New material could unlock potential for hydrogen powered vehicle revolution

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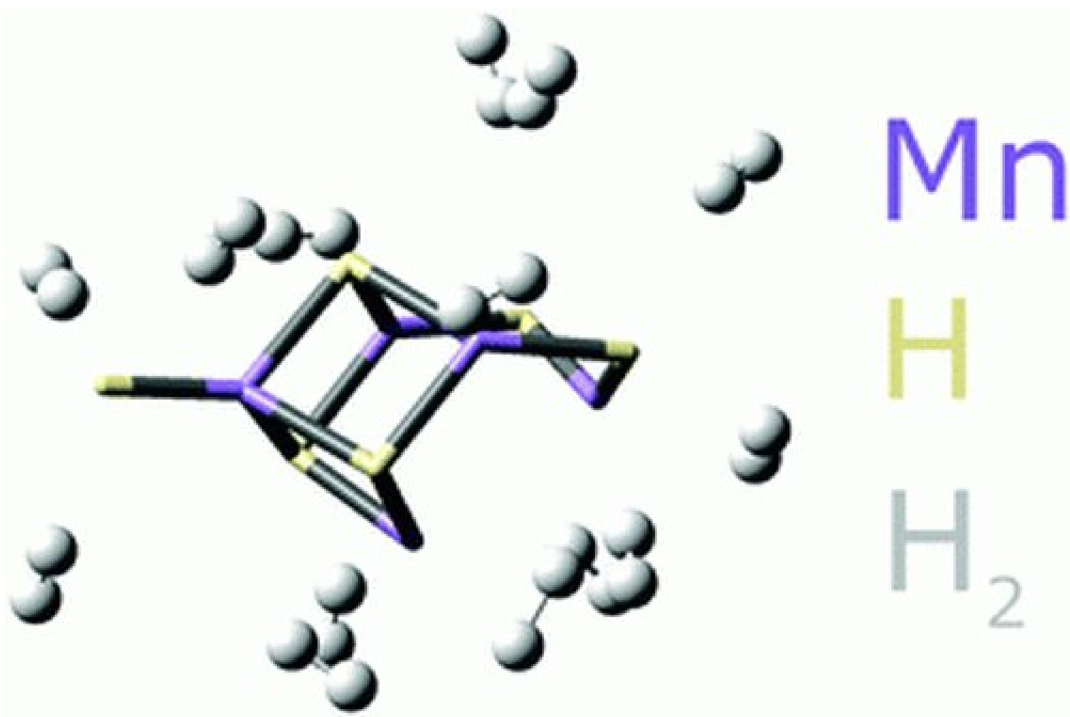

Credit: *Energy & Environmental Science* (2018). DOI: 10.1039/C8EE02499E

Scientists have discovered a new material that could hold the key to unlocking the potential of hydrogen powered vehicles.

As the world looks towards a gradual move away from fossil fuel powered cars and trucks, greener alternative technologies are being explored, such as electric battery powered vehicles.

Another 'green' technology with great potential is hydrogen power. However, a major obstacle has been the size, complexity, and expense of the fuel systems—until now.

An international team of researchers, led by Professor David Antonelli of Lancaster University, has discovered a new material made from manganese hydride that offers a solution. The new material would be used to make molecular sieves within fuel tanks—which store the hydrogen and work alongside fuel cells in a hydrogen powered 'system'.

The material, called KMH-1 (Kubas Manganese Hydride-1), would enable the design of tanks that are far smaller, cheaper, more convenient and energy dense than existing hydrogen fuel technologies, and significantly out-perform battery-powered vehicles.

Professor Antonelli, Chair in Physical Chemistry at Lancaster University and who has been researching this area for more than 15 years, said: "The cost of manufacturing our material is so low, and the energy density it can store is so much higher than a lithium ion battery, that we could see hydrogen fuel cell systems that cost five times less than lithium ion batteries as well as providing a much longer range—potentially enabling journeys up to around four or five times longer between fill-ups."

The material takes advantage of a chemical process called Kubas binding. This process enables the storage of hydrogen by distancing the hydrogen atoms within a H2 molecule and works at room temperature. This eliminates the need to split, and bind, the bonds between atoms, processes that require high energies and extremes of temperature and need complex equipment to deliver.

The KMH-1 material also absorbs and stores any excess energy so external heat and cooling is not needed. This is crucial because it means cooling and heating equipment does not need to be used in vehicles, resulting in systems with the potential to be far more efficient than existing designs.

The sieve works by absorbing hydrogen under around 120 atmospheres of pressure, which is less than a typical scuba tank. It then releases hydrogen from the tank into the fuel cell when the pressure is released.

The researchers' experiments show that the material could enable the storage of four times as much hydrogen in the same volume as existing hydrogen fuel technologies. This is great for vehicle manufactures as it provides them with flexibility to design vehicles with increased range of up to four times, or allowing them to reducing the size of the tanks by up to a factor of four.

Although vehicles, including cars and heavy goods vehicles, are the most obvious application, the researchers believe there are many other applications for KMH-1.

"This material can also be used in portable devices such as drones or within mobile chargers so people could go on week-long camping trips without having to recharge their devices," said Professor Antonelli. "The real advantage this brings is in situations where you anticipate being off grid for long periods of time, such as long haul truck journeys, drones, and robotics. It could also be used to run a house or a remote neighbourhood off a fuel cell."

The technology has been licenced by the University of South Wales to a spin-out company part owned by Professor Antonelli, called Kubagen.

The research, which is detailed in the paper 'A Manganese Hydride Molecular Sieve for Practical Hydrogen' is being published on the cover and within the printed version of the academic journal *Energy and*

Environmental Science.

More information: Leah Morris et al, A manganese hydride molecular sieve for practical hydrogen storage under ambient conditions, *Energy & Environmental Science* (2018). DOI: 10.1039/C8EE02499E

Provided by Lancaster University