Fraunhofer IFAM

Fraunhofer Institute for
Manufacturing Technology and
Advanced Materials IFAM
Branch Lab Dresden

METAL HYDRIDE TECHNOLOGY FOR HYDROGEN STORAGE, PURIFICATION AND COMPRESSION APPLICATIONS

SOLID HYDROGEN CARRIERS

Solid Hydrogen Carriers (SHC)

Hydrogen can be safely stored in a very compact form and at low pressure through a chemical reaction with a hydrogen-absorbing alloy: A solid metal hydride is formed (Fig. 1). Fraunhofer IFAM designs, produces and characterizes hydride forming alloys according to customer requirements using state-of-the-art methods.
In addition, we provide engineering services for the design, construction, and testing of metal hydride storage tanks and other metal hydride-based systems, including integration into fuel cell power systems.

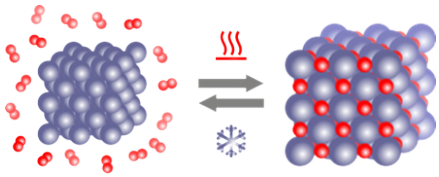

Fig. 1 Metal hydride formation (schematics)

Applications

- Hydrogen storage
- Thermochemical hydrogen compression
- Hydrogen purification (7.0 and better)
- Hydrogen separation from gas mixtures
- D_2 / H_2 separation
- Hydrogen gettering
- Thermochemical devices (heat/cold production in e.g. FC-vehicles)

Metal Hydrides made at Fraunhofer IFAM

- Based on transition metal alloys, e.g. Fe-Ti, Zr-Mn, La-Ni or Ti-Mn
- Complex hydrides (including dopants), e.g. $LiAlH_4$, $NaAlH_4$ or $LiNH_2$
- Based on lightweight metal alloys, e.g. Mg-Ni or Mg-RE alloys

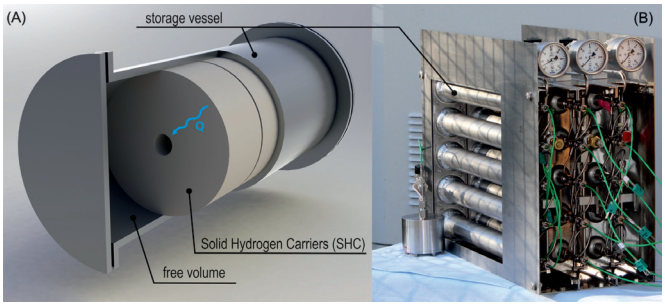

Fig. 2 A: Schematic drawing of a SHC storage module. B: A 15-module storage device equipped with temperature, pressure, and filling level sensor.

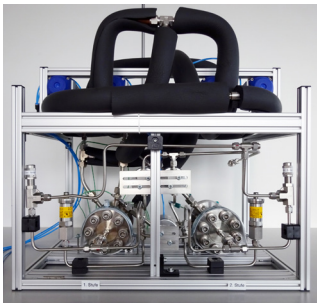

Fig. 3 Two-stage metal hydride compressor testing unit (max. 200 bar, 400 °C).

Fig. 4 Metal hydride composites for dynamic sorption processes.

Research and Engineering Services at Fraunhofer IFAM

- Metal hydride (MH) development and testing:
  - Storage capacity
  - Hydrogenation kinetics
  - Heat and gas transfer properties
  - Cycle stability
  - State-of-health analysis
  - Reactivation and recycling
- Production of MH composites (dynamic hydrogen sorption in minutes):
  - MH-metal composites
  - MH-graphite composites
  - MH-polymer composites
- Testing and evaluation of MH (in operando, post mortem)
- Development and testing of MH processing technologies
- Design and construction of MH storage tanks and MH cartridges
- Simulation of hydrogen loading and unloading processes in MH storage tanks
- Reliability tests of MH tanks
- System integration of MH storage tanks with:
  - Electrolysers
  - H_2 fuel cells
  - H_2 internal combustion engines
- System development and testing of MH-based devices:
  - H_2 compressors (vibrationless)
  - Heat pumps
  - Thermoboosters
  - D_2 / H_2 separators
  - H_2 purifiers
  - Thermomechanical actuators
  - MH gauges (filling meters)

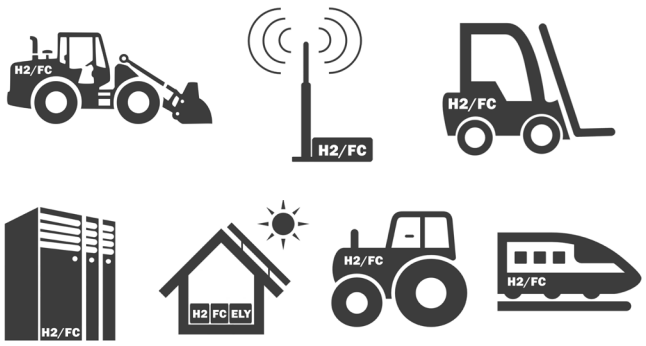

Fig. 7 Metal hydrides for hydrogen storage applications to run wheel loaders, submarines, forklift trucks, railed vehicles, stationary power devices and portable electronics.

Fig. 5 Test rig for metal hydride tank evaluation.

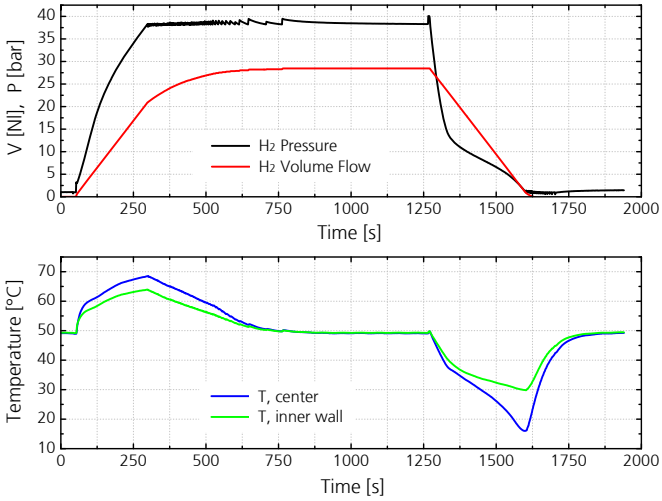

Fig. 6 Fast loading and unloading characteristics of metal hydride composite materials (cf. Fig. 4). Hydrogen is absorbed and desorbed in a few minutes.

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