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research highlights

HYDROGEN STORAGE

Pressure swing

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Hydrogen is a useful fuel but transport and storage challenges remain due to the need for high pressures or low temperatures to achieve practical energy densities. Therefore, other molecules that are easier to handle, such as liquid organic hydrogen carriers (LOHCs), which undergo catalytic hydrogenation and dehydrogenation reactions to store and release hydrogen on demand, present a potential solution. Within this class of molecules, pure hydrocarbon species are attractive due to their compatibility with existing liquid-fuel infrastructure and low cost, but have the downside of requiring relatively high heat inputs to release hydrogen. Now, Peter Wasserscheid and colleagues in Germany present a one-pot reaction system where the main variable required to control the storage and release of hydrogen is the reactor pressure, simplifying the setup and providing potential enhancements in efficiency.

The researchers use perhydro-dibenzyltoluene (H18-DBT) as the LOHC and find that a Pt/alumina catalyst is capable of effective hydrogenation and dehydrogenation, allowing the use of a single reactor for both halves of the cycle. By swinging the pressure from 30 bar at 301 °C to 1 bar at 291 °C, the researchers are able to switch the degree of hydrogenation of the LOHC between 95% and 30%. In this regime, hydrogenation heat could be used in the subsequent cycle for the endothermic hydrogen release step — a process facilitated by the ability to use the same reactor and catalyst — enabling heat integration between charging and discharging steps that could improve the viability of the technology.

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