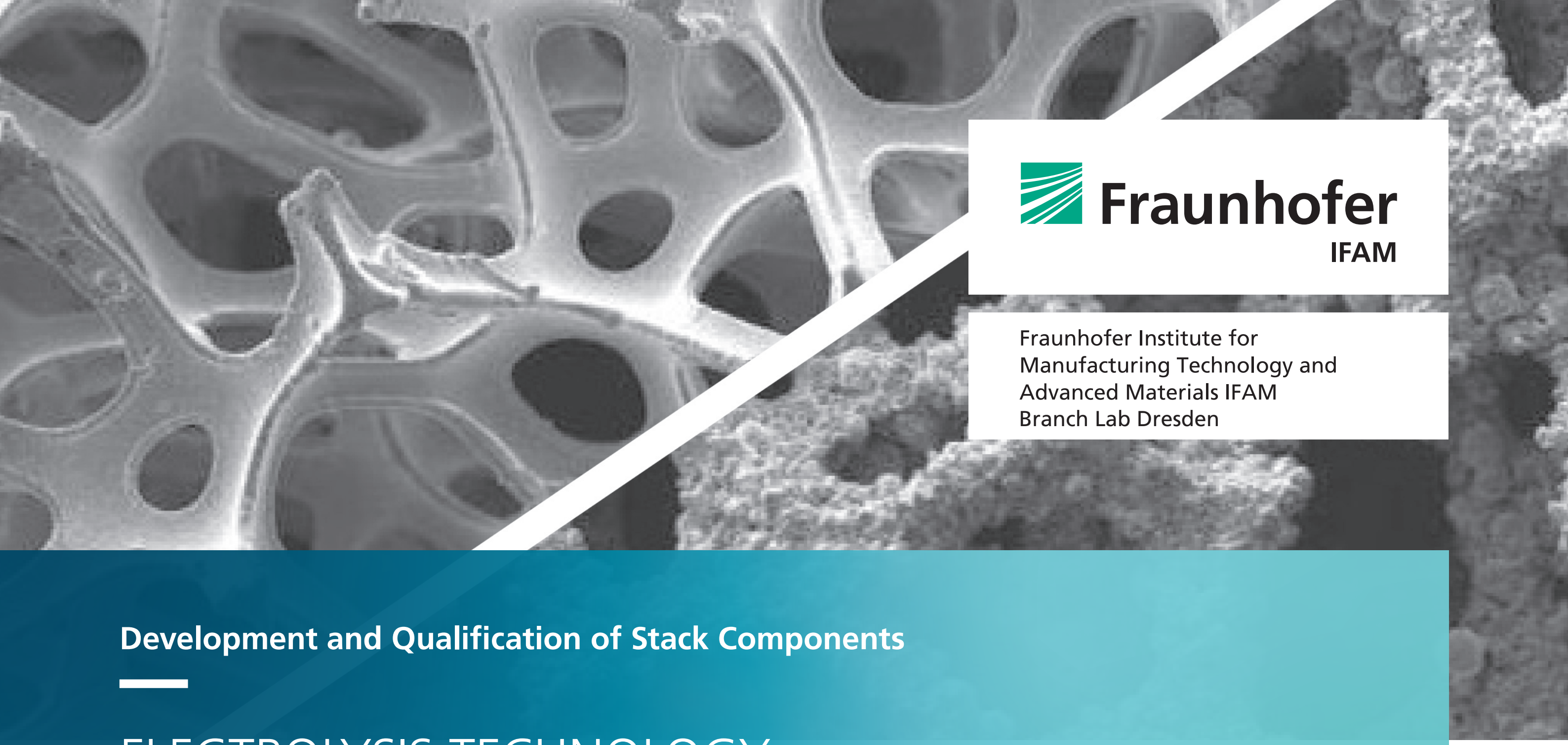


Fraunhofer IFAM

Fraunhofer Institute for
Manufacturing Technology and
Advanced Materials IFAM
Branch Lab Dresden

Development and Qualification of Stack Components

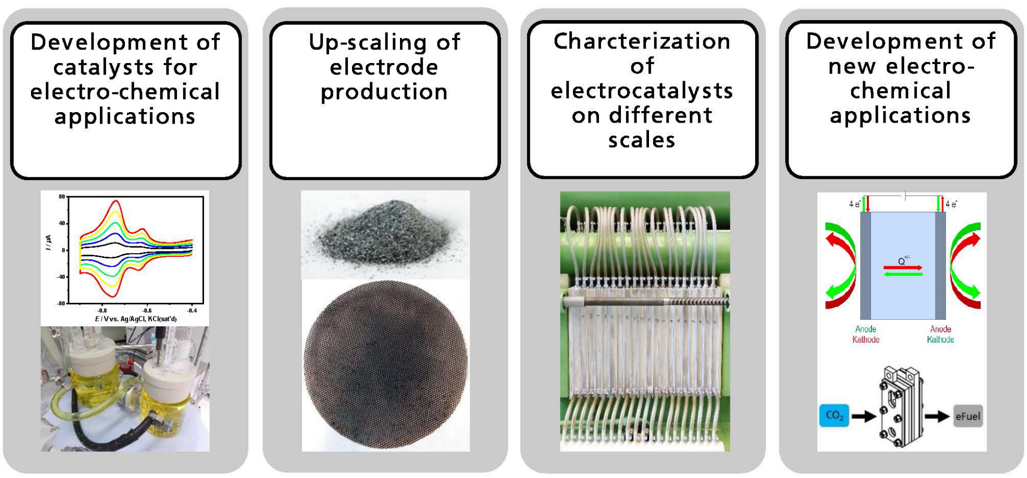
ELECTROLYSIS TECHNOLOGY

Electrodes for Energy Conversion

The electrodes are key components of any electrochemical reactor.
At Fraunhofer IFAM, we develop, manufacture and test electrodes for various applications, e.g. hydrogen production or CO_2 conversion. Tailored selectivity and high activity of the electrocatalyst improve the efficiency of the energy conversion process. In this regard, 3D electrodes with a multi-hierarchy porosity are our speciality. The 3D structure provides a huge active surface area for the electrochemical reaction and also maximizes the product turnover.

Electrode Production

An appropriate production process is crucial to minimize the costs of the electrodes. At Fraunhofer IFAM, different methods (e.g. powder metallurgy, electrodeposition, spraying, printing) can be applied to produce highly efficient and robust electrodes.



Schematic description of Fraunhofer IFAM's R&D offer to customers

In cooperation with our industrial partners, the process is scaled up in order to obtain a high output at yield.

Hydrogen Production

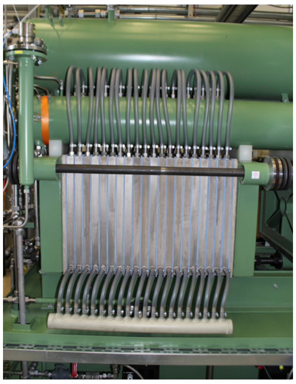
Hydrogen can be produced directly from renewable energy sources by water electrolysis. At Fraunhofer IFAM, new electrode materials are fabricated and tested regarding their hydrogen and oxygen evolution activity and long-term stability. Electrodes are tested in small (cm^2) and large (several dm^2) test cells.

Electrochemical CO_2 Conversion

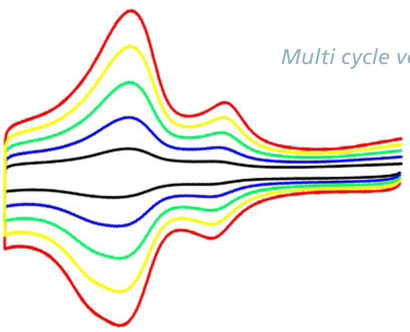
Fraunhofer IFAM develops electrocatalysts for the electrochemical reduction of carbon dioxide (ERC) to produce valuable chemicals (e.g. formic acid, carbon monoxide).

AEL stack component qualification and development

Fraunhofer offers customers the qualification and development of stack components for the AEM and the AEMEL. For this purpose, the laboratory infrastructure can be used to qualify e.g. separators, PTLs, seals, electrodes, electrode-separator-packages and MEAs. Furthermore, IFAM has a long-standing expertise in the development of electrode materials (substrate, PTL and catalyst) for the AEL and the AEMEL, as well as the optimization of electrode-separator configurations.



30 kW AEL System at Fraunhofer IFAM



Multi cycle voltammogram

Analysis techniques:

- Electrochemical analysis
  - Cyclic voltammetry (CV)
  - Impedance spectroscopy (EIS)
  - Polarization methods
- Scanning tunneling microscopy (STM)
- Electrochemical STM (EC-STM) and scanning electrochemical potential mapping (SECPM) for *in situ* experiments

Electrode Testing under Real Operation Conditions

All electrode materials can be tested under realistic operation conditions to demonstrate their applicability (e.g. at 80 °C and 30 wt.%-KOH). For this purpose, lab-scale electrolyzer cells are available in which the electrical energy consumption per generated hydrogen volume is determined. Due to the simplicity of the system different electrode configurations can be easily realized.

Lab-scale electrolyzer cells:

- Single cell or short-stack design
- Operating conditions
  - Up to 80 °C
  - Up to 30 wt.%-KOH
  - Atmospheric pressure
- *In situ* gas quality monitoring

AEL component test on industrial scale:

- 30 kW AEL electrolyzer
- 20 cells
- Atmospheric system
- Gap and zero-gap design
- Gas quality measurement
- Test of cell components on industrial scale

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