Hydrogen storage goes solid-state

Hydrogen for use by fuel cells in cars still faces many limitations, mostly because of issues related to its storage and transport. However, new systems of storing and transporting are now available that are safer and more compact than previous technologies.

Hydrogen pressurised in tanks, where gas is typically under pressure from 700 to 2 100 bar, has limited storage capacity because of its extremely low density. Tank-based storage has other disadvantages too. The tanks take up a lot of space, and the refuelling process can be dangerous because of the high pressure of hydrogen coming out of the pump.

To overcome the challenges associated with tank-based storage systems, EU-funded researchers have worked on a way to hold hydrogen in a benign, chemical form and release this when needed. Within the SSH2S (Fuel cell coupled solid state hydrogen storage tank) project, they explored the combination of mixed-metal borohydrides and lithium amide/magnesium hydride in the new storage solution.
The modular hydrogen tank consisted of tubes placed side by side and filled with the two different solids. These materials absorb hydrogen like a sponge. This extraordinary property enables storage of hydrogen gas in a small volume under a pressure of 70 bar – substantially smaller than a conventional tank that requires hydrogen to be kept under a pressure higher than 700 bar.

More importantly, the use of solid materials in the new tank means that hydrogen can be stored safely. Even if there is a leak, the strong bond developed between the gas and the storage materials ensures that hydrogen escapes at such a slow rate that there is no risk of explosion.

As part of SSH2S, researchers connected the new hydrogen tank to a high-temperature polymer electrolyte membrane fuel cell. The tank had a volume of 10 l and offered storage for up to 1 400 l of hydrogen. The system was fitted into a van as an auxiliary power unit and supplied 1 kW of electrical energy for air conditioning, heating and lighting for 2 hours.

The patent granted for the solid-state storage of hydrogen attests to the success of SSH2S work. The new hydrogen storage system is expected to have an important impact on further development of high-temperature fuel cells for consumer and industrial applications of hydrogen-powered devices.

Keywords

Hydrogen, fuel cells, SSH2S, mixed-metal borohydrides, solid-state storage

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SSH2S

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