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Cheap hydrogen fuel from seawater may be a step closer

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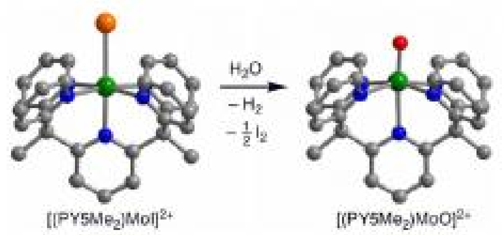

Reaction of [(PY5Me2)MoI]2+ with water to form [(PY5Me2)MoO]2+ and release H2 and half an equivalent of I2. The release of hydrogen was confirmed by mass spectrometry. Image credit: Nature, doi:10.1038/nature08969.

(PhysOrg.com) -- A new catalyst has been developed to generate hydrogen from water cheaply, but the research was originally intended to make molecules that behaved like magnets. Hydrogen is a clean power source currently produced from natural gas, with carbon dioxide as a by-product. Producing hydrogen from water produces oxygen as a by-product instead.

Conventional catalysts capable of splitting water into hydrogen and oxygen are generally too expensive or too weak to work on water effectively enough to produce hydrogen for an inexpensive fuel, but new research has developed a molybdenum catalyst that is robust and cheap enough to do the job, but still requires too much energy to be immediately useful. It does open up new possibilities for scientists to follow in the search for the perfect water-splitting catalyst.

One conventional means of splitting water into H_2 and O_2 is to use a platinum catalyst but the metal is far too expensive for the process to be commercially viable. Other methods use microbial enzymes called hydrogenases containing proteins using nickel and iron, but these methods are either too bulky, slow, or too inefficient to be successful on a commercial basis.

The new study by scientists at the University of California, Berkeley, aimed at combining metal atoms with organic molecular groups (called PY5) to produce molecules with the properties of bulk magnets. The researchers, led by Jeffrey Long, found that one of their molecules, a molybdenum-oxo complex, was capable of transferring electrons. This is a major requirement of water-splitting systems, so they tested its ability to split water to generate hydrogen gas and found it was highly successful.

The molybdenum compound was so successful it could work on seawater or pure water without additives. The compound is stable due to five bonds holding the molybdenum in place. Long said the molecule is stable for long periods in aqueous solutions, and they saw no degradation in catalytic activity over their three-day experiment. The molecule remains stable even when impurities, such as those found in seawater, are present. This would further reduce the cost since no organic acids or solvents are needed.

The compound's stability makes it more durable than the nickel and iron compounds used previously, but it is slower than the natural hydrogenases and needs a higher electric voltage to operate. The group is now experimenting with different metals and "tweaking" the PY5 groups to see if they can improve the speed and efficiency and reduce the energy requirements. They are also looking at the possibility of coupling the system to solar-generated electricity to make it even more viable.

More information: A molecular molybdenum-oxo catalyst for generating hydrogen from water, *Nature* 464, 1329-1333 (29 April 2010), doi:10.1038/nature08969