MN Renewable Hydrogen Initiative News Update – May 2008

Samsung Developing Water-Powered Cell Phone Battery
Samsung Electro-Mechanics has developed a micro-fuel cell and hydrogen generator that runs on water. When the handset is turned on, metal and water in the phone react to produce hydrogen gas. The gas is then supplied to the fuel cell where it reacts with oxygen in the air to generate power. Other fuel cells need methanol to produce hydrogen, while Samsung's needs only water. http://www.mobiledia.com/news/65860.html

A new hydrogen storage system
Hydrogen (H2) is a promising synthetic fuel that has many advantages over fossil fuels. H2 is abundant and its oxidation product is water, which is benign. Along with benefits, there are some drawbacks. One major problem is the storage of H2. For example, if H2 were to be used for powering vehicles, the on-board storage must be light, compact, economical, and safe. Conventional systems such as high-pressure gas cylinders and cryogenic liquid/gas containers do not fit that description; they are cumbersome and potentially hazardous. Thus, many research groups are intent on developing new methods for efficient H2 storage. In a recent Angewandte article, the Laurenczy group reported the design of a robust and efficient H2 storage system by using formic acid and homogenous ruthenium (Ru)-based catalysts. H2 makes up 4.4 percent weight of formic acid and, with the right catalyst, hydrogen can be released efficiently from this chemical. The researchers synthesized suitable Ru catalysts by reacting a highly soluble ligand, meta-trisulfonated triphenylphosphine, with either RuCl3 or Ru(H2O)6. The catalysts that they created decompose formic acid in aqueous media and produce H2 with a 90-95 percent yield. The rate of the reaction can be regulated to maintain a constant pressure of H2. This steady pressure allows the H2 to be directly used in electric or combustion engines. The catalysts can also operate over one year in solution and remain stable up to 170oC.
http://arstechnica.com/journals/science.ars/2008/04/22/anew-hydrogen-storage-system

Hydrogen-powered plane takes off
The first manned, hydrogen-powered plane has been successfully tested in the skies above Spain, its makers say. The small, propeller-driven craft, developed by aviation giant Boeing, made three short flights at an airfield south of Madrid, the company said. It was powered by hydrogen fuel cells, which produce only heat and water as exhaust products. .. Three test flights of the two-seater aircraft took place in February and March at an airfield at Ocana, south of Madrid. The plane was modified to include a hybrid battery and fuel cell system developed by UK firm Intelligent Energy. http://news.bbc.co.uk/1/hi/technology/7330311.stm

Solar-powered hydrogen fuel station opens despite cutbacks
SACRAMENTO—A solar-powered hydrogen fueling station is officially open, just days after the state gutted rules designed to increase the number of hydrogen-powered cars on the road. The station uses solar energy to separate hydrogen from water to power clean-fuel vehicles. Its solar panels produce 80 kilowatts of electricity, roughly enough to power 40 homes, or about 14 fuel-cell vehicles.
http://www.mercurynews.com/breakingnews/ci_8770935?nclick_check=1

Hydrogen storage in nanoparticles 'is effective'
Storing hydrogen gas in nanoparticles is efficient and effective, according to research by Dutch chemist Kees Balde. Mr Balde says that nanoparticle hydrogen storage will allow the gas to be used more easily in mobile applications and that "30 nanometre particles of the metal hydride sodium alanate make the favourable extraction and storage of hydrogen possible". The chemist claims that hydrogen can be stored even more efficiently through the addition of a titanium catalyst, which can reduce the particle to 20 nanometres in size. Mr Baldé also studied the deactivation process of the titanium catalyst, which can affect the uptake and release of the hydrogen gas. http://www.fuelcelltoday.com/online/news/articles/2008-04/Hydrogen-storage-in-nanoparticle

New system makes hydrogen from plant sugar
BLACKSBURG, Va., April 10 (UPI) -- A U.S. scientist says he has developed a technology that can convert plant sugars into hydrogen to be used in hydrogen-fueled cars.Virginia Tech Assistant Professor Percival Zhang says the process involves combining plant sugars, water and a cocktail of powerful enzymes to produce hydrogen and carbon dioxide under mild reaction conditions…Zhang and colleagues said they believe they can produce hydrogen from cellulose, which has a similar chemical formula to starch, but is far more difficult to break down. In laboratory studies, the scientists collected 13 different, well-known enzymes and combined them with water and starches inside a specially designed reactor. The resulting broth reacted to produce only carbon dioxide and hydrogen, with no leftover pollutants. However, they said the amount of hydrogen produced was too low for commercial use and the speed of the reactions wasn't optimal.
http://www.upi.com/NewsTrack/Science/2008/04/10/new_system_makes_hydrogen_from_plant_sugar/8235/

MOF-74, A Potential Hydrogen-Storage Compound
One of the key engineering challenges to building a clean, efficient, hydrogen-powered car is how to design the fuel tank. Storing enough raw hydrogen for a reasonable driving range would require either impractically high pressures for gaseous hydrogen or extremely low temperatures for liquid hydrogen. In a new paper* researchers at the National Institute of Standards and Technology's Center for Neutron Research (NCNR) have demonstrated that a novel class of materials could enable a practical hydrogen fuel tank. A research team from NIST, the University of Maryland and the California Institute of Technology studied metal-organic frameworks (MOFs). One of several classes of materials that can bind and release hydrogen under the right conditions, they have some distinct advantages over competitors. In principle they could be engineered so that refueling is as easy as pumping gas at a service station is today, and MOFs don't require the high temperatures (110 to 500 C) some other materials need to release hydrogen. In particular, the team examined MOF-74, a porous crystalline powder developed at the University of California at Los Angeles. MOF-74 resembles a series of tightly packed straws comprised of mostly carbon atoms with columns of zinc ions running down the inside walls. A gram of the stuff has about the same surface area as two basketball courts. The researchers used neutron scattering and gas adsorption techniques to determine that at 77 K (-196 C), MOF-74 can adsorb more hydrogen than any unpressurized framework structure studied to date—packing the molecules in more densely than they would be if frozen in a block. NCNR scientist Craig Brown says that, though his team doesn't understand exactly what allows the hydrogen to bond in this fashion, they think the zinc center has some interesting properties.
"When we started doing experiments, we realized the metal interaction doesn't just increase the temperature at which hydrogen can be stored, but it also increases the density above that in solid hydrogen," Brown says. "This is absolutely the first time this has been encountered without having to use pressure."
http://www.technologynewsdaily.com/node/9618

Revolutionary wind project set for fall launch
A cutting-edge project that may revolutionize how isolated communities are powered is on track to launch later this year. Since early 2007, Newfoundland and Labrador Hydro and some research partners have been preparing to install a system in Ramea that converts excess energy generated from wind turbines into hydrogen that will be stored and converted back to electricity…The project expands on a successful wind demonstration project implemented in the southwest coast community in 2004.That system sees Ramea residents getting their juice from a combination of six, 65-kilowatt wind turbines owned by Frontier Power Systems and a three, 900-kilowatt diesel generators owned by Hydro. The initiative has reduced the amount of diesel required to power the community by more than 325,000 litres since inception. But under the existing network, when the wind is too strong, excess energy is wasted. The new process - which adds three 100-kilowatt turbines, specialized hydrogen devices and a new control system to the mix - will store that wasted power in the form of hydrogen. Basically, the turbines will generate power, which will be used to run a hydrogen electrolyzer that splits water into hydrogen and oxygen. "The oxygen is released into the atmosphere," Jones says. "The hydrogen is put into storage tank. Now we have a fuel that is basically derived from wind."
http://www.thewesternstar.com/index.cfm?sid=125802&sc=506

Silicon nanotubes for hydrogen storage in fuel cell vehicles (Nanowerk News)
After powering the micro-electronics revolution, silicon could carve out an important new role in speeding the debut of ultra-clean fuel cell vehicles powered by hydrogen, researchers in China suggest. Their calculations show for the first time that silicon nanotubes can store hydrogen more efficiently than their carbon nanotube counterparts. The study will appear in the April 24 issue of ACS' Journal of Physical Chemistry C. Dapeng Cao and colleagues note that researchers have focused on the potential use of carbon nanotubes for storing hydrogen in fuel cell vehicles for years. Despite nanotubes' great promise, they have been unable to meet the hydrogen storage goals proposed by the U.S. Department of Energy for hydrogen fuel cell vehicles. A more efficient material for hydrogen storage is needed, scientists say. In the study, Cao's group used powerful molecular modeling tools to compare the hydrogen storage capacities of newly developed silicon nanotubes to carbon nanotubes. They found that, in theory, silicon nanotubes can absorb hydrogen molecules more efficiently than carbon nanotubes under normal fuel cell operating conditions.
http://www.nanowerk.com/news/newsid=5318.php

The Power of Pond Scum: Biodiesel and Hydrogen From Algae 21 April 2008
Food riots erupting around the world have been partly blamed on the growing use of food products to produce fuels like biodiesel and corn ethanol. But biofuels need not come from food crops. According to some researchers, the best source of biofuel may be algae, best known as pesky green pond scum. As anyone who has had to clean a swimming pool or fish tank knows, algae grow quickly. All they need is light, carbon dioxide, and a little water to grow like, well, weeds. It turns out that algae produce oil that can be processed to make biodiesel. In some species, this oil represents more than half of the plantlike organism's mass. Researchers are also trying to genetically alter algae to make them give off copious amounts of hydrogen to meet the needs of future fuel-cell-powered cars. Algae's biodiesel capacity compares well with today's sources, says Glen Kertz, president and CEO at Valcent Products, a Vancouver, B.C., start-up that aims to become a leading algae oil supplier. A single hectare planted with corn will yield about 40 liters of oil per year; a hectare planted with oil palm would yield 1000 L. But according to Kertz, an algae bioreactor occupying the same space could yield more than 48 000 L. "And we think we can do far better than that," says Kertz. "In a few years, when we come to understand more about this crop we're growing, we could see bioreactors producing more than [150 000 L per hectare per year]." Valcent's proprietary technique, called Vertigro (which the company is also applying to the cultivation of plants like lettuce), is one of a bunch of approaches to growing algae. Instead of growing pond scum in large open ponds —whose yields are affected by seasonal variations like air temperature and relative humidity—Valcent uses the area above a plot of land to increase its yield.
http://www.spectrum.ieee.org/apr08/6175

Designer plants may produce hydrogen for fuel
Scientists at Argonne National Laboratory, the University of Illinois and Northwestern University are collaborating to design plants that use photosynthesis to churn out hydrogen, which could be a clean alternative to fossil fuels.And they think the single-celled algae is well-suited to the task.
"This is long-term research," said David Tiede, a senior chemist at Argonne. "Hydrogen is one generation or two generations away as the basis for our energy, but we have to start now to find efficient ways to extract it."
Algae has no roots, can be grown in water anywhere and creates an enzyme, hydrogenase, that separates hydrogen gas from water. Like most plants, algae combines carbon dioxide, sunlight and water to create biomass, biological material that can be used as fuel or for industrial production. With excessive sunlight, some unwanted byproducts are converted to hydrogen by the enzyme. Tiede and his colleagues believe they can incorporate that hydrogen into the algae's core photosynthesis process, making hydrogen a primary product.
"We're suggesting the idea of photosynthesis to do hydrogen reduction instead of carbon dioxide reduction," Tiede said. "That would be much more efficient than current processes that must break down biomass to get usable energy." http://www.chicagotribune.com/business/chi-mon-tech-notebook-0428-apr28,0,7819670.story

By combining three processes of capturing sunlight, generating oxygen and hydrogen groups of scientists are hoping to unleash abundant energy for earthlings.

Solar cells can take sunlight and produce a current, giving instant power. But as soon as the sun goes down, the lights go dim. If you could turn sunlight into fuel - to use for transportation or simply to store for later - you'd be onto a good thing. Nature can already do this, thanks to photosynthesis. Green plants take water, sunlight and carbon dioxide to make sugars and starches. This provides all the fuel they need, and most of the fuel we need too, in the form of food or oil. The problem is that plants aren't very efficient at fuel making - only about 3 per cent of the sun's energy ends up as useable fuel. And the fuel that works for plants doesn't necessarily work for us - the sugars and starches have to be further processed if our needs are more sophisticated than simply eating or burning. But where plants excel is in getting electrons out of water to produce a fuel. A photovoltaic system, or solar cell, is simply a means of shifting electrons from one place to another. To make a fuel, the electrons are siphoned off, and stored in chemical bonds.Plants get their electron supply from water. Chemists worldwide are trying to design synthetic systems that do the same. And the design they have to beat not only works at room temperature, it does so without the need for expensive metal catalysts. Making something cheap and similar to the machinery used by plants, the photosystem-II protein complex (PSII), remains a fundamental challenge. Some US chemists taking on the challenge are part of a collaborative effort called Powering the Planet, backed by the National Science Foundation. Three basic chemistry problems, each tackled by a different research team, form the crux of the project. One is to design an affordable material to collect energy from the sun and convert it into current (led by Nate Lewis at the California Institute of Technology, or Caltech). Another is to perfect a catalyst at one end of the material to split water and produce oxygen (led by Dan Nocera at the Massachusetts Institute of Technology). And, the third is to design another catalyst at the other end to produce hydrogen, to be used as a fuel (led by Harry Gray, also at Caltech).
http://www.deccanherald.com/Content/Apr292008/snt2008042865198.asp