishing a comprehensive hydrogen fuel infrastructure in many parts of the world. The company has helped build new fueling stations that make hydrogen more accessible to those

with fuel cell vehicles. This infrastructure is needed in order for fuel cell vehicles to find any degree of success. Indeed, the lack of an infrastructure has made fuel cell vehicles somewhat less attractive to consumers when compared to other clean vehicles.

Source: http://www.hydrogenfuelnews.com/linde-to-supply-hydrogen-fuel-for-the-shell-eco-marathon-2/8527789/

Hydrogen oxidation and evolution reactions in fuel cells slow down because of hydrogen binding

As scientists look for alternative energy sources, fuel cells that operate in a basic environment have garnered much attention. Typically fuel cells require an expensive catalyst, such as platinum. Hydroxide exchange fuel cells involve the movement of hydroxide ions (OH^-) across a polymer membrane. The alkaline environment is conducive to the oxidation and reduction reactions without the need for expensive metals. However, these reactions are quite slow requiring a better catalyst.

In order to make a better catalyst for these fuel cells, Jie Zheng, Wenchao Sheng, Zhongbin Zhuang, Bingjun Xu, and Yushan Yan from the University of Delaware and Columbia University studied the factors that affect the hydrogen oxidation reaction (HOR) and the hydrogen evolution reaction (HER) in a hydroxide exchange fuel cell. Their previous studies showed that the dominant controlling factor in the HOR/HER reactions is hydrogen adsorption on the platinum electrode, i.e., hydrogen binding energy. In this study they determined that the hydrogen binding energy was directly related to electrolyte pH, not metal identity or the metal's oxophilicity. Their work appears in *Science Advances*.

Previous studies have shown that there is some correlation between the hydrogen oxidation reaction, hydrogen binding energy, and electrolyte pH. These factors seemed to be independent of the metal's properties. In this study Zheng, et al. sought to better understand the effect of pH on hydrogen binding energy and how hydrogen binding energy affects the HOR/HER kinetics. They tested this by investigating current densities over a large pH range on carbon-supported platinum-metal nanoparticles (e.g., Pt, Ir, Pd, and Rh).

Using cyclic voltammetry, Zheng, et al. determined desorption peak potentials for deposited hydrogen on each of the supported metal nanoparticles at various pH values. They observed a similar linear correlation for all of the metals in which higher pH lead to a positive shift. The results of this study indicate that there is a generalizable trend between hydrogen binding energy and electrolyte pH that is independent of the metal used.

If pH affects hydrogen binding energy, then does it also affect the hydrogen oxidation and evolution reactions? In order to relate pH to HOR/HER activities, they used a rotating disk electrode and calculated exchange current density. They found that as pH increased, current density decreased, demonstrating that, indeed, higher hydrogen binding energy leads to lower HOR/HER activity.

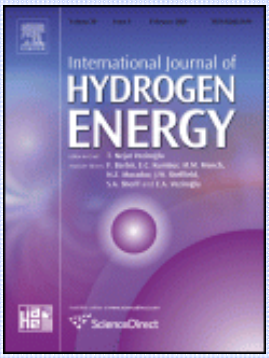
Armed with this data, Zheng, et al. then used mathematical manipulations to generalize the trends between exchange current density and hydrogen binding energy. From these they could calculate the activation energy of the hydrogen oxidation and evolution reactions in 0.1M KOH for all of the metal nanoparticles. Their results verify that the reaction's high activation energy is due to hydrogen binding energy, and therefore, it is the dominant factor in HOR/HER kinetics in alkaline electrolytes.

Finally, their last study looked at whether hydroxide ions played a role in the hydrogen oxidation reaction. Since hydrogen binding to the metal electrode is the key factor in HOR kinetics, Zheng, et al. wanted to determine whether adsorbed hydroxide ions also affected the kinetics. By looking at potentials where carbon monoxide is stripped from the electrode, they were able to deduce that hydroxide likely does not play a key role in HOR/HER activities.

This research provides important insight into why the reaction kinetics is significantly slower in hydroxide exchange fuel cells. The pH apparently affects hydrogen binding energy, which directly affects HOR/HER kinetics. Of particular significance is that this trend holds regardless of the platinum-group metal used. Further research will look into ways to tailor hydrogen adsorption.

Source: http://phys.org/news/2016-03-hydrogen-oxidation-evolution-reactions-fuel.html

International Journal of Hydrogen Energy Highlights



The *International Journal of Hydrogen Energy* provides scientists and engineers throughout the world with a central vehicle for the exchange and dissemination of basic ideas in the field of hydrogen energy. The emphasis is placed on original research, both analytical and experimental, which is of permanent interest to engineers and scientists, covering all aspects of hydrogen energy, including production, storage, transmission, utilization, as well as the economical, environmental and international aspects. When outstanding new advances are made, or when new areas have been developed to a definitive stage, special review articles will be considered. As a service to readers, an international bibliography of recent publications in hydrogen energy is published quarterly.

Most Cited IJHE Articles (past 5 years)

1. **A comprehensive review on PEM water electrolysis.**
   Carmo M, Fritz DL, Mergel J, Stolten D. Int J Hydrogen Energy 2013;38(12):4901–4934.
2. **Nanoscale and nano-structured electrodes of solid oxide fuel cells by infiltration: Advances and challenges.**
   Jiang SP, Int J Hydrogen Energy 2012;37(1):449–470.
3. **Non precious metal catalysts for the PEM fuel cell cathode.**
   Othman R, Dicks AL, Zhu Z, Int J Hydrogen Energy 2012;37(1):357–372.
4. **An overview of hydrogen safety sensors and requirements.**
   Buttner WJ, Post MB, Burgess R, Rivkin C, Int J Hydrogen Energy 2011;36(3):2462–2470.
5. **Hydrogen from renewable electricity: An international review of power-to-gas pilot plants for stationary applications.**
   Gahleitner G, Int J Hydrogen Energy 2013;38(5):2039–2061.
6. **Progress in sodium borohydride as a hydrogen storage material: Development of hydrolysis catalysts and reaction systems.**
   Muir SS, Yao X, Int J Hydrogen Energy 2011;36(10):5983–5997.
7. **Pd–Ni electrocatalysts for efficient ethanol oxidation reaction in alkaline electrolyte.**
   Zhang Z, Xin L, Sun K, Li W, Int J Hydrogen Energy 2011;36(20):12686–12697.

Top IJHE Downloads (Jan. 2016-March 2016)

1. **Hydrogen from renewable electricity: An international review of power-to-gas pilot plants for stationary applications.**
   Gahleitner G, Int J Hydrogen Energy 2013;38(5):2039–2061.
2. **Hydrogen and fuel cell technologies for heating: A review.**
   Dodds PE, Staffell I, Hawkes AD, Li F, Grünewald P, McDowall W, Ekins P. Int J Hydrogen Energy 2015;40(5):2065–2083.
3. **A comprehensive review on PEM water electrolysis.**
   Carmo M, Fritz DL, Mergel J, Stolten D. Int J Hydrogen Energy 2013;38(12):4901–4934.
4. **Metal hydride materials for solid hydrogen storage: A review.**
   Sakintuna B, Lamaridarkrim F, Hirscher M. Int J Hydrogen Energy 2007;32(9):1121–1140.
5. **Study on method of domestic wastewater treatment through new-type multi-layer artificial wetland.**
   Lu S, Pei L, Bai X, Int J Hydrogen Energy 2015;40(34):11207–11214.
6. **Changing the fate of fuel cell vehicles: Can lessons be learnt from Tesla Motors?**
   Hardman S, Shiu E, Steinberger-Wilckens R. Int J Hydrogen Energy 2014;40(4):1625–1638.
7. **Review of the proton exchange membranes for fuel cell applications.**
   Peighambardoust SJ, Rowshanzamir S, Amjadi M. Int J Hydrogen Energy 2010;35

First principle predictions of new crystal structures for hydrogen reservoirs

- Peltzer y Blancá EL. Int J Hydrogen Energy 2016;41(13):5682–5687.

This work explores the capability of metal hydrides to store hydrogen that can produce power as a cleaner energy alternative. The main objective was to investigate elements that could be used in a compound with lithium and hydrogen (to increase the ability of hydrogen storage. Two main requirements for the third element "X" in the compound of type Li-X-H, were that it would have a large gravimetric hydrogen density and that it was a light metal, so that it is readily available. In order to investigate the possible compounds, Full Potential Local Orbital and WIEN2k package codes were used to compute properties of the compound and the crystal structure. After examining many different compounds, it was found that $LiAlH_4$, $LiBH_4$, Li_2BeH_4, and $LiNH_4$ resulted in stable compounds with relatively high gravimetric hydrogen densities. These four compounds still need to withstand thorough investigations to observe how they store hydrogen energy, but the possibilities are certainly present.

http://www.sciencedirect.com/science/article/pii/S0360319915306108

-By Travis Roock

Consumer attitudes to fuel cell vehicles post trial in the United Kingdom

- Hardman S, Chandan A, Shiu E, Steinberger-Wilckens R. Int J Hydrogen Energy 2016; In press.

The widespread deployment of fuel cell vehicles (FCVs) is beneficial due to the societal and environmental benefits. Policy makers are keen to see FCVs taken up by commercial organizations and by consumers as they can help solve the long-standing issues of global climate change, urban air pollution and energy security. Furthermore they have the potential to contribute toward grid power balancing, as any oversupply of power can be stored as hydrogen gas to be later used in a FCV. This is likely to become a problem due to growing market shares of intermittent renewables, predominantly wind and solar in electricity grids.

In order for FCVs to have the biggest impact on these issues they need to be employed in large numbers. First, though, they need to be adopted by consumers. Their acceptance depends on positive consumer attitudes towards the vehicles. Currently there is a limited understanding within the literature on how consumers perceive FCVs and what the likelihood of adoption by consumers would be, despite significant governmental and organizational investments into the technology. Therefore this study assesses consumer attitudes towards FCVs in the United Kingdom. 81 persons drove a Hyundai FCV at the Low Carbon Vehicle Event in September 2015 of which 30 took part in this study. The results show that at present FCVs are perceived mostly as being similar to incumbent internal combustion engine vehicles. This is an admirable technical achievement, however in order for consumers to adopt FCVs they will need to be perceived as having distinctive benefits. Two significant barriers to the adoption of FCVs are observed in this sample: high costs and lack of refueling infrastructure. This paper goes on to make suggestions on how and which beneficial attributes of the vehicles can be promoted to consumers and also makes suggestions on how the barriers can be overcome so that FCVs will be adopted by consumers.

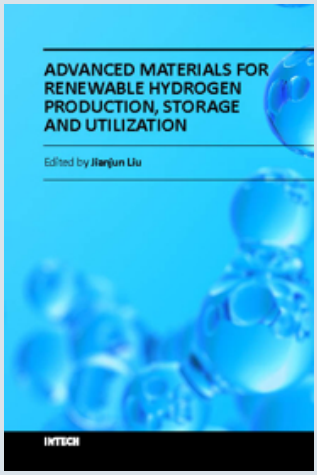
http://www.sciencedirect.com/science/article/pii/S0360319915314336

-By Yasser Ashraf Gandomi

From the Bookshelf

Advanced Materials for Renewable Hydrogen Production, Storage and Utilizaton

-Edited by Jianjun Liu



This open access book is available as a free electronic download from the publisher, and it focuses on the progress of three main areas of hydrogen energy: production, storage, and utilization. The main purpose of this book is to present developments in high-performance materials and their chemical and physical properties as they relate to hydrogen energy. The first topic covered is an investigation of InSe- and GaSe-layered crystals intercalated with hydrogen and hydrogen-containing molecules for various hybrid layered structures. Chapter 3 then discusses the potential of ammonia borane and its derivatives as potential energy storage mediums because of their high hydrogen gravimetric density and dehydrogenation properties. The final two chapters present modelling efforts to investigate the fundamental properties of hydrogen. The first, of the final chapters, used COMSOL Multiphysics to simulate the influence of operating parameters on the rate of adsorption-desorption in metal hydrides for on-board hydrogen storage technologies. The text concludes with an investigation of hydrogen bonds and their interactions in protein folding simulations and illustrates the necessity of polarization effect in such simulations. Overall, this book stresses the importance of advanced materials for hydrogen production and storage to ensure sustainable energy sources for the future.

http://www.intechopen.com/books/editor/advanced-materials-for-renewable-hydrogen-production-storage-and-utilization

-By Travis Roock

**Have a book suggestion for a review in an upcoming issue of the IAHE newsletter? Send suggestions to Kathy Williams at williamk@utk.edu.*

Become a Member of IAHE

The International Association for Hydrogen Energy (IAHE) has four categories of membership:

- **H-Members:** Scientists, engineers, and laypersons who are interested in fields relating to Hydrogen Energy. They receive IAHE e-Newsletter, hard copies of the International Journal of Hydrogen Energy (IJHE), and reduced registration for IAHE conferences.
- **E-Members:** Scientists, engineers and laypersons who are interested in fields relating to Hydrogen Energy. They receive IAHE e-Newsletter, access to electronic copies of the International Journal of Hydrogen Energy (IJHE), and reduced registration for IAHE conferences.
- **Student Members:** They are students who are interested in hydrogen energy. They receive the IAHE e-Newsletter. The student membership is free.
- **IAHE Fellows:** Long-time IAHE members who have significantly impacted society by promotion of Hydrogen Economy through research, education and/or service.

If you are interested in becoming a member of IAHE, please visit the membership page at www.iahe.org. You can sign up for membership directly on the membership page.

Featured Research Group

International Institute for Carbon-Neutral Energy Research

The World Premier International Research Center Initiative (WPI) was launched in 2007 by the Japanese government's Ministry of Education, Culture, Sports, Science and Technology (MEXT) with the goal of building within Japan "globally visible" research centers that maintain a very high research standard and outstanding research environment in order to attract top-tier, internationally-recognized researchers from around the world.

In 2007, 5 WPI Centers were established throughout Japan: AIMR (Advanced Institute for Materials Research), Kavli IPMU (Kavli Institute for the Physics and Mathematics of the Universe), iCeMS (Institute for Integrated Cell-Material Sciences), IFReC (Immunology Frontier Research Center), and MANA (International Center for Materials Nanoachitectonics).

In 2010, I^{2}CNER (International Institute for Carbon-Neutral Energy Research) became the sixth WPI Center. The I^{2}CNER Center at the University of Illinois at Urbana-Champaign is the Satellite Institute of the International Institute for Carbon-Neutral Energy Research (I^{2}CNER) located at Kyushu University in Fukuoka, Japan. The advancement of low carbon emission and cost effective energy systems, and improvement of energy efficiency are among the main objectives in this center. The array of technologies that I^{2}CNER's research aims to enable includes Solid Oxide Fuel Cells (SOFCs), Polymer Membrane based fuel cells, biomimetic and other novel catalyst concepts, and production, storage, and utilization of hydrogen as a fuel. There are several cutting edge research projects are being conducted at I^{2}CNER that in the following, two important topics are highlighted.

Hydrogen Storage

The research in this division aims at developing new carrier materials for hydrogen mobile and stationary storage, as well as for hydrogen delivery. For mobile hydrogen storage, the material based storage system must meet the needs of hydrogen fuel cell vehicles in terms of volume, weight percent hydrogen, cost, fast charging and discharging, and durability with high well-to-wheel energy efficiency. Hydrogen delivery systems based on hydrogen-absorbing materials are focused on cost effective truck transport of large amounts of hydrogen. Material based stationary hydrogen storage applications must be more cost effective and energy efficient than conventional pressurized gaseous hydrogen storage or uniquely meet particular requirements of specific stationary applications.

The unique, important accomplishments of this division are: demonstration of the microscopic degradation mechanisms in certain hydrogen storage materials; development of advanced materials synthesis methods to advance the performance of other hydrogen storage materials; and the discovery of a method that greatly enhances the performance of a third hydrogen storage material and opens an entirely new range of materials and approaches to hydrogen storage.

Thermal Science and Engineering

The objective of this division is to enable the most effective use of materials in carbon-neutral energy technologies and to improve the energy efficiency of thermal processes by expanding the knowledge of material thermophysical properties and thermal science and engineering.

More specifically, research in the division aims at: expanding the knowledge-base of the thermophysical properties of hydrogen and alternative refrigerants to enable their most efficient uses to reduce CO_2 emissions; improving the understanding of the basic science of heat and mass transfer to enable the development of more efficient energy systems; and researching new thermal energy heat pump refrigeration systems focused on the use of waste heat and new refrigerants for improved overall energy efficiency and reduced CO_2 emissions.

For more information on this research group, visit http://i2cner.illinois.edu/.

-By Yasser Ashraf Gandomi

INTERNATIONAL CONFERENCE ON HYDROGEN PRODUCTION
ICH2P 2016
May 8-11, 2016
Hangzhou, China

Goals - The International Conference on Hydrogen Production (ICH2P-2016) is a multi–disciplinary international conference on the production of hydrogen through various thermal, chemical, biological and other methods, as well as its use in various systems, including fuel cells. It will provide a forum for the exchange of latest advances and technical information, dissemination of new research developments in the areas of hydrogen production, storage and usage, and debate involving the future directions and priorities in the hydrogen economy for a sustainable future.

Format - The format of ICH2P-2016 will be arranged with the following major elements as general papers presented in oral sessions, keynote papers by invited speakers, and panel discussions and specialized sessions on selected topics. There will also be exhibitions, social events and pre- and post-symposium tours. High quality papers of archival value will be considered in extended form for publication in various reputable international journals.

Venue - The conference will be held at Zhejiang University (ZJU), Hangzhou, China. Founded in 1897, Zhejiang University is one of China's oldest and best institutions of higher education. Famed for its natural scenery, Hangzhou and the West Lake have been immortalized by countless poets and artists, and it is known as one of the most beautiful cities and tourist destination in China.

Conference Topics

The topics of the conference include, but are not limited to:

- Hydrogen Production Methods
- Hydrogen Combustion and Usage
- Fuel Cell
- Hydrogen Storage & Safety
- Hydrogen Technologies
- Hydrogen Vehicles
- International Perspectives on Hydrogen
- Life Cycle Assessment
- Life Cycle Costing
- Renewable and their use for hydrogen
- Sustainable development
- Thermochemical and hybrid cycles

Important date

December 15, 2015:
One-page abstract due

January 5, 2016:
Notification of abstract acceptance

February 22, 2016:
Full manuscript due

March 31, 2016:
Notification of manuscript acceptance

Website: http://ich2p-16.csp.escience.cn E-mail: ich2p2016@zju.edu.cn

Upcoming Meetings & Activities

May 2016

International Conference on Hydrogen Energy
May 8-11, 2016
Hangzhou, China
http://ich2p-16.csp.escience.cn/dct/page/1

Fuel Cell & Hydrogen Technical Conference 2016
May 25-26, 2016
Birmingham, United Kingdom
http://www.birmingham.ac.uk/research/activity/chemical-engineering/energy-chemical/fuel-cells/FCH2/index.aspx

ECS 229th Meeting
May 29-June 3, 2016
San Diego, California
http://www.electrochem.org/meetings/biannual/229/

June 2016

CIMTEC 2016 - 7th Forum on New Materials, including 5th International Conference on Smart & Multifunctional Materials, Structures & Systems
June 5-9, 2016
Perugia, Italy
http://2016.cimtec-congress.org/

21st World Hydrogen Energy Conference
June 13-16, 2016
Zaragoza, Spain
http://www.whec2016.com

Energy Systems Conference 2016: 21st Century Challenges
June 14-15, 2016
London, United Kingdom
http://www.energysystemsconference.com/

29th Electric Vehicle Symposium & Exhibition
June 19-22, 2016
Montreal, Quebec
http://www.evs29.org/

ASME 14th Fuel Cell Science, Engineering & Technology Conference, within ASME 2016 Power & Energy Conference & Exhibition
June 26-30, 2016
Charlotte, North Carolina
http://www.asme.org/events/power-energy

Workshop on Ion Exchange Membranes for Energy Applications, EMEA 2016
June 27-29, 2016
Bad Zwischenahn, Germany
http://www.next-energy.de/EMEA2016.html

6th Annual New Energy Forum, NEF- 2016: The Light of Hope for New Energy
June 30-July 3, 2016
Goyang City, Gyeonggi
http://www.bitcongress.com/nef2016

July 2016

Energy Future Conference & Exhibition, EF 2016: Energy Storage—From Generation to Distribution
July 4-6, 2016
Sydney, Australia
http://www.ozenergyfuture.com

12th European SOFC & SOE Forum
July 5-8, 2016
Lucerne, Switzerland
http://efcf.com

Nano Energy 2016, International Conference on Nanotechnology, Nanomaterials & Thin Films for Energy Applications
July 27-29, 2016
Liverpool, UK
http://www.nanoenergy.co.uk

Do you have a hydrogen-related meeting, workshop, or activity you would like us to include in the next issue of the IAHE Newsletter? If so, please email a description and web link to Kathy Williams at williamk@utk.edu .

Get Connected—Internet Groups of Interest

LinkedIn Connections

Hydrogen Group

Hydrogen Group is a global specialist recruitment business, placing exceptional, hard to find candidates in over 70 countries.

Global Hydrogen Ambassadors Network

Their goal is to exchange opinions on a topic, which may look easy at first glance, but is rather complex. All questions are allowed. A wealth of answers can be expected.

World EcoEnergy Forum: Driving Innovation in the Energy Storage and Smart Grid Industry

The aim of this group is to bring together executives responsible for R&D to discuss about new product development and sustainable development in the energy storage and smart-grid industry.

Hydrogen Pathway

This is a very active group-page within LinkedIn that includes discussions and latest news regarding hydrogen energy.

Renewable Energy Solutions

I.R.E.S. platform to create bridges between international based investors, manufactures and wholesale companies in the Renewable Business Industry. Solar power, wind energy, tidal power, geothermal power, air power, hydrogen, waste management.

Global Renewable Energy Network

Global Renewable Energy Network (GReEN) is the premier business network for professionals and companies involved in the development, commercialization, and utilization of renewable energies (e.g. bioenergy, geothermal, hydro, hydrogen, ocean, solar, and wind), worldwide.

Fuel Cell & Hydrogen Network

Bringing together professionals and enthusiasts alike, the Fuel Cell & Hydrogen Network serves to connect those advocating fuel cell and hydrogen technologies. The group welcomes people who are interested in all types of fuel cell technologies as well as the wide variety of hydrogen technologies, and is not exclusive of hydrogen fuel cells.

Fuel Cells

Welcomes those who are interested in clean energy fuel cell applications and technologies. Encourages members to start discussions that are relevant to fuel cells, to post promotions and jobs, and to use this group to develop their professional network.

Fuel Cell Energy

The Fuel Cell Energy Group advocates the use of Fuel Cell Energy & the promotion of its Technology and for those interested in learning more about Fuel Cell Technology. Fuel Cell Professionals, Renewable Energy, Clean Technology, and Environmental Advocates are welcome. Solar, Wind, Biomass, Biofuel, Tidal Power & Wave Professionals also welcome to learn about this emerging technology.

Facebook Connections

Horizon Fuel Cell Technologies

Horizon Fuel Cell Technologies was founded in Singapore in 2003 and currently owns 5 international subsidiaries, including a new subsidiary in the United States. Having started commercialization with small and simple products while preparing for larger and more complex applications, Horizon already emerged as the world's largest volume producer of commercial micro-fuel cell products, serving customers in over 65 countries.

Fuel Cell Nation

Fact-Based Analysis and Discussion of Clean Energy
http://blog.fuelcellnation.com/

International Association for Hydrogen Energy

Facebook community for sharing the information regarding advances in hydrogen energy.

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