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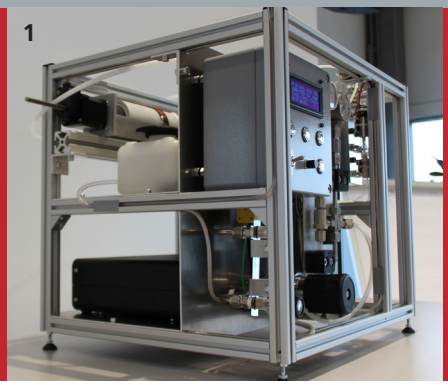

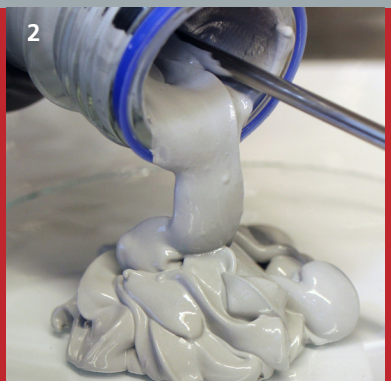

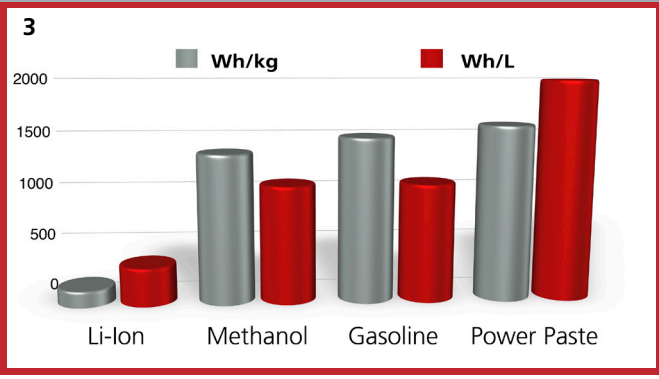

1 *TRL 4 prototype (50 W)*
2 *MgH_2 Power Paste*
3 *Electrical energy densities of energy storage materials*

POWER ON DEMAND BY MgH_2 HYDROLYSIS

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Power Paste Key Facts

The hydrolysis reaction of MgH_2-based paste (Power Paste) with water is a very promising means to generate hydrogen for ultra high energy fuel cell applications. Through hydrolysis of Power Paste, hydrogen storage capacities of more than 10 wt.-% are possible if water is available on-site. In combination with fuel cells, material specific electrical energy densities as high as **1.6 kWh/kg** and **1.9 kWh/liter** can be achieved - including all conversion losses. This makes the specific energy of Power Paste **ten times higher** than in lithium ion batteries.

By providing a paste, not only ultra-high power densities as well as a highly controlled and safe hydrogen production reaction can be achieved. Also the amount of produced hydrogen can be matched exactly to the requirements of the fuel cell at any time and for all load scenarios through a microprocessor controller and simple mechatronical components.

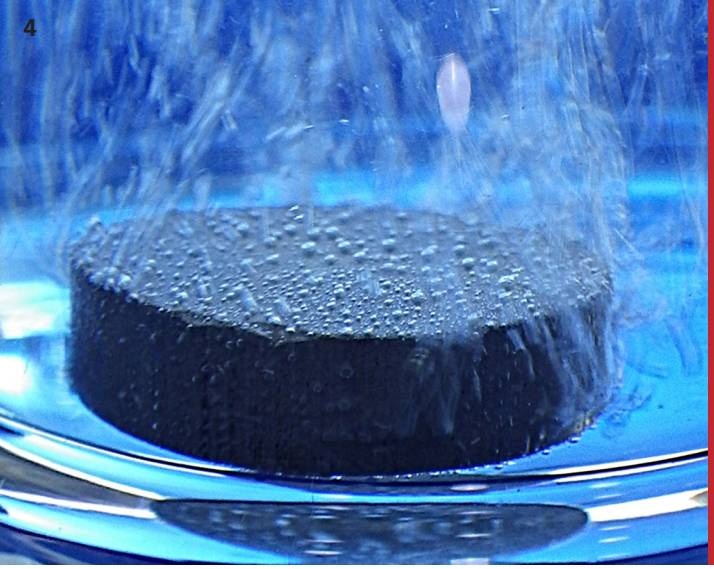
Applications

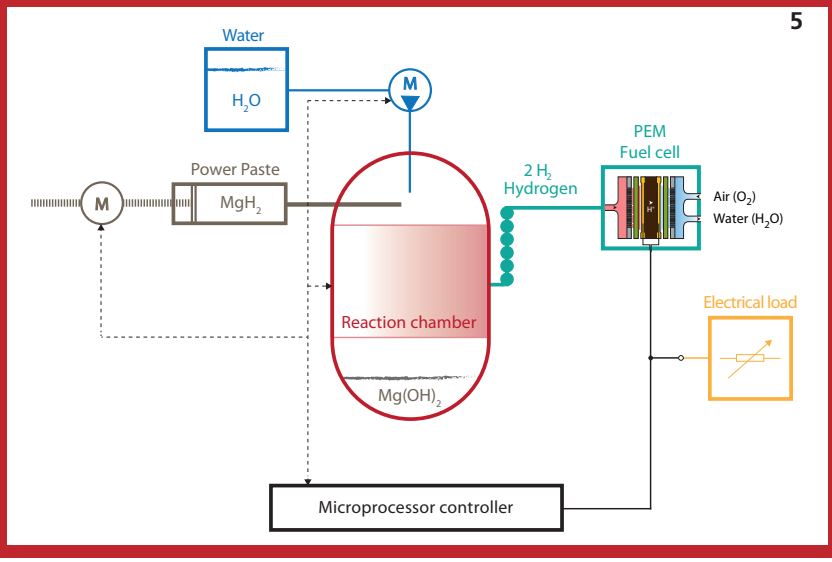
- Backup and emergency power
- Electric bicycles
- Unmanned aerial vehicles
- Personal power generators
- Medical devices
- Marine power generators
- Camping and outdoor equipment
- Surveillance and security systems

Advantages of Power Paste

Power Paste as hydrogen storage material for hydrolysis reactions has a variety of advantages over other high energy materials:

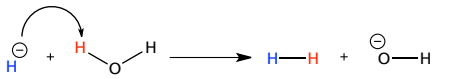
- Ultra-high energy densities
- Long shelf life (no self-discharge)
- Non-toxicity and safety of all materials
- No special fuel cells (no reformers)
- Instantaneous energy output
- Noiseless and zero emission
- Operation temperature: –30 °C to 80 °C
- Power range: 1 W to 10 kW





Detailed Information

$$MgH_2 + 2\,H_2O \longrightarrow 2\,H_2 + Mg(OH)_2\downarrow$$



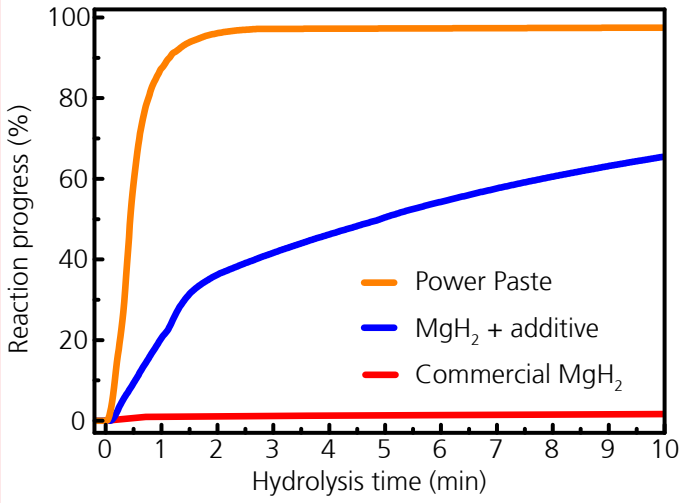
The storage technology is based on a chemical reaction between magnesium hydride (MgH_2) and any kind of water (H_2O) to hydrogen (H_2) and non-toxic magnesium hydroxide ($Mg(OH)_2$).
When MgH_2 in Power Paste is hydrolyzed, half of the generated hydrogen comes from the water, which is one reason for its ultra-high energy capacity. However, normally, the reaction is very slow due to passivation. At Fraunhofer IFAM, a special MgH_2-based paste with an optimal reaction characteristics has been developed. The underlying technology is patent-pending and has been awarded with the **2013 f-cell award**.

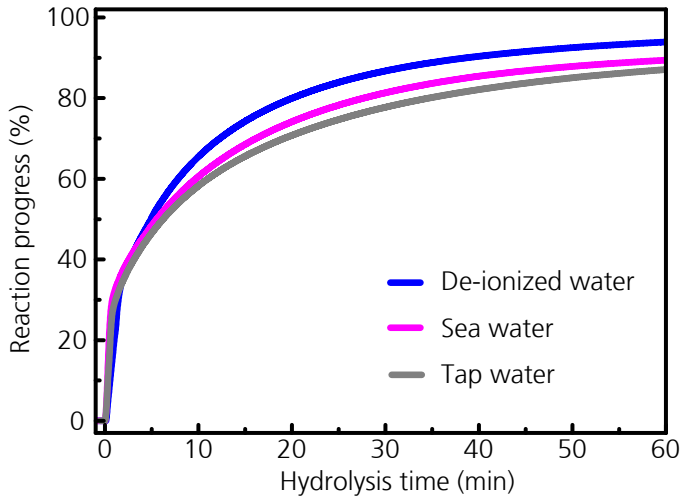
Fraunhofer R&D Services

At customer's demand, Fraunhofer IFAM develops power-on-demand solutions based on MgH_2 Power Paste including:

- Preparation and evaluation of hydrogen storage materials and pastes
- Power Paste production up-scaling
- Construction and evaluation of hydrogen generators and Power Paste cartridges
- System integration with fuel cells (construction of power generators)
- Feasibility studies and market analyses
- Tailored technology adaptation to specific customer needs
- Safety and reliability tests

4 *Hydrolysis reaction of MgH_2*
5 *Outline of a hydrolysis power generator*





Left: Time-dependent hydrogen generation for conventional MgH_2 and MgH_2 + additive in comparison with Power Paste.

Right: Perfomance of MgH_2 + additive with different water qualities under pseudo-isothermal conditions.