Hydrogen is an environmentally friendly energy carrier with a very high gravimetric energy density. Its chemical energy can be readily converted to electrical energy by means of fuel cells. However, direct storage of pressurized H₂ is difficult as it involves expensive, heavy and bulky tanks as well as safety fittings, which goes far beyond the requirements for many portable applications. In low power applications especially, diffusion losses limit the direct storage of hydrogen.

Metal hydrides as lightweight, compact, non-volatile, safe and reasonably priced compounds overcome these issues. In combination with water they can thus serve as energy sources similar to conventional or special batteries (e.g. Li-SOCl₂) but with a gravimetric and volumetric energy density at least one order of magnitude higher.

### Applications

- backup / emergency power supplies
- standalone radiocommunication
- beacons
- sensors
- probes

### Properties of Lightweight Metal Hydrides

**NaH**
- gravimetric H₂ density of 8.4 %
- electric energy density 1259 Wh/kg
- very fast hydrolysis kinetics

**MgH₂**
- gravimetric H₂ density 15.3 %
- electric energy density 2295 Wh/kg
- slow hydrolysis kinetics

**LiH**
- gravimetric H₂ density 25.4 %
- electric energy density 3800 Wh/kg
- fast hydrolysis kinetics

1) under the assumption that H₂O is recuperated / available in excess
Hydrolysis Reactions

MeH + H₂O → H₂ + MeOH

In hydrolysis reactions both the total amount of released hydrogen and the reaction kinetics strongly depend on a number of factors:
- type of hydride
- active surface area
- pH
- presence of buffers
- salinity of water
- water temperature

Beyond that the reaction is catalyzed by the addition of certain Lewis acids. Therefore, an optimization of hydrolysis reactions is feasible for a wide range of different applications.

Fraunhofer R&D Services

- Development of storage materials with regard to specific requirements, e.g.
  - suitable kinetics
  - high energy density
  - environment-related aspects
- Development of materials processing technologies
- Specialized water treatment (e.g. for sea water applications)
- Construction, test and evaluation of metal hydride cartridges suitable for hydrolysis
- Safety and reliability tests
- System development and testing
- System integration with fuel cells
- Software development

All measurements were performed with de-ionized water at pH₀ = 4.5; T₀ = 20 °C and a weight ratio of 1:100.

Fig. 1 Time-dependent hydrogen generation for mixtures of commercially available MgH₂ and activated MgH₂ with various solid catalysts