

Pressemitteilung

Fraunhofer-Institut für Angewandte Polymerforschung IAP

Dr. Sandra Mehlhase

20.03.2025

<http://idw-online.de/de/news849323>

Forschungs- / Wissenstransfer, Wissenschaftliche Tagungen
Chemie, Energie, Umwelt / Ökologie, Verkehr / Transport, Werkstoffwissenschaften
überregional



Hydrogen: catalysts and membranes for a sustainable future

Hydrogen is regarded as key energy source of the future. The Fraunhofer Institute for Applied Polymer Research IAP is developing and processing novel catalysts and PFAS-free membranes to make the technologies for producing and using hydrogen more environmentally friendly, cost-effective and durable. At the Hannover Messe (Hall 13, Booth C41/2), the institute will be presenting its contributions at the Fraunhofer Hydrogen Network booth.

Precious metal-reduced catalysts for electrolysis and fuel cells

Catalysts are indispensable components for the production of hydrogen as well as its conversion in fuel cells for the generation of electrical energy. Their main task is to accelerate electrochemical reactions. Their quality and cost therefore have a direct influence on the performance, durability and economic efficiency of these systems.

Nanoscale precious metals such as platinum are typically used as the catalytically active electrode material - a rare and expensive metal whose extraction is associated with considerable environmental pollution. In order to improve ecological and economic sustainability, scientists at Fraunhofer IAP are developing new types of multi-element catalysts that use significantly less platinum without compromising performance. Multi-element catalysts consist of several metals or elements and enable several functionalities on one catalyst surface at the same time. Compared to conventional catalysts, they therefore offer higher activity, longer service life and lower CO₂ emissions.

PFAS-free ion-conducting membranes

Proton- or anion-conducting membranes are also key components in electrolyzers and fuel cells. They ensure ion transport with simultaneous electrical insulation and gas separation.

Until now, membranes based on per- and polyfluoroalkyl substances (PFAS) have dominated the market, as they are very efficient and chemically stable. However, they entail considerable ecological, health and economic risks: PFAS are considered to be persistent chemicals that are difficult to degrade, they accumulate in the environment and in the human body, are suspected of being carcinogenic, and are complex and costly to produce and dispose of.

In response to these challenges and in view of stricter EU environmental regulations, Fraunhofer IAP is developing PFAS-free membranes that are not only more environmentally friendly, but also more efficient and durable. These membranes offer significant advantages, particularly in applications with high operating temperatures such as fuel cells.

In current research projects, the scientists are combining these innovative membranes with the precious metal-reduced multi-element catalysts they have developed themselves. Their goal: efficient, catalyst-coated membranes which, as core components in electrolyzers and fuel cells, are significantly more environmentally friendly, cheaper to manufacture

and more powerful in use.

Membranes for hydrogen purification

The hydrogen produced by electrolysis contains moisture and impurities that can impair both the quality and safety of the gas. This makes efficient processes for separation, purification and drying all the more important. Innovative membranes specially designed for low pressures are being developed at the Fraunhofer IAP for this purpose. The membranes for drying are also used in other industrial sectors such as biogas processing.

A unique feature of membrane development at the Fraunhofer IAP is the precise adaptation of the membrane to specific process requirements. This includes both the synthesis of optimized polymers and the targeted tuning of the membrane structure during production. In this way, properties such as permeability, pore size, porosity, stability and permeability can be precisely tailored for the respective application.

At the Hannover Messe, the institute will be presenting a test module that separates hydrogen from exhaust air in the low-pressure range. The purified and dried hydrogen is then available for further technical applications.

Scaling for industrial use

To ensure that the newly developed materials quickly can become economically competitive and usable in industry, the Fraunhofer IAP can scale up the manufacturing processes for catalysts and membranes to industry-relevant levels.

In the development of catalysts, the researchers rely on the production of high-quality nanoparticles using flow synthesis. This process, developed and patented by Fraunhofer IAP, enables the scalable production of precisely defined catalyst nanoparticles on a pilot plant scale.

The polymers required for the membranes can be synthesized up to the ton scale at the Fraunhofer Pilot Plant Center for Polymer Synthesis and Processing PAZ. The high-performance membranes developed are processed in rolls, which ensures efficient and continuous production for industrial use.

All these developments mark important steps towards a more sustainable and efficient hydrogen economy. Interested parties at the Hannover Messe are cordially invited to find out more about these innovative Fraunhofer IAP technologies at the Fraunhofer Hydrogen Network booth (Hall 13, Booth C41/2).

The Fraunhofer Hydrogen Network

The Fraunhofer Hydrogen Network combines the expertise of 39 Fraunhofer Institutes and covers the entire hydrogen value chain - from production, storage and distribution to infrastructure and a wide range of applications in industry, mobility, energy and heating. The aim of the network is to develop market-ready hydrogen technologies and thus make an important contribution to the energy transition.

URL zur Pressemitteilung: https://www.iap.fraunhofer.de/en/press_releases/2025/hydrogen-catalysts-and-membranes-for-a-sustainable-future.html to the Press release

URL zur Pressemitteilung: <https://www.fraunhofer.de/en/research/fraunhofer-strategic-research-fields/hydrogen-technologies/fraunhofer-hydrogen-network.html> to the Fraunhofer Hydrogen Network



PFAS-free, catalyst-coated membranes are set to make electrolyzers and fuel cells significantly more environmentally friendly, cost-effective and powerful in the future.

© Fraunhofer IAP, Jadwiga Galties