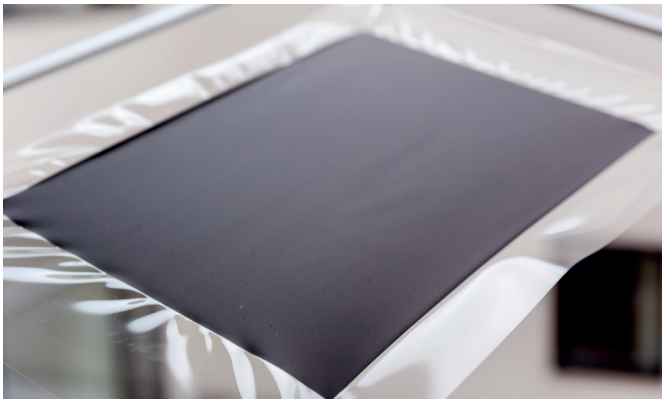
Fraunhofer ENAS

Technology

# Inkjet Printed Catalyst Coated Membrane (CCM) for Electrolysis Applications

## Fast Facts

- Research and development service provider
- Wide range of expertise in high-volume production of CCMs
- Availability of catalyst inks for inkjet



*Both side catalyst coated membrane (CCM) with the size of 17 cm x 17 cm.*

## General description

The European Union as well as national governments aim for the substitution of fossil energy carriers by renewables. One path into a climate neutral economy is to establish hydrogen as an energy carrier. The transfer of electrical energy into chemical energy can be realized with electrolyzers. A low temperature, polymer electrolyte membrane (PEM) electrolyzer (PEMEL) consists out of a stack of several tens of single cells. The heart of the PEMEL is a catalyst coated membrane (CCM).

The inkjet printing of catalyst inks is performed directly onto the polymer electrolyte membrane omitting the use of any intermediate decal substrate as well as the heat transferring of pre-manufactured layers onto membrane. Furthermore, the change in layout can be realized in every printout. The costly catalyst ink is deposited only at the area of the membrane that is used for the application. Based on the digital patterning, also gradient layers can be realized in plane as well as perpendicular to it.

## Main features of production technology

- Catalyst deposition directly onto membrane by inkjet printing
- Tailoring of: size, layer thickness, catalyst loading
- CCM for application in electrolyzers
- Manufacturing of layers with catalyst gradient distribution
- Variability of membrane type and thickness

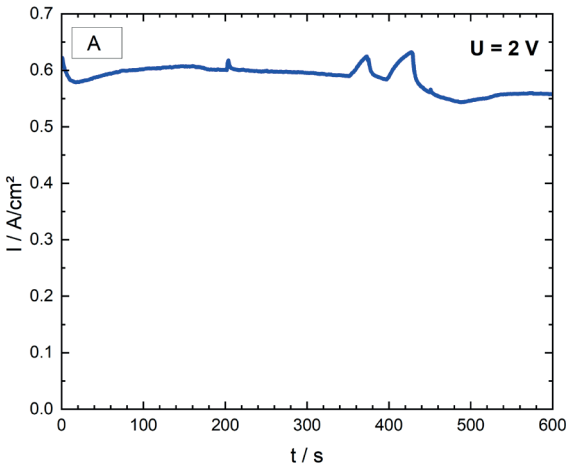
The inkjet process enables the usage of membranes of different vendors. The parameters for layer thickness as well as catalyst loading can be adjusted. An overview is given in table.

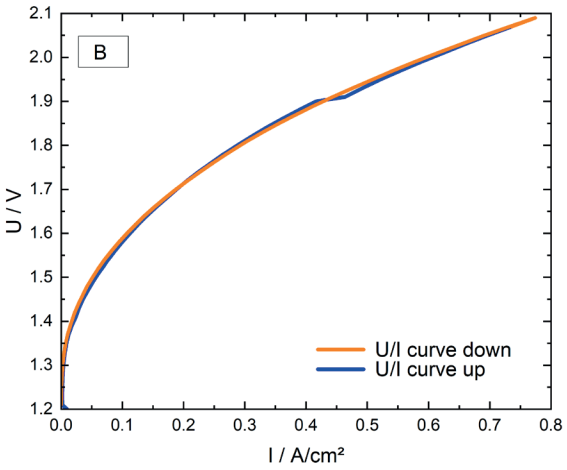
| Material | Width [cm] | Length [cm] | Thickness [µm] | Loading |
|---|---|---|---|---|
| PEM | max. 25 | max. 30 | 50 – 150 | n/a |
| **Anode** | 1 – 25 | 1 – 30 | customized* (1 – 10) | customized* (≥ 0.1 $mg_{Ir}/cm^2$) |
| Cathode / Anode | 1 – 25 | 1 – 30 | customized* (1 – 10) | customized* (≥ 0.1 $mg_{Pt}/cm^2$) |

*Typical parameter regime for inkjet printed CCM demonstrators for electrolyzer applications.*
**Customized – depend on catalyst and customer requirements*

## Electrolyzer demonstrator performance

Inkjet printed CCM on Fumatech membrane.




*Inkjet printed CCM performance (Fumatech F-990-PK, loading: 0.9 $mg_{Ir}/cm^2$, 0.15 $mg_{Pt}/cm^2$) with constant power density at 2 V (A) and U-I-curves at a water temperature of 80 °C.*

*CCM and performance measurements were done by ZBT Zentrum für Brennstoffzellen-Technik, Duisburg, Germany.*

Parts of the given data have been achieved in the Flagship Project H2Giga-FRHY. FRHY receives funding from the Federal Ministry of Education and Research.

**More about Printed Functionalities**

Fraunhofer ENAS is part of

Forschungsfabrik Mikroelektronik Deutschland

**Contact**

Prof. Dr. Ralf Zichner
Phone +49 371 45001-441
ralf.zichner@enas.fraunhofer.de

Dr. Andreas Willert
Phone +49 371 45001-440
andreas.willert@enas.fraunhofer.de

Fraunhofer ENAS
Technologie-Campus 3
09126 Chemnitz | Germany

www.enas.fraunhofer.de