Formic acid in the engine (w/ Video)

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(PhysOrg.com) -- Do ants hold the key to the fuel of the future? Formic acid provides more efficient and safer storage of hydrogen. It is an ideal way to store energy from renewable sources or to power 21st century cars.

Hydrogen is often referred to as the future replacement for fossil fuels. Despite being environmentally-friendly and efficient, it nevertheless has many drawbacks. Because it is extremely flammable, it must be stored in bulky pressurized cylinders. Scientists from the EPFL and their colleagues at the Leibniz-Institut für Katalyse have found a way around these obstacles. Once converted to formic acid, hydrogen can be stored easily and safely. This is an ideal solution for storing energy from renewable sources like solar or wind power, or to power the cars of tomorrow.

Hydrogen is easy to produce from electrical energy. With a catalyst and the CO_2 present in the atmosphere, scientists have been able to convert it to formic acid. Rather than a heavy cast iron cylinder filled with pressurized hydrogen, they obtain a non-flammable substance that is liquid at room temperature.

In November 2010, EPFL laboratories produced the opposite reaction. Through a catalytic process, the formic acid reverts to CO_2 and hydrogen, which can then be converted into electricity. A compact working prototype producing 2 kilowatts of power has been developed, and two companies have purchased a license to develop this technology: Granit (Switzerland) and Tekion (Canada).

Storing Renewable Energy

“Imagine for example that you have solar panels on your roof,” says Gabor Laurenczy, professor at the Laboratory of Organometallic and Medicinal Chemistry and Head of the Group of Catalysis for Energy and Environment.“In bad weather or at night, your formic acid battery will release the excess energy stored while the sun was shining.” In such a configuration, the method can restitute more than 60% of the original electrical energy.

This solution is extremely safe. The formic acid continuously releases very small amounts of hydrogen, “just what you need at the time for your energy consumption,” says the researcher.

Another advantage over conventional storage is that the method can store almost twice as much energy at equal volume. One liter of formic acid contains more than 53 grams of hydrogen, compared to just 28 grams for the same volume of pure hydrogen pressurized to 350 bars.

Finally, the researchers have developed a catalytic process using iron, which is readily available and inexpensive compared to “noble” metals such as platinum or ruthenium. As with all catalysts, no material is degraded during the process.

Formic acid at the pump

It is probably in the automotive field that the invention has the greatest potential. Currently, the prototypes produced by certain carmakers store hydrogen in conventional form, which entails problems such as risk of explosion, large volume pressurized tanks, difficulties in filling the tank quickly, etc.

The vehicles of the 21st century may run on formic acid. This solution allows for safer, more compact hydrogen storage as well as easier filling at the pump – formic acid is liquid at room temperature. “Technically, it is quite feasible. In fact, a number of major automobile manufacturers contacted us in 2008, when oil prices reached record highs,” says Gabor Laurenczy. “In my opinion, the only obstacle is cost.” It will be several years before drivers can pull up to any anthill and fill their tanks.

More information: onlinelibrary.wiley.com/doi/10 … e.201004263/abstract

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