METAL HYDRIDE TECHNOLOGY

LOW PRESSURE HYDROGEN STORAGE

Metal Hydrides

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 hydrogen storage materials 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. 2).

Applications

- Hydrogen storage
- Hydrogen purification (7.0 and better)
- D₂ / H₂ separation
- Hydrogen gettering
- Hydrogen separation from gas mixtures
- Thermochemical devices

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. LiAlH₄, NaAlH₄ or LiNH₂
- Based on lightweight metal alloys, e.g. Mg-Ni or Mg-RE alloys

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Fig. 1 Metal hydride formation (schematics)  Fig. 2 Metal hydride fuel cell power system
Metal hydride (MH) development and testing:
- Storage capacity
- Hydrogenation kinetics
- Heat and gas transfer properties
- Cycle stability
- State-of-health analysis
- Recycling

Production of MH composites:
- 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
- H₂ fuel cells
- H₂ internal combustion engines

System development and testing of MH-based devices:
- H₂ compressors (vibrationless)
- Heat pumps
- Thermoboosters
- D₂ / H₂ separators
- H₂ purifiers
- Thermomechanical actuators
- MH gauges (filling meters)

Fig. 3 Flow diagram test rig

Fig. 4 Loading and unloading characteristics of a metal hydride