Hydrogen Storage for Cars?

Hydrogen is the fuel of the future. Unfortunately, one problem remains: Hydrogen is a gas and cannot easily be pumped into a tank like gasoline. Storage in the form of solid hydrides, chemical compounds of hydrogen and a metal or semimetal, are good storage materials in principle, but have not been well suited to automotive applications.

An American research team at the Ford Motor Company in Dearborn and the University of California, Los Angeles, has now developed a novel hydride that could be a useful starting point for the development of future automotive hydrogen-storage materials.

As Jun Yang and his team report in the journal *Angewandte Chemie*, an “autocatalytic” reaction mechanism causes the composite made of three different hydrides to rapidly release hydrogen at lower temperatures and without dangerous by-products.

Certain hydrogen compounds, such as lithium borohydride (LiBH4) and magnesium hydride (MgH2), can release hydrogen and then take it up again. However, for automotive applications, they require temperatures that are too high to release hydrogen, the hydrogen release and uptake are far too slow, and decomposition reactions release undesirable by-products such as ammonia.

In addition, these compounds can only be “recharged” under very high pressure and temperature conditions. The combination of two different hydrides (binary hydride) has previously been shown to improve things, as these compounds partly release hydrogen at lower temperatures than either of the individual components.

The researchers led by Yang went a step further and combined three hydrogen-containing compounds—lithium amide (LiNH2), lithium borohydride, and magnesium hydride—in a 2:1:1 ratio to form a ternary hydride. This trio has substantially better properties than previous binary materials.

The reason for this improvement is a complex sequence of reactions between the various components. The first reactions begin as soon as the starting components are ground together. Heating starts off more reactions, releasing the hydrogen. The mixture is “autocatalytic”, which means that one of the reactions produces the product cores for the following reaction, which speeds up the entire reaction sequence.

The result is a lower desorption temperature; the release of hydrogen begins at 150 °C.

In addition the hydrogen is very pure because neither ammonia nor any other volatile decomposition products are formed. Recharging the ternary hydride with hydrogen can be accomplished under moderate conditions.

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