Fraunhofer ISE

Fraunhofer Institute for Solar Energy Systems ISE

**Upscaling Fuel Cells and Electrolyzers**

# Production Research on Membrane Electrode Assemblies

**www.ise.fraunhofer.de/hydrogen-technologies**

# Production Research on Membrane Electrode Assemblies

The membrane electrode assembly (MEA) is the electrochemical heart of electrolyzers and fuel cells. Our production research, from catalyst powder to seven-layer MEAs, comprises the influences of process design and parameters, materials and component architecture on MEA cost, quality and performance.

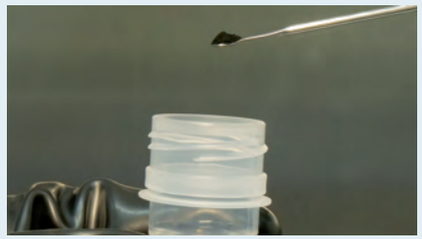
## Our Offer

Investigation of sheet-to-sheet as well as roll-to-roll processes for the production of MEAs from laboratory to industrial scale:

- catalyst ink formulation
- process variation and parameter evaluation for coating and drying
- direct printing or decal transfer route
- cutting and subgasket lamination
- application of porous transport layer or gas diffusion layer
- quality control along the process chain with in-line and off-line, industrial-scale or laboratory-scale ex-situ analytics
- investigation of effects of defects with state-of-the-art in-situ characterization
- techno-economic analysis of MEA production costs with respect to process technologies

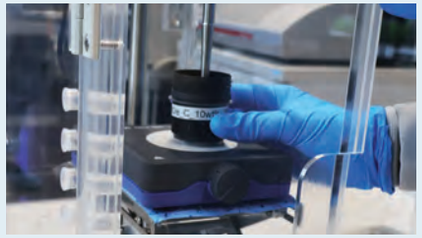
## Our Research and Development Covers the entire Production Process for MEAs

1 *Research services for solvent and ionomer mixing*



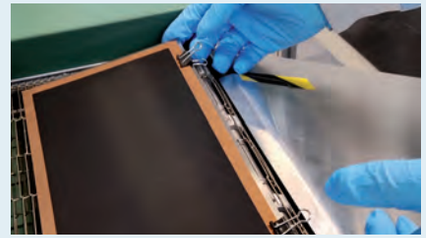
2 *Investigation of catalyst ink formulation with respect to different coating technologies*

3 *Development of catalyst ink mixing processes*



4 *Analysis of ink homogenisation processes to break up agglomerates*

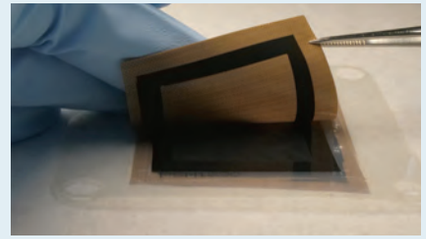
5 *Development of optimized coating processes and process parameters*



6 *Investigation and improving processes for drying wet catalyst layers*

7 *Research on both laboratory sheet-to-sheet and industrial roll-to-roll processes*

8 *Development of quality control methods for the entire value chain from catalyst powder to MEA*



9 *Investigation of production processes for the transfer, cutting and lamination from catalyst coated membranes (CCM) to MEAs*

## Upscaling Fuel Cells and Electrolyzers

The ramp-up of the electrolysis and fuel cell market is driving investments in machinery for mass production. At the same time, many aspects of high-throughput production have not yet been thoroughly investigated. In our research, we evaluate the process parameters along the entire value chain, from catalyst powder up to a full-scale seven-layer membrane electrode assembly, including quality control. We concentrate on laboratory-scale manufacturing processes with well-defined conditions – typically with sheet-to-sheet production – as well as industrial-scale processes such as roll-to-roll for mass production.

### Empowering the Membrane Production

Our portfolio addresses material and component developers, machine suppliers and manufacturers. We help to optimize machine process parameters to integrate new materials, components and process steps. In addition, we conduct research on innovative MEA designs. Our process validations include cost assessments to understand cost sensitivity in terms of machinery, material consumption, quality control, personnel, footprint and environmental impact, etc.

### We know MEAs

Our core competence is our understanding of the membrane electrode assembly. We emphasize four perspectives in our research and development. A strong in-situ characterization with state-of-the-art electrochemical measurement techniques enables us to evaluate MEA behavior in operation. Together with a broad range of ex-situ analytical equipment we can correlate MEA performance and degradation to its microstructure. With our industry-like MEA production processes we are able to design specific MEA architectures and use selected material compositions. Our modeling confirms our physical understanding of the MEA and allows for assessment of variations with regard to materials and operation mode.

## Further Information

## Virtual Tour of Fraunhofer ISE's MEA-Production Lab

## Contact

**Hydrogen Technologies – Production of Fuel Cells**
Linda Ney
Phone +49 761 4588-5484
fuelcell@ise.fraunhofer.de

Fraunhofer ISE
Heidenhofstr. 2
79110 Freiburg, Germany
www.ise.fraunhofer.de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