Metal Hydride Technology

1. Uniaxial press for the densification of metal hydride composites
2. Cross-section of metal hydride composites (blue-red) with optimized heat transfer properties
3. Metal hydride composites for high-density hydrogen storage
4. Metal hydride storage tank for stationary fuel cell power systems

Hydrogen gas can be stored highly compactly at low pressure through a chemical reaction with a hydrogen absorbing alloy whereby a solid metal hydride is formed (Fig. 1).

Based on our customer demands, Fraunhofer IFAM designs, fabricates and characterizes hydrogen storage materials with state-of-the-art methods. Furthermore, we offer engineering services to design, construct and test metal hydride storage tanks and other metal hydride-based devices, including their integration into hydrogen power systems (Fig. 2).

Materials Classes Offered by Fraunhofer IFAM

- Transition metal hydride-forming alloys, e.g.: Fe-Ti, Zr-Mn, La-Ni, Ti-Mn alloys
- Complex hydrides (including dopants), e.g. LiAlH4, NaAlH4, LiNH3
- Lightweight hydride-forming alloys, e.g.: Mg-Cu, Mg-Ni, Mg-RE alloys

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Metal Hydride Research and Engineering Services

- Production and manufacturing of hydrogen storage materials
- Metal hydride „design“ regarding:
  - Storage capacity
  - Hydrogenation kinetics
  - Heat and gas transfer properties
  - Cycle stability
  - State-of-health analysis
  - Recycling
- Metal hydride composites
- Testing and evaluation of metal hydrides (in operando, ex situ)
- Development and testing of metal hydride processing technologies
- Design and construction of metal hydride storage tanks and cartridges
- Simulation of hydrogen loading and unloading processes in metal hydride storage tanks
- Reliability tests of metal hydride tanks
- System integration of metal hydride storage tanks with
  - Electrolysers
  - H₂ fuel cells
  - H₂ internal combustion engines
- System development and testing of metal hydride-based devices:
  - H₂ compressors (vibrationless)
  - Heat pumps
  - Thermoboosters
  - D₂ / H₂ separators
  - H₂ purifiers
  - Thermomechanical actuators
  - Metal hydride gauges (filling meters)

5 Metal hydride tank for a fuel cell vehicle
6 In-operando testing of metal hydride composites (here: radiography)
7 Universal testing reactor for metal hydrides (200 bar; max. 400 °C)
8 Test rig for metal hydride tank evaluation

Fig. 3 Flow Diagram Test Rig

Fig. 4 Loading and unloading characteristics of a hydrogen storage material (hydride)