SOLID-STATE HYDROGEN STORAGE SYSTEMS

Project features

- Hydrogen energy is environment benign. Its efficient use can reduce the dependence on conventional fossil fuel and lessen the emission of greenhouse gas.
- Chemical storage of hydrogen in solid-state can be high both in volumetric and gravimetric hydrogen density to meet the requirements for on-board applications.
- Hydrogen storage by metal nitride, amide and imide has high H_2 capacity and low operation temperature compared to rival approaches.

Research activities

Li-N-H system Li-Mg-N-H system Li-Al-N-H system

Sponsors and cooperation partners

- Agency for Science, Technology and Research (A*STAR, Singapore)
- New Energy and Industrial Technology Development Organization (NEDO, Japan)
- Sandia National Laboratories (SNL, USA)
- General Motor (GM, USA)
- US Army

nature highlights — **nature** 21 November 2002

Clean energy: Towards a hydrogen economy

Hydrogen could be a much 'cleaner' source of energy than fossil fuels, if only efficient ways of producing and storing it can be devised. Practical – and reversible – hydrogen storage has long been particularly problematic. The latest candidate hydrogen storage system is based on lithium nitride and has a maximum hydrogen storage capacity of 11.4 wt%, which is high compared with rival systems. The temperature required to release the hydrogen at useable pressures is too high for practical applications, so further work on this new class of storage material will concentrate on developing metal-nitride-based systems that don't cling on to their hydrogen quite so tightly……

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The Latest Technology Research News

Metal stores more hydrogen

January 15/22, 2003

By Eric Smalley, Technology Research News

Hydrogen is the most abundant element in the universe, and when it is burned its only byproduct is water. One reason the world isn't running on hydrogen fuel is that it's hard to store. Researchers from the National University of Singapore have made an accidental discovery that brings the promise of clean hydrogen energy a big step forward. The challenges to using hydrogen as a fuel include finding a hydrogen storage system that is reasonably small and light, and finding a way to release the stored fuel quickly enough when it is needed. The researchers have found a material that can store and quickly release large amounts of hydrogen. Lithium nitride can store 11.4 percent of its own weight in hydrogen, which is 50 percent more than magnesium hydride, the previous best hydrogen storage material. Other metal hydrides generally store only 2 to 4 percent of their weight. The new material is not ready for practical applications because the temperature required to release the hydrogen is too high, but it points the way to a practical hydrogen storage material, according to Ping Chen, a senior research fellow at the National University of Singapore. "We think the main application might be... on-board hydrogen storage," she said.


BEST IN NEWSPAPER DESIGN IN ASIA
The Straits Times
NUS team may have key to drive hydrogen economy
Aug. 17, 2004

Small steps in storage

22 **materialstoday** December 2004

Two other recent studies also take H2 storage a step closer. Firstly, researchers from the National University of Singapore have made initial studies of Li-alkali earth metal imides as H2 storage materials [Xiong et al., Adv. Mater. (2004) 16(17),1522]. Metal imides have a maximum storage capacity of 7.0wt%. However, the materials requires a relatively high operating temperature, which would limit real applications. Ping Chen and coworkers show that the addition of alkali earth metals such as Mg or Ca dramatically decrease H2 storage temperatures, increase desorption pressures, and allow high storage capacities to be achieved. "This result takes the metal-N-H system a big step forward to practical targets," says Chen. "More importantly, a method for the design and synthesis of varieties of metal-N-H complexes can be inferred from the work, that is, by reacting different metal amides with hydrides we will have the possibility of developing a broad range of metal-N-H systems for hydrogen storage." Meanwhile, Japanese researchers have found a way of enhancing methane storage capacity in single-walled nanostructured carbon [Murata et al., Adv. Mater. (2004) 16 (17), 1520] The ability to store methane in porous solids is not only necessary for the development of natural-gas-powered vehicles, but could also provide a H2 source for fuel cell vehicles. Methane absorption in carbon nanostructrured material can be enhanced by charge transfer, which is achieved by dispersing a small amount of lanthanides. The researchers believe that the same principle could be applied to carbon nanotubes.

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