

## Climate-friendly hydrogen and fuel cells

As a versatile energy carrier, hydrogen will play a key role in the long-term success of the energy transition and in climate protection. In addition to climate policy aspects, hydrogen and fuel cell technologies pave the way for many sustainable jobs, new value chains, and a global market worth billions. With this in mind, [Fraunhofer IFAM](#) is developing innovative materials, manufacturing technologies, and technical components so that technical systems for the production, distribution, storage, and use of hydrogen can become more efficient, robust, safe, and economical.

Our development spectrum ranges from hydrogen production, storage and distribution to its conversion into energy or materials, for example in fuel cells. Major challenges are not only the material and manufacturing costs of components, but also their efficiency and durability, in order to arrive at sustainable and economically viable solutions. Current research work on hydrogen and fuel cells at Fraunhofer IFAM is presented below using specific examples.

### Hydrogen production:

**Scalable electrodes for alkaline electrolysis:** Fraunhofer IFAM is extensively involved in the further development of electrodes for alkaline electrolysis and the scaling of the production route. The manufacturing route addresses in particular the research questions of scalable production, raw material-conserving process steps, and highly active and long-term stable electrodes up to 1.6 meters in diameter.

**Seawater electrolysis:** The direct electrolysis of seawater has the advantage that the provision of expensively treated water can be dispensed with. However, this technology requires completely new material concepts since the conditions inside the electrolysis cell are highly corrosive. Components of seawater electrolyzers (electrocatalysts, anion exchange membranes, coatings for bipolar plates, etc.) are being developed at the Dresden and Bremen sites of Fraunhofer IFAM.

**Transport and infrastructure:** Fraunhofer IFAM is working on use of unique material test stands on Helgoland and material development and testing for LOHC tanks (LOHC: Liquid Organic Hydrogen Carrier). Other contents include the development and testing of sustainable corrosion and fouling protection concepts for the protection of offshore structures for the production and transport of hydrogen. Fraunhofer IFAM, is actively involved in the development of concepts for the reliable operation and safe maintenance of infrastructure in maritime environments.

### Storage of hydrogen:

**Metal hydrides** are solids which can be used in various applications such as sorptive hydrogen storage or thermochemical hydrogen compression. The aim of Fraunhofer IFAM is to develop metal hydride systems for commercialization. Compared to conventional technology, which often uses highly porous hydrides in the form of granules or powders, advanced metal hydride composites consisting of the hydride-forming metal alloy and secondary auxiliary materials such as graphite and/or polymers are used. These secondary materials ensure that the composites can retain their shape as well as increase the reaction kinetics over their lifetime, resulting in greater economy.

**POWERPASTE - Hydrogen storage solution for small vehicles & more:** One of the greatest challenges of hydrogen technology is the safe provision of hydrogen at the point of use. The elements of hydrogen logistics, refueling infrastructure, but also hydrogen storage play a key role here. POWERPASTE - a patented invention of Fraunhofer IFAM - is a novel hydrogen storage material based on the light metal hydride  $MgH_2$ , which enables the use of hydrogen when one or more of these elements are missing or uneconomical for an application. POWERPASTE can be filled into cartridges and release hydrogen in a hydrolysis reactor by dosing the paste and adding water. By means of a suitable reaction control, hydrogen is released as required, i.e. only as much hydrogen is produced as is needed at any given time - for example by a PEM fuel cell.

*Fraunhofer is one of the world's largest applied R&D organizations, with nearly 80 research units in all sectors of industry, 30000 employees and an annual outlay of Euros 2.9 billion. Of this sum, 2.4 billion euros is generated through contract research. Our global footprint is very strong, with offices and research centers in the Europe, USA and Asia. Some of our renowned innovations are the MP3 format, the white LED, the smallest of cameras. Fraunhofer covers the entire spectrum of energy (Renewables, Storage, E-Mobility, Grid, Hydrogen...) across the value chain from materials to testing and certification. Fraunhofer has been active in India since the past several years, bringing innovative technologies and research competence to India. Fraunhofer in India is the chosen R&D and innovation technology partner of some of the major players in the field of Energy, Environment, Automotive, Electro-mobility, Materials, Production Technology and Smart Cities working with Industry, Government and Public Sector.*

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Thanks and Regards,

Ms. Anandi Iyer  
Director, Fraunhofer Office India

Mr. Sanmati Naik  
Sr. Manager - Energy (RE), Fraunhofer Office India  
405-406, 30 MG Road, Bengaluru – 1  
E-Mail: [sanmati.naik@fraunhofer.in](mailto:sanmati.naik@fraunhofer.in)  
Tel: +91 80 40965008/09  
[www.fraunhofer.in](http://www.fraunhofer.in)      [www.fraunhofer.de](http://www.fraunhofer.de)