research highlights

HYDROGEN STORAGE

Improving reversibility

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For the transportation of hydrogen — an important energy carrier — efficient storage materials with both high gravimetric and high volumetric densities are required. Recent decades have seen the development of many solid-state hydrogen storage materials such as amides, hydrides, and their hybrids. Despite promising weight and volume percentages of hydrogen that can be stored in those materials, facile storage and release has remained challenging. Ping Chen, Guotao Wu and colleagues in China, Germany, and Italy have now reported a ternary hydride composite, comprising $\text{Mg}(\text{NH}_2)_2$, LiH and LiBH_4 with a molar ratio of 2:3:4, that enables reversible hydrogenation and dehydrogenation at temperatures below 373 K.

Attempts have been made before to mix hydrides and amides of light elements such as Li and Mg, but problems such as side reactions, irreversibility and in particular, sluggish dehydrogenation kinetics, still exist. The ternary composite shown in this work has a low dehydrogenation enthalpy of 24 kJ per mole of H_2 , meaning that at 1 bar H_2 pressure the theoretical H_2 desorption temperature is just 266 K. In their experiments, the researchers find that H_2 desorption can take place at 371 K and full rehydrogenation at 326 K. Owing to the complexity of the ternary system, the detailed structure and phase diagram of the process are yet to be characterized. Nevertheless, the researchers speculate that the key to the improved kinetics lies in the relatively large amount of LiBH_4 used in the composite. Based on the *in situ* and *ex situ* powder X-ray diffraction measurements, they suggest that instead of decomposing to H_2 as seen in other hydride composites, LiBH_4 reacts with dehydrogenation intermediates such as LiNH_2 and Li_2NH to form stable compounds during the hydrogen release process, improving the kinetics.

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