diamond

Energy

CASE STUDY

Metal-organic frameworks for hydrogen storage

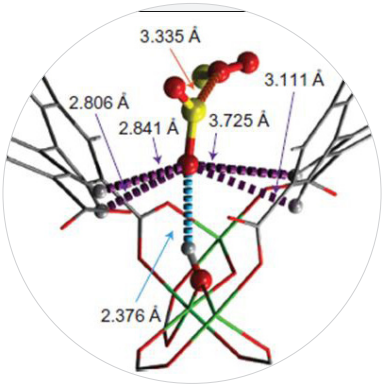
Using current technologies, it is possible to store and transport hydrogen as a liquid at very low temperatures, or a gas under very high pressure, but both of these have serious implications for weight, cost and safety.

Metal-organic frameworks (MOFs) are extended molecular structures constructed from metal cations linked by organic molecules. They have recently shown considerable promise in a wide range of applications, including hydrogen storage, catalysis and drug delivery.

The University of Nottingham

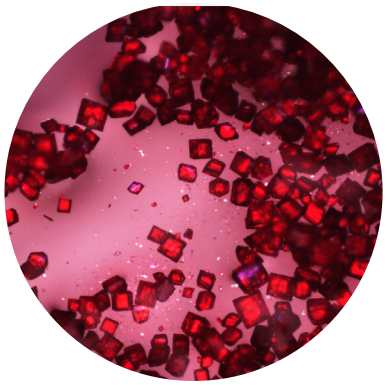
The Challenge

A major programme of research into MOFs as materials for hydrogen and fuel gas storage is underway. The new materials allow hydrogen to be stored at relatively low pressures leading to cost and weight savings in storage tanks. Accurate structural characterisation is key to the new metal-organic frameworks they have developed. However, the crystals produced by the synthesis routes tend to be very small and weakly diffracting, precluding the use of laboratory based methods for structure determination.



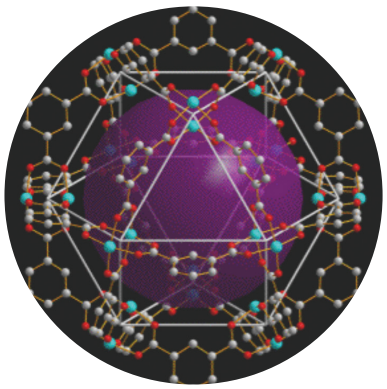
The Solution

Researchers from the University of Nottingham, in collaboration with General Motors, used beamline I19 at Diamond to determine the three-dimensional structures of a series of MOFs to understand how they interact with hydrogen and other gases. By altering the organic linkers, the team were able to change the size of the pores and their electronic properties, so as to alter their capacity to bind and release gases and solvents. Such detailed analysis needs to use the intense X-rays produced at Diamond to look at tiny single crystals and volatile solvent molecules within these new metal-organic frameworks.



The Benefits

The high intensity X-rays produced on beamline I19 allowed for structure determination from previously intractable samples. The research team could then design the next generation of MOFs using the insights gained from having a full structural understanding of the materials.



"Hydrogen storage is a real race against nature. Having access to the right tools to carry out research is a vital part of any scientific endeavour. Our metal-organic frameworks for hydrogen storage have achieved unprecedented capacities. We are pleased with progress made so far in our ability to characterise them and indeed we are encouraged by recent findings obtained with the help of Diamond."

Prof. Sandy Blake, University of Nottingham

For further information

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