Hydrogen boride nanosheets: A promising material for hydrogen carrier

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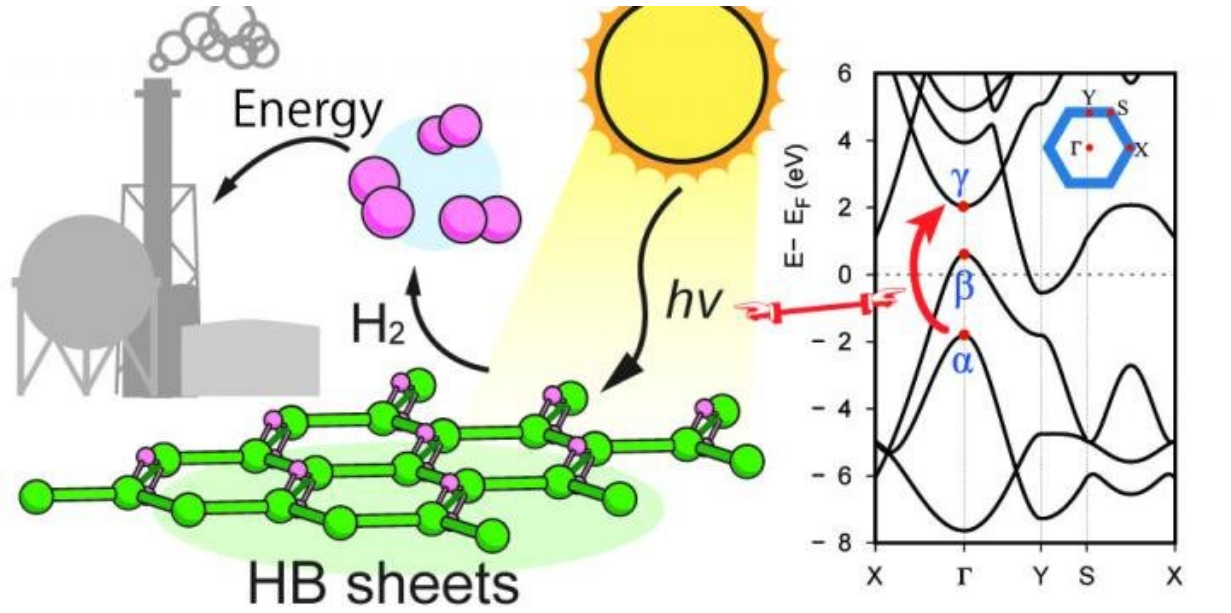

The hydrogen storage and release capacity of HB sheets is exceptionally high due to their two-dimensional nature and unique electronic band structure. Credit: Nature Communications

Researchers at Tokyo Institute of Technology, University of Tsukuba, and colleagues in Japan have reported a promising hydrogen carrier in the form of hydrogen boride nanosheets. This two-dimensional material, which is not yet well studied, could eventually be used for lightweight, high-capacity hydrogen storage materials with good safety profiles.

Innovative nanosheets made from equal parts of hydrogen and boron have a greater capacity to store and release hydrogen compared with conventional metal-based materials.

This finding by researchers at Tokyo Institute of Technology (Tokyo Tech), the University of Tsukuba, Kochi University of Technology and the University of Tokyo reinforces the view that hydrogen boride nanosheets (HB sheets) could go beyond graphene as a nano-sized multifunctional material.

Their study, published in *Nature Communications*, found that hydrogen can be released in significant amounts (up to eight weight percent) from HB sheets under ultraviolet light, even under mild conditions—that is, at ambient room temperature and pressure.

Such an easy-to-handle setup opens up possibilities for HB sheets to be utilized as highly efficient hydrogen carriers, which are expected to become increasingly in demand as a clean energy source in the coming decades.

When HB sheets burst onto the scene in 2017, scientists recognized that they could become an exciting new material for energy, catalysis and environmental applications. The breakthrough research garnered plaudits for its creative approach to materials design. A review article published in *Chem* in 2018 hailed the successful realization of HB sheets as "an exquisite example of human ingenuity at the pinnacle of innovative synthetic chemistry."

HB sheets are expected to be applied for light-weight, light-responsive, and safe hydrogen carrier. Currently, HB sheets are only responsive to ultra-violet light, thus, the visible-light sensitivity is important for their industrial application.

Also, refilling of hydrogen remains a key challenge in developing sustainable, viable hydrogen storage solutions. To address this issue, Miyauchi explains his team is investigating the visible-light sensitivity, rechargability, and long-term durability of HB sheets.

"Cost reduction of the starting materials—magnesium diboride—for HB sheets will be another important factor," he adds.

The cross-institutional study showcases the predictive power of first-principles calculations in materials science, namely as a way of investigating the mechanism of hydrogen release.

More information: Photoinduced hydrogen release from hydrogen boride sheets*Nature Communications* (2019). DOI: 10.1038/s41467-019-12903-1

Geoffrey Ozin et al. Catalyst: New Materials Discovery: Machine-Enhanced Human Creativity, *Chem* (2018). DOI: 10.1016/j.chempr.2018.05.011

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