Minnesota Renewable Hydrogen Initiative News Update
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'Crispy noodle' chemistry could reduce carbon emissions
Dr Peter Budd, a materials chemist working in the Organic Materials Innovation Centre (OMIC) at The University of Manchester, has won £150,000 worth of new funding to explore the use of a special polymer to effectively remove CO2 as it's belched from fossil fuel power stations or hydrogen production plants. The 18 month study, which is funded by the Engineering and Physical Sciences Research Council (EPSRC), will look at the feasibility of using catalytic membrane systems to capture and recover carbon dioxide. Dr Budd proposes to explore the potential of composite membranes made from a 'polymer of intrinsic microporosity', or PIM, and a synthetic catalyst. He even hopes to make progress towards creating a unique and highly efficient double membrane system that can be used for both CO2 removal and CO2 recovery.
This latest project expands on exciting work by Dr Budd, Professor Neil McKeown at Cardiff University and David Book at the University of Birmingham, which is aiming to use PIMs to store large amounts of hydrogen. This works could bring about the attractive possibility of safe hydrogen storage with an energy efficient release for consumption… The polymers developed by Dr Budd and colleagues do possess significant microporosity – and preliminary hydrogen sorption results are encouraging, with significant quantities adsorbed. Most importantly, the chemical composition of PIMs can be tailored via synthetic chemistry. http://www.manchester.ac.uk/aboutus/news/display/?id=3540

Hydrogen-powered phones on the horizon
PARIS (AFP) - French researchers said on Wednesday they had invented a hydrogen fuel cell as a backup power source for mobile phones, thus easing dependence on an electricity supply to charge the gadget. The miniature fuel cell uses a hydrogen-filled cartridge about the size of a small cigarette lighter, according to the press presentation made by the researchers at the Atomic Energy Commission (CEW).
http://news.yahoo.com/s/afp/20080521/tc_afp/sciencetechnologyphonesfuelcells

Power from Formic Acid
Björn Loges, Albert Boddien, Henrik Junge, and Matthias Beller at the Leibniz Institute of Catalysis in Rostock have now succeeded in the controlled extraction of hydrogen from formic acid—without the need for the high-temperature reforming process usually involved in other hydrogen generation systems. As they report in the journal *Angewandte Chemie*, this hydrogen source, generated at room temperature, can be directly introduced into fuel cells. . . The researchers from Rostock have now developed a feasible process for the on-demand release of hydrogen; they produce hydrogen from formic acid (HCO_2H). In the presence of an amine (e.g. N,N-dimethylhexylamine) and with a suitable catalyst (e.g. the commercially available ruthenium phosphine complex $[RuCl_2(PPH_3)_2]$), formic acid is selectively converted into carbon dioxide and hydrogen at room temperature. A simple activated charcoal filter is enough to purify the hydrogen gas for use in a fuel cell. The use of formic acid for "hydrogen storage" allows the advantages of established hydrogen/oxygen fuel cell technology to be combined with those of liquid fuels. Formic acid is nontoxic and easy to store. Because formic acid can be generated catalytically from CO_2 and biomass-derived hydrogen, the cycle is CO_2 neutral in principle.
http://www.physorg.com/news129355046.html | http://www.technologyreview.com/Energy/20778/

Findings Could Improve Fuel Cell Efficiency
ScienceDaily (Mar. 24, 2008) — A new type of membrane based on tiny iron particles appears to address one of the major limitations exhibited by current power-generating fuel cell technology. While there are many types of fuel cells, in general they generate electricity as the result of chemical reactions between an external fuel -- most commonly hydrogen -- and an agent that reacts with it. The membrane that separates the two parts of the cell and facilitates the reaction is a key factor in determining the efficiency of the cell. Fuel cells are commonly used in such settings as satellites, submarines or remote weather stations because they have no moving parts, do not require combustion and can run unattended for long periods of time. However, current fuel cells lose efficiency as the temperature rises and the humidity falls. Researchers at Duke University's Pratt School of Engineering have developed a membrane that allows fuel cells to operate at low humidity and theoretically to operate at higher temperatures.
"The current gold standard membrane is a polymer that needs to be in a humid environment in order to function efficiently," said Mark Wiesner, Ph.D., a Duke civil engineer and senior author of the paper. "If the polymer membrane dries out, its efficiency drops. We developed a ceramic membrane made of iron nanoparticles that works at much lower humidities. And because it is a ceramic, it should also tolerate higher temperatures.
http://www.sciencedaily.com/releases/2008/03/080319133704.htm

Researchers Observe Hydrogen-Bond Exchange
Hydrogen bonds are quite small, on the level of a few angstroms. They can also be passed between two different molecules very quickly, at speeds of tens of times per second. But in spite of these properties, researchers have recently observed hydrogen-bond exchange taking place in real-time. In their study published in *Physical Review Letters*, a team of chemists from Kyoto University and Osaka University, both in Japan, describe how they used a scanning tunneling microscope to directly observe a hydrogen-bond exchange taking place within a single water dimer (two molecules of H_2O bound together). The observation provides evidence to support the model in which quantum tunneling and molecular vibrations play important roles in the hydrogen-bond exchange process. "The dynamics of hydrogen-bond exchange is visualized at single-molecule level in this work," Hiroshi Okuyama of Kyoto University told *PhysOrg.com*. "Previous studies used spectral splittings as evidence for the exchange reaction. This [direct observation] enabled us to clearly show that the exchange process involves quantum tunneling and also can be promoted by correlated vibrational excitation. This work is, I believe, of fundamental importance." … In the current experiment, the researchers prepared water dimers from water monomers (single H2O molecules) on a copper surface at a cold 6 degrees K. The water dimers bonded to the copper surface via the oxygen atom of its "hydrogen-bond donor" molecule, along with its "hydrogen-bond acceptor" molecule weakly interacting with the adjacent copper atom. The researchers also substituted some of the H_20 dimers with heavy water deuterium dimers, $(D_20)_2$, for comparison. While the D_20 dimers appeared stationary under the microscope, the H20 dimers fluctuated continuously. As the scientists explained, these fluctuations represent the rapid exchange of hydrogen bonds between the two H_20 molecules as they interchange their roles of donor and acceptor molecules. By rearranging the hydrogen bond that holds them together, the molecules switched back and forth between these two roles at a rate of about 60 times per second. The reason that the D_20 dimers didn't appear to fluctuate under the microscope was because their hydrogen-bond exchange rate was much slower, at just 1 time per second.
This rate difference, which the researchers call an isotope effect, means that the interchange must overcome a large energy barrier, one that is too large for mere thermal processes. It implies that the interchange proceeds instead via quantum tunneling.
http://www.physorg.com/news129471213.html

Improved Ion Mobility Is Key to New Hydrogen Storage Compound
A materials scientist at the National Institute of Standards and Technology has deciphered the structure of a new class of materials that can store relatively large quantities of hydrogen within its crystal structure for later release. The new analysis may point to a practical hydrogen storage material for automobile fuel cells and similar applications. Hui Wu, a research associate from the University of Maryland working in a cooperative research program at the NIST Center for Neutron Research, has been investigating a new hydrogen storage compound that mixes lithium amide with lightweight metal hydrides. Lithium amide can hold more than 10 percent of hydrogen by weight, well above the 6 percent target set by the U.S. Department of Energy as a 2010 goal for a hydrogen storage material for transportation. The material absorbs and releases hydrogen reversibly, but both absorbing and releasing the hydrogen requires high temperatures and also produces a toxic byproduct, ammonia. Metal hydrides also store hydrogen, though not as well, but recently it's been shown that a combination of the two not only can store significant quantifies of hydrogen but also can release it at lower temperatures than the lithium amide alone (about 100 degrees Celsius) while generating much less ammonia. To understand how the compound achieves this, Wu used neutron analysis to work out the atomic structure of the material, which she found consists of layers of calcium between which lithium ions travel rapidly. The easy travel allows the material to transfer the hydrogen at lower temperatures. Also the hydrogen ions in the amide and hydride mixture combine easily and release hydrogen at lower temperature without creating much ammonia.
http://www.physorg.com/news129997316.html

Newest GREET Model Updates Environmental Impacts Of Specific Fuels And Automobiles *ScienceDaily (May 10, 2008)* — The newest version of the Greenhouse gases, Regulated Emissions and Energy use in Transportation (GREET) model from the U.S. Department of Energy's (DOE) Argonne National Laboratory will provide researchers with even more tools to evaluate and compare the environmental impacts of new transportation fuels and advanced vehicle technologies… Today, GREET can simulate more than 100 fuel production pathways and more than 80 vehicle/fuel systems. The model has more than 4,000 registered users worldwide. The newest update released May 9 will allow scientists to model combustion of ethanol produced from Brazilian sugarcane and used by U.S. automobiles; production and use of bio-butanol as a potential transportation fuel; and production and use of biodiesel and renewable diesel via hydrogenation, coal/biomass co-feeding for Fischer-Tropsch diesel production and various corn ethanol plant types with different process fuels. In addition, simulations of many existing fuel pathways in GREET are updated. For example, petroleum refining energy efficiencies in GREET are updated with recent survey data from the Energy Information Administration. Enhancements to current pathways include three methods for dealing with co-products for soybean-based biodiesel, compression energy efficiencies for natural and hydrogen gases are calculated with the first law of thermodynamics and a tube trailer delivery option for hydrogen gas to refueling stations.
http://www.sciencedaily.com/releases/2008/05/080508115822.htm

Hydro-4000 or 5000, hydrogen into engine for 60% more mpg
This is the Hydro-4000 that is said to give your car 60% more miles per gallon, and the company behind this gadget also have another version called the Hydro-5000 for 18-wheelers. With gas prices rising and no sign of stopping, many auto owners have been forced to buy gas savers and other devices, but this new gadget hopes to help you get more MPG. When the Hydro-4000 is installed on your vehicle, it only needs water to run and can then give you a 60 percent discount on your gas bill.The device costs $1200 and I am sure not many homes could afford this kind of price with high gas prices and the credit crunch, but you also cannot afford not to have this installed on your vehicle. The makers say that you will make the $1200 back very quickly, thanks too the huge savings it creates. It would not be the first time we have heard of some great products and then they just turn out to be rubbish, but News Channel 5 wanted to find out with a hands-on look and see if this miracle device really worked.
The results were spot on, with their company truck getting a 61% increase in miles per gallon on a dynamometer and an increase of 58% on the road. The Hydro-4000 works by sending “hydrogen into your engine, creating a cleaner burning environment”. It helps burn all of the gas that goes into an engine, instead of sending unused gas out the exhaust pipe. When you fill up your vehicle with the expensive gas prices, you do not expect to waste some out the exhaust, but that is just what happens without the Hydro-4000. http://www.product-reviews.net/2008/05/09/hydro-4000-or-5000-hydrogen-into-engine-for-60-more-mpg/
http://machinist.salon.com/blog/2008/05/09/hydro_4000_gas/

Hydrogen generator that increases gas mileage being tested in S.A
Scientists in San Antonio are testing a hydrogen generator that could dramatically raise your fuel efficiency. Some scientists, however, say it just doesn't wash. "You can't get something for nothing. And starting with water is a very difficult way to get energy," said Dr. Charlie Roberts, with the Southwest Research Institute. The technology to produce hydrogen gas is actually about 100 years old. Through electrolysis, two molecules of hydrogen are separated from the one molecule of oxygen in H20 (water). The relatively new use is burning the elements separately to supplement gasoline. "We tested several vehicles in New Jersey last month and the numbers were like fiction, you know — 80 miles per gallon with a 4-cylinder Honda, 80 miles per gallon with a 4-cylinder Ford Focus," said professional mechanic Steve Gerhlein. "This system doesn't do anything more than help stretch the gasoline dollar by converting water with a chemical, which is potassium hydroxide mixed up in a special proportion. And then it makes hydrogen and oxygen that the engine then uses as a fuel." Gerhlein, a professional mechanic for more than 30 years, was so intrigued by what he read about hydrogen generators that he put one on his wife's Lexus. Without the hydrogen generator, Gerhlein said the Lexus, running on super unleaded, got about 14 miles per gallon. With the hydrogen generator the vehicle gets about 19 miles per gallon. By tweaking the computer to accept the extra fuel, Gerhlein says the truck now gets 26 miles per gallon. .. There are plans for hydrogen generators all over the Internet. However, Gerhlein says 98 percent of them won't produce enough hydrogen to help much. None of them come with a computer to help today's car read and understand the additional source of fuel except the one he is researching. Gerhlein's hydrogen generator costs $1,500 to have installed in your vehicle.
http://www.kvue.com/news/state/stories/052108kvuegassaver-cb.16780e2a.html

Hula's hydrogen-assist generator helps drivers increase gas mileage
With gasoline closing in on $4 per gallon, people across the country have begun to take innovative steps to improve fuel efficiency and increase gas mileage. One of these people is Ed Hula, who believes consumers themselves and small companies must come up with innovative ideas for the future… Hula is known in these parts mostly as the Buffalo High School football and wrestling coach, but he also is an inventor and former science teacher. In fact, his latest innovation stemmed from a science project in his class five years ago.He feels that he has perfected what he calls the hydrogen-assist generator, and has formed a corporation called Hydrogen Assist Enterprises LLC. Those interested in further information can call his business phone number at (417) 993-1111. The innovation starts with a quart jar filled with water and some electrodes hooked up to the vehicle's ignition. Through electrolysis, the gadget separates the hydrogen atom from the oxygen atom. When the ignition is turned on, the generator starts producing what Hula calls "hydrogen on demand" that makes the gas burn more efficiently. He said it is safer than "hydrogen under pressure," which is featured in some automobiles that run on hydrogen. He explained that the gas cylinder has a short burn time, but adding hydrogen extends the burn time."This means more power and gas mileage," Hula said. "It cuts down on bad emissions, because the only thing this puts out is water vapor."Hula is the first to admit that this is not a new idea, and in fact consumers can find many versions of this type of generator on the Internet. But he has tested his generator thoroughly on his own vehicles and knows that it will work. He installed one on his wife's vehicle, and then on his pickup truck. Mileage on his truck increased from 16 miles per gallon to 24. He is currently experimenting with the idea of using two generators on his pickup, to see if that will improve mileage even more. What's more, he is selling his generators for only $600 each, plus tax, whereas the cheapest one he has seen on the Internet sells for $1,200.
http://www.zwire.com/site/tab2.cfm?newsid=19727088&BRD=2841&PAG=461&dept_id=603504&rfi=6

Nano-breakthrough: Dramatic Increase In Thermoelectric Efficiency Heralds New Era In Heating, Cooling And Power Generation

ScienceDaily (Mar. 21, 2008) — Researchers at Boston College and MIT have used nanotechnology to achieve a major increase in thermoelectric efficiency, a milestone that paves the way for a new generation of products -- from semiconductors and air conditioners to car exhaust systems and solar power technology -- that run cleaner. The team's low-cost approach, details of which are published in the journal Science, involves building tiny alloy nanostructures that can serve as micro-coolers and power generators. The researchers said that in addition to being inexpensive, their method will likely result in practical, near-term enhancements to make products consume less energy or capture energy that would otherwise be wasted.The findings represent a key milestone in the quest to harness the thermoelectric effect, which has both enticed and frustrated scientists since its discovery in the early 19th century. The effect refers to certain materials that can convert heat into electricity and vice versa. But there has been a hitch in trying to exploit the effect: most materials that conduct electricity also conduct heat, so their temperature equalizes quickly. In order to improve efficiency, scientists have sought materials that will conduct electricity but not similarly conduct heat. Using nanotechnology, the researchers at BC and MIT produced a big increase in the thermoelectric efficiency of bismuth antimony telluride -- a semiconductor alloy that has been commonly used in commercial devices since the 1950s -- in bulk form. Specifically, the team realized a 40 percent increase in the alloy's figure of merit, a term scientists use to measure a material's relative performance. The achievement marks the first such gain in a half-century using the cost-effective material that functions at room temperatures and up to 250 degrees Celsius. The success using the relatively inexpensive and environmentally friendly alloy means the discovery can quickly be applied to a range of uses, leading to higher cooling and power generation efficiency. http://www.sciencedaily.com/releases/2008/03/080320150027.htm

Gut Reaction: Cow Stomach Holds Key To Turning Corn Into Biofuel

ScienceDaily (Apr. 10, 2008) — An enzyme from a microbe that lives inside a cow's stomach is the key to turning corn plants into fuel, according to Michigan State University scientists. The enzyme that allows a cow to digest grasses and other plant fibers can be used to turn other plant fibers into simple sugars. These simple sugars can be used to produce ethanol to power cars and trucks. MSU scientists have discovered a way to grow corn plants that contain this enzyme. They have inserted a gene from a bacterium that lives in a cow's stomach into a corn plant. Now, the sugars locked up in the plant's leaves and stalk can be converted into usable sugar without expensive synthetic chemicals…. Cows, with help from bacteria, convert plant fibers, called cellulose, into energy, but this is a big step for biofuel production. Traditionally in the commercial biofuel industry, only the kernels of corn plants could be used to make ethanol, but this new discovery will allow the entire corn plant to be used -- so more fuel can be produced with less cost. Turning plant fibers into sugar requires three enzymes. The new variety of corn created for biofuel production, called Spartan Corn III, builds on Sticklen's earlier corn versions by containing all three necessary enzymes.The first version, released in 2007, cuts the cellulose into large pieces with an enzyme that came from a microbe that lives in hot spring water. Spartan Corn II, with a gene from a naturally occurring fungus, takes the large cellulose pieces created by the first enzyme and breaks them into sugar pairs. Spartan Corn III, with the gene from a microbe in a cow, produces an enzyme that separates pairs of sugar molecules into simple sugars. These single sugars are readily fermentable into ethanol, meaning that when the cellulose is in simple sugars, it can be fermented to make ethanol.
http://www.sciencedaily.com/releases/2008/04/080408085453.htm