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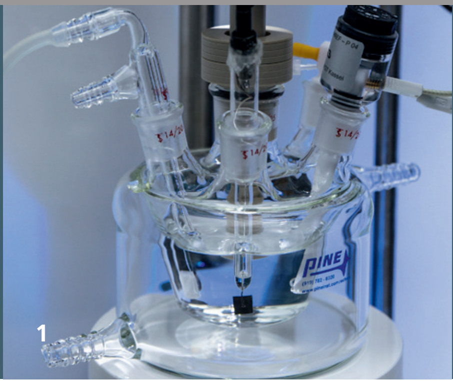

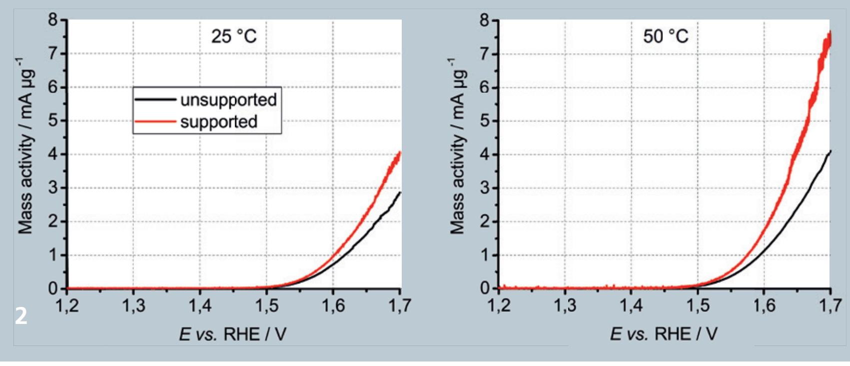

1 *Rotating disc electrode.*

2 *Increase of oxygen evolution activity with SiC-based catalyst support.*

INNOVATIVE MATERIALS TO REDUCE THE COST OF PEM WATER ELECTROLYSIS

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Introduction

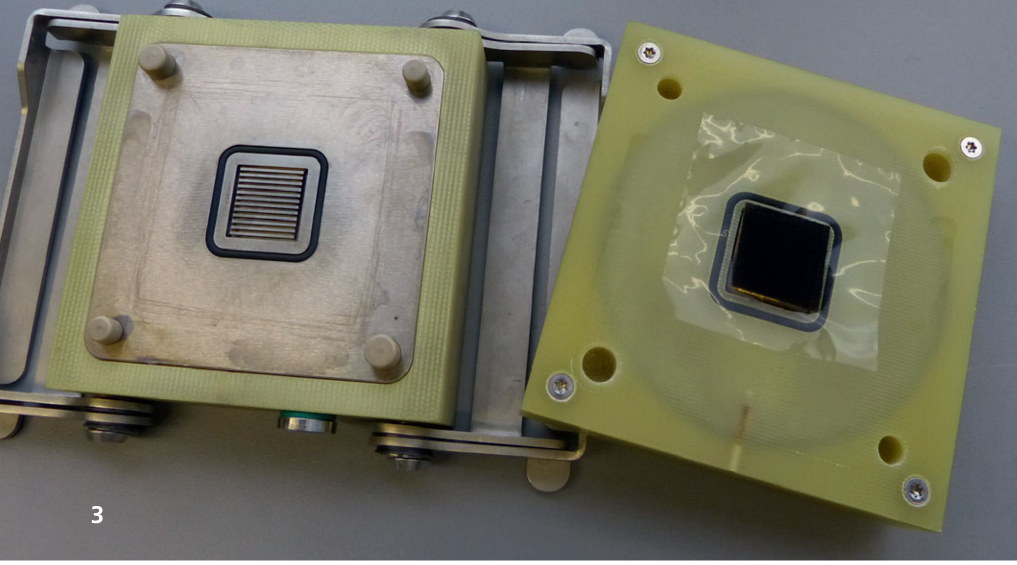
Proton exchange membrane water electrolysis (PEM-WE) offers the possibility of generating ultrapure H_2 from renewable energy sources. When the process is coupled for example with wind turbines or solar cells, excess electricity can be stored as H_2 gas. Liquid water is oxidized to O_2 at the anode, while protons are conducted through the membrane and reduced to H_2 at the cathode.

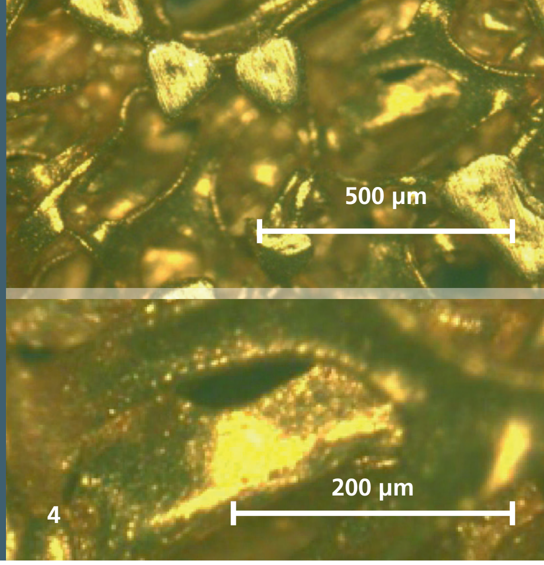
Challenge: catalyst

One of the main research areas for PEM-WE at Fraunhofer ICT is the development and optimization of new cost-efficient catalysts for oxygen evolution. The first steps are synthesis and electrochemical characterization, mainly via a rotating disc electrode, which only requires a small amount of catalyst and is consequently ideal for the rapid screening of different materials or compositions.

Approach: support material

In order to reduce the amount of catalyst and hence the costs, our approach is to disperse the catalyst on a support material. One of the main challenges is to obtain sufficient stability for use at high electrode potentials. Our group at Fraunhofer ICT was able to identify a suitable support material based on SiC. The oxygen evolution activity of an iridium-oxide-based catalyst could be increased substantially using this SiC-based support, especially at high temperatures.





Porous transport layer

Another PEM-WE research area at Fraunhofer ICT focuses on the evaluation and optimization of porous transport layers. These components establish electrical contact between the catalyst layer and the bipolar plate. At the same time they provide good mass transport of liquid water into the cell and gaseous reaction products out it.

Figure **4** shows an example of a metallic foam, functionalized with a thin gold layer. This layer reduces contact resistance and helps to prevent the corrosion of the components.

Membrane-electrode assembly

In order to investigate the newly synthesized and optimized components in terms of their application, membrane-electrode assemblies are produced and characterized in single-cell measurements. The measurement environment is similar to that of industrial stacks, with only one cell (see figure **3**).

Our expertise

- Catalyst synthesis (oxygen evolution and hydrogen evolution)
- Development of the catalyst support
- Physical characterization (e.g. XRD, BET, particle size)
- Electrochemical characterization (e.g. RDE)
- Porous transport layers and gas diffusion layers
- Development and fabrication of membrane-electrode assemblies
- Single-cell measurements

Desired partners

Manufacturers of:

- Water electrolysis systems
- Catalysts
- Proton exchange membranes and binders
- Porous transport layers
- Bipolar plates

Other partners that use or are interested in:

- Hydrogen storage and hydrogen technology
- Renewable energy
- Metallic foams for other applications, e.g. current collectors

3 *Single-cell holder for investigation of membrane-electrode assemblies.*
4 *Gold-coated nickel foam.*