PRESS RELEASE

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Tokyo Institute of Technology
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Subject line: **Hydrogen boride nanosheets: A promising material for hydrogen carrier**

(Tokyo, October 25 2019) **Researchers at Tokyo Institute of Technology, University of Tsukuba, and colleagues in Japan report a promising hydrogen carrier in the form of hydrogen boride nanosheets[1]. This two-dimensional material, which has only recently begun to be explored, could go on to be used as safe, light-weight, high-capacity hydrogen storage materials.**

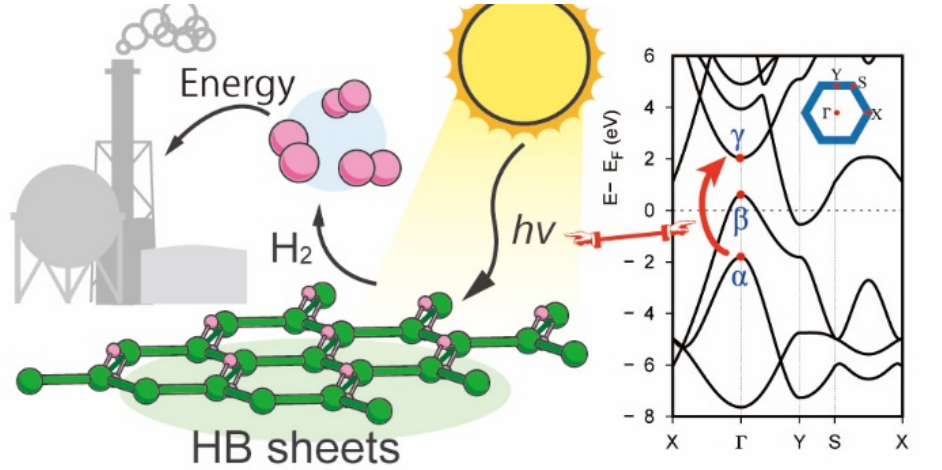

Figure 1. Hydrogen boride nanosheets (HB sheets) release hydrogen under UV light
The hydrogen storage and release capacity of HB sheets is exceptionally high due to their two-dimensional nature and unique electronic band structure.

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), 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 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, rechargeability, 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[2] in materials science, namely as a way of investigating the mechanism of hydrogen release.

Technical terms

[1] hydrogen boride nanosheets: Two-dimensional materials derived from magnesium diboride (MgB_2) that were first reported by researchers in Japan in 2017. The nanosheets exhibit extraordinary electronic and mechanical properties in addition to hydrogen storage capacity.

[2] First-principles calculations: Referring to a way of calculating mechanical, electronic or other properties of a given material based on the laws of quantum mechanics, which can lead to useful, predictive results prior to experimentation.

References

Reiya Kawamura[1,8], Nguyen Thanh Cuong[2,8], Takeshi Fujita[3], Ryota Ishibiki[4], Toru Hirabayashi[1], Akira Yamaguchi[1], Iwao Matsuda[5], Susumu Okada[2], Takahiro Kondo [6,7,*]

and Masahiro Miyauchi[1,*]. Photoinduced hydrogen release from hydrogen boride sheets. *Nature Communications* (2019).

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