

## Invention could solve 'bottleneck' in developing pollution-free cars

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Hydrogen-powered cars that do not pollute the environment are a step closer thanks to a new discovery which promises to solve the main problem holding back the technology. Whilst hydrogen is thought to be an ideal fuel for vehicles, producing only water on combustion, its widespread use has been limited by the lack of a safe, efficient system for onboard storage.

Scientists have experimented with ways of storing hydrogen by locking the gas into metal lattices, but metal hydrides only work at temperatures above 300°C and metal organic framework materials only work at liquid nitrogen temperatures (-198°C).

Now scientists at the University of Bath have invented a material which stores and releases hydrogen at room temperature, at the flick of a switch, and promises to help make hydrogen power a viable clean technology for the future.

Although its fuel to weight ratio is insufficient to make an entire hydrogen tank from it, the material could be used in combination with metal hydride sources to store and release energy instantaneously whilst the main tank reaches sufficient temperature, 300°C, to work.

They hope to have the fully-working prototype ready within two to three years.

"The problem of how to store hydrogen has been a major bottleneck in



the development of the hydrogen power technology," said Dr Andrew Weller from the Department of Chemistry at the University of Bath (UK).

"Hydrogen has a low density and it only condenses into liquid form at -252°C so it is difficult to use conventional storage systems such as high-pressure gas containers which would need steel walls at least three inches thick, making them too heavy and too large for cars.

"The US Department of the Energy has said that it wants six per cent of the weight of hydrogen storage systems to be hydrogen in order to give new hydrogen powered cars the same kind of mileage per tank of fuel as petrol-based systems.

"Whilst metal hydrides and metal organic framework materials can achieve this kind of ratio, they only work at extremes of temperature which are difficult to engineer into an ordinary vehicle.

"Our new material works at room temperature and at atmospheric pressure at the flick of a switch. Because it is made from a heavy metal (Rhodium), its weight to fuel ratio is low, 0.1 per cent, but it could certainly fill the time lag between a driver putting their foot on the accelerator and a metal hydride fuel tank getting up to temperature.

"We are really very excited about the potential this technology offers."

The University of Bath researchers made the discovery whilst investigating the effect that hydrogen has on metals. Having constructed an organo-metallic compound containing six rhodium (a type of metal that is also currently found in catalytic converters in cars) atoms and 12 hydrogen atoms, they began studying the chemical properties of the complex with researchers in Oxford (UK) and Victoria (Canada).



They soon realised that the material would absorb two molecules of hydrogen at room temperature and atmospheric pressure – and would release the molecules when a small electric current was applied to the material.

This kind of take up and release at the atomic scale makes the material an ideal candidate for solving the hydrogen storage problem.

The researchers are now looking at ways of printing the material onto sheets that could be stacked together and encased to form a storage tank.

Potentially this tank could sit alongside a metal hydride tank and would kick into action as soon as the driver put their foot on the accelerator, giving the metal hydride store the time to heat up to 300°C - the temperature that normal petrol-powered engines run at.

"With the growing concern over climate change and our over-reliance on fossil fuels, hydrogen provides us with a useful alternative," said Dr Weller.

"We have been able to use hydrogen to power fuel cells, which combine hydrogen and oxygen to form electricity and energy, for a number of years.

"But whenever the fuel is considered for cars we hit the stumbling block of how to store hydrogen gas in everyday applications.

"The new material absorbs the hydrogen into its structure and literally bristles with molecules of the gas. At the flick of a switch it rejects the hydrogen, allowing us to turn the supply of the gas on and off as we wish.

"The fact that we discovered the material by chance is a fantastic



advertisement for the benefits of curiosity driven research.

"In principle it should be possible to produce ready amounts of hydrogen using sea water and solar cells, giving the next generation of vehicles an inexhaustible supply of environmentally-friendly fuel.

"In fact other research in Bath's Department of Chemistry is at the forefront of the solar cell research, new battery technologies and new fuel cell technologies which could help unlock what many people are calling the hydrogen economy.

Source: University of Bath

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