New Progress in the Quest for Practical Hydrogen Power

A UCLA chemist has taken a significant step in creating storage for hydrogen that can be used in cars and other electronic devices.

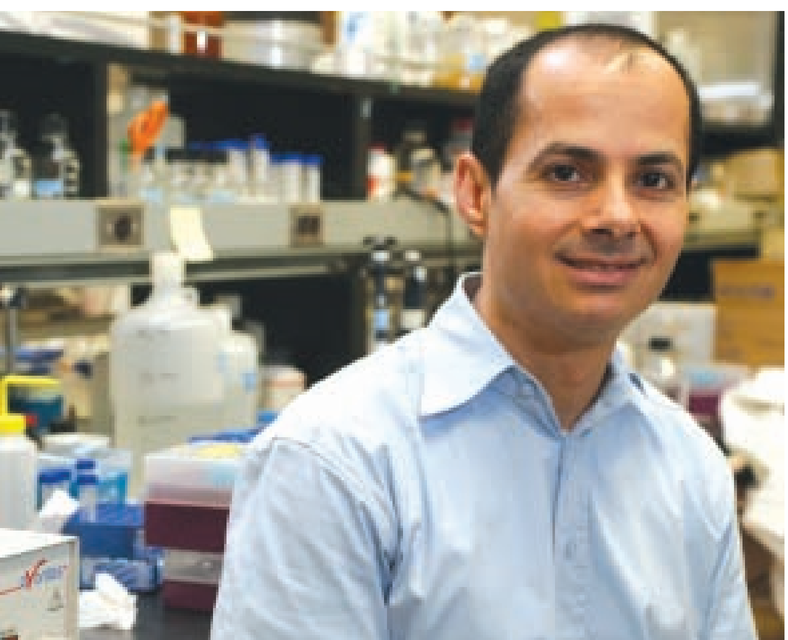
In the push to develop practical hydrogen fuel cells to power cars and other devices, one of the biggest challenges has been finding ways to store hydrogen at the right temperatures and concentrations. Now UCLA chemist Omar Yaghi and colleagues at the University of Michigan have demonstrated the ability to store large amounts of hydrogen at the proper concentration—using materials of his own invention.

The materials, which Yaghi developed in the early 1990s, are called metal-organic frameworks (MOFs). Pronounced "moffs," the materials have been described as crystal sponges—tiny openings on the nanoscale in which Yaghi and his colleagues can store gases that are usually difficult to store and transport.

MOFs can be made highly porous to increase their storage capacity; so porous that one gram of a MOF has the surface area of a football field. Yaghi's laboratory has made more than 500 MOFs with a variety of properties and structures.

"We have made a class of materials in which we can change the components nearly at will," said Yaghi, a professor in the Department of Chemistry and Biochemistry.

"Our idea was to create a material with pores that attract hydrogen, making it possible to stuff more hydrogen molecules into a small volume."



While the U.S. Department of Energy estimates that practical hydrogen fuel will require concentrations of at least 6.5 percent, the UCLA team has achieved concentrations of 7.5 percent—nearly three times as much as has been reported previously.

Hydrogen, when burned, produces only water, and is harmless to the environment. Yaghi's research could lead to a more practical hydrogen fuel that powers not only cars, but also laptop computers, cellular phones, digital cameras and other electronic devices.

"Before this work, the challenge has been: how do you store enough hydrogen for an automobile to run for 300 miles without refueling?" Yaghi said. "You have to concentrate the hydrogen into a small volume without using high pressure at very low temperature.

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In the research, which was funded by the National Science Foundation, the U.S. Department of Energy and the BASF Corporation, MOFs are used as storage devices in which hydrogen is physically absorbed.

How would hydrogen work in devices like cell phones, laptop computers and digital cameras?

"Instead of a battery, a medium such as a MOF would store hydrogen and release it into a fuel cell," Yaghi said.

"Molecules can go in and out of MOFs unobstructed," said Yaghi, whose research overlaps chemistry, materials science and engineering.

"We can make polymers inside the pores with well-defined and predictable properties. There is no limit to what structures we can get, and thus no limit to the applications."

www.chem.ucla.edu/dept/Faculty/yaghi

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