STORHY FINAL EVENT
HYDROGEN STORAGE SYSTEMS FOR AUTOMOTIVE APPLICATION
PSA POISSY, JUNE 3-4, 2008

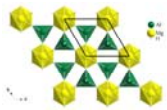
Solid Storage - Overview

Objectives

- Light weight complex alanates were studied as one of the most promising materials for solid hydrogen storage. The investigations concentrated on screening possible candidates and improving their hydrogen storage density as well as hydrogenation / dehydrogenation kinetics. Safety experiments were also performed and prototype tanks built.

Achievements

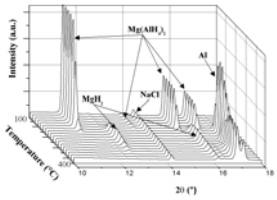
Desorption behaviour of novel nanocomposite based storage material



Magnesium Alanate

- $Mg(AlH_4)_2$: Solvent-free and fast synthesis
- Structure of $Mg(AlH_4)_2$: Neutron (with D) and synchrotron X-ray diffraction
- Details of thermal and isothermal decomposition of $Mg(AlH_4)_2$

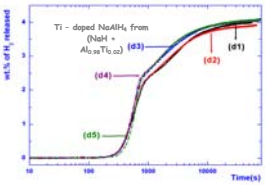
Scale-up strategies promising, but reversibility not sufficient



Kinetic properties on Na-alanates

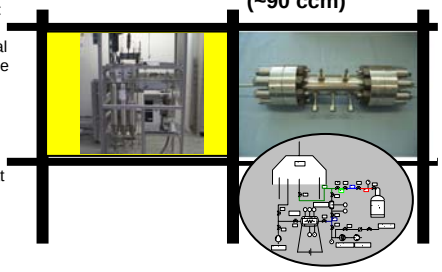
Improved synthesis of catalyst: Ti_{13}*6THF

- Kinetics is improving with increasing number of cycles for Na-alanates
- Reversible storage capacity is stable around 4 wt.% H_2
- Comparably constant behaviour, unlike the standard material in the literature



H_2 measuring device built up for determination of: H_2 uptake, H_2 release, technical kinetics, influence of material densification, influence of H_2 impurities, influence of additives for heat transfer

Sieverts rig **Test reactor (~90 ccm)**



Screening experiments for synthesis and characterization for new mixed alanates:

Systems studied are mixtures of Mg-Al-Li-H, Mg-Al-Ca-H, Mg-Al-Na-H, Mg-Al-K-H, Ca-Al-Li-H, Ca-Al-Na-H, Ca-Al-K-H. Peaks of new compounds found, but not reversible.

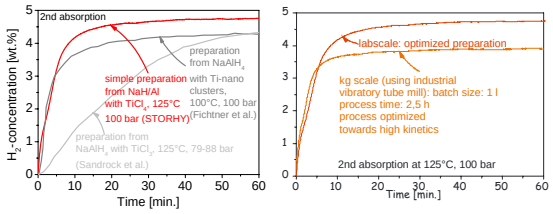
Alanes (AlH_3)

Simplified method to synthesize AlH_3 by milling at liquid nitrogen temperature, compared to wet chemistry. Improved comprehension of the desorption and stability behaviour of alanes.

Safety experiment with nanoscale storage material

Optimization of $NaAlH_4$ and up-scaling to industrial production

Evaluation of low cost production routes for complex hydrides using catalysed $NaAlH_4$ as model material

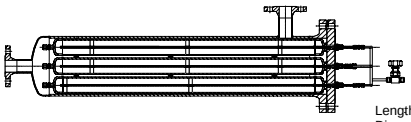


- fast kinetics can be achieved on kg scale
- optimization of capacity in progress

Design and development of prototype solid storage tanks

Length: 40 cm
Diameter: 6 cm
Capacity: 20 g H_2

Test tank for 500 g of alanate

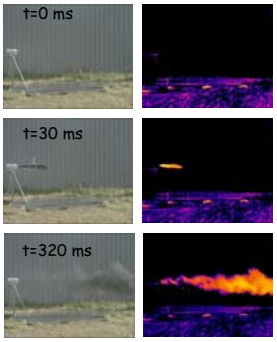


8 kg alanate pilot tank (currently manufactured)

Length: 129 cm
Diameter: 34 cm
Capacity: 0.4 kg H_2

Safety experiment

Infrared images



T = 120°C at disk opening

Safety experiment with Ti doped $NaAlH_4$. A batch of 100 ml of hot (130°C) nanoscale storage material was shot into ambient air with an over-pressure of 10 bar.

High speed images at different times are shown on the left, the corresponding infrared images are shown on the right.

The powder cloud did not self-ignite in the air.

Future Perspectives

The alanates investigated within StorHy show no possibility for vehicle application, according to the StorHy targets. Nevertheless, the results of this work have increased our knowledge of reaction mechanisms of complex alanates, upscaling, safety tests and tank constructions. In particular, there has been significant progress on cost efficient production routes for kinetically improved, up-scaled quantities of sodium alanate. The experience gained can be applied to other promising complex hydride materials.

Partners	❖ Institute for Energy Technology IFE (NO) ❖ Forschungszentrum Geesthacht GKSS (DE) ❖ Forschungszentrum Karlsruhe FZK (DE) ❖ Daimler AG (DE) ❖ NCSR Demokritos (EL)
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