Supramolecular material able to store compressed hydrogen in a way that is not too heavy

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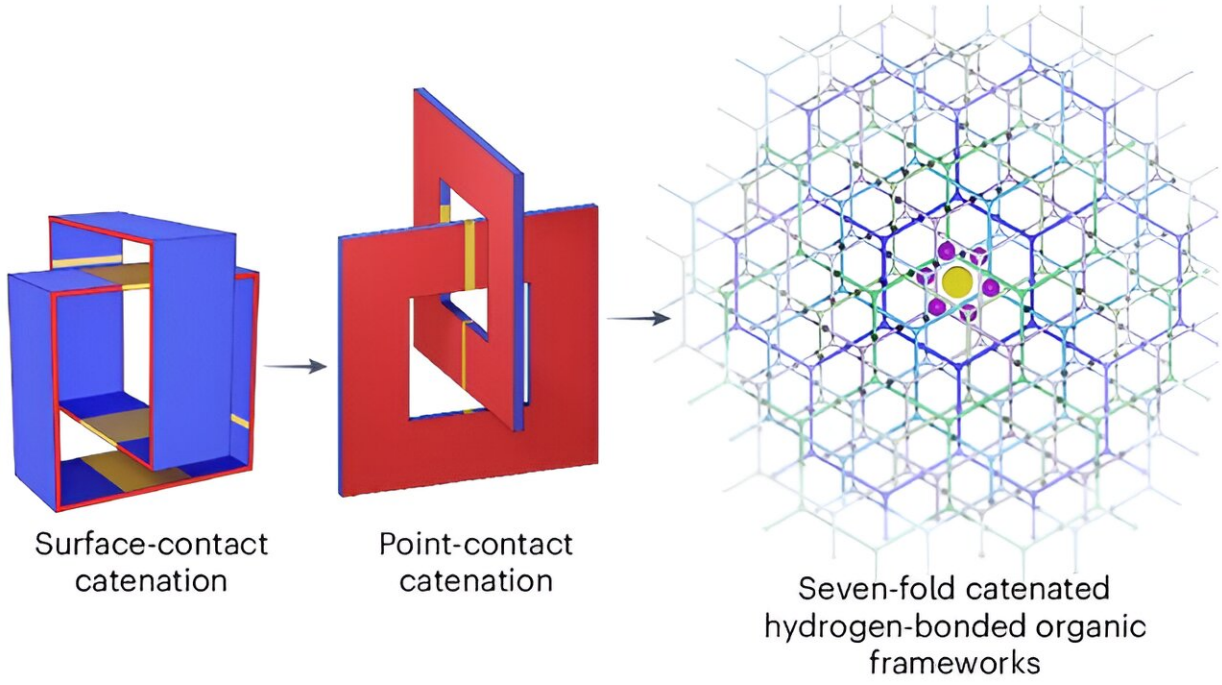

Credit: *Nature Chemistry* (2024). DOI: 10.1038/s41557-024-01622-w

A team of chemists with members from the University of Hong Kong, Northwestern University and Duke University has developed a supramolecular material that can be used to compress hydrogen for storage that is not too heavy. In their study, published in the journal

Nature Chemistry, the group used porous organic crystals to store hydrogen.

Hydrogen has been promoted as a clean energy source for many years, yet it is still not used in a general way because it presents storage problems—it takes up a lot more space than gasoline. So researchers around the globe have been working to develop better compression techniques.

For this new study, the research team developed an approach that meets the U.S. Department of Energy's targets; the first is storing at least 50 g of hydrogen per liter of material used for its storage. The second is that it should not be too heavy, or more specifically, that the weight of the hydrogen stored in a given material should be 6.5% of its total weight or more.

Efforts to meet both targets have failed thus far. But the researchers claim to have developed a material that allows for storing hydrogen in a way that meets both targets.

The material is made up of organic molecules created using robust crystals that have been interlinked in a honeycomb shape, with pores just the right size for hydrogen molecules. The hydrogen bonds with the crystals, keeping them in place.

Such interlinking, the researchers point out, allows for efficient, tight storage in a way that makes for a more stable material. It also reduces the porousness of materials made by others attempting to reach the same goals.

Testing of the material showed it capable of storing 53.7 g of hydrogen per liter of material, where the hydrogen was making up 9.3% of the system's overall weight. One major drawback of the system is that it

requires cryogenic cooling, which, in a commercial operation, would likely be bulky and expensive.

More information: Ruihua Zhang et al, Balancing volumetric and gravimetric capacity for hydrogen in supramolecular crystals, *Nature Chemistry* (2024). DOI: 10.1038/s41557-024-01622-w