Fraunhofer
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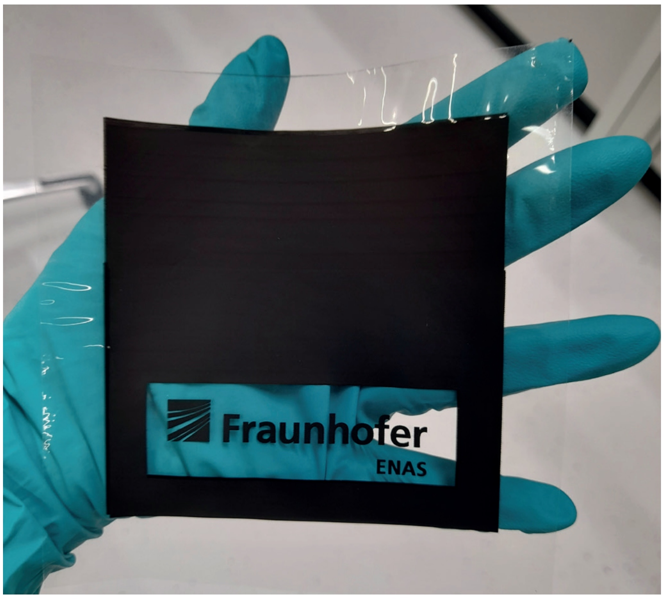
Technology

Inkjet Printed Catalyst Coated Membrane (CCM) for Fuel Cell 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 10 cm x 10 cm printed by inkjet – photo shows patterning capabilities.

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. To transfer this chemical energy into electricity, fuel cells are used. A low temperature, polymer electrolyte membrane (PEM) fuel cell (PEMFC) consists out of a stack of several hundreds of single cells. The heart of the fuel cell 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 fuel cells
- Manufacturing of layers with catalyst gradient distribution
- Variability of membrane type and thickness

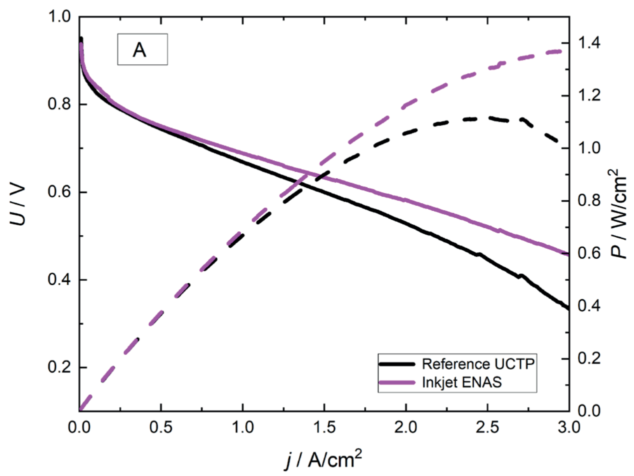
The inkjet process enables the usage of membranes of different vendors. The parameters for layer thickness as well as catalyst loading can be adjusted. An overview is given in table.

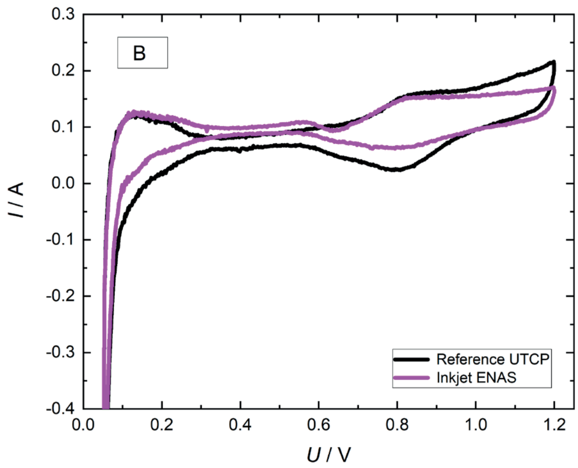
Material	Width [cm]	Length [cm]	Thickness [µm]	Loading
PEM	max. 25	max. 30	8 – 60	n/a
Cathode / Anode	1 – 25	1 – 30	customized* (2 – 8)	customized* (≥ 0.1 mg_{Pt}/cm^2)

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

Electrochemical performance of a typical demonstrator

Inkjet printed CCM on Nafion™ membrane reaches peak power density of 1.4 W/cm^2.





Electrochemical performance reference ultrasonic sprayed CCMs (Nafion™ 212, 0.4 mg_{Pt}/cm^2) from UCTP and inkjet-printed CCMs (Nafion™ HP, 0.19 mg_{Pt}/cm^2) by Fraunhofer ENAS (both CCMs have a ratio of cathode:anode loading 1:1): A – load curves (dynamic, 5 mV/s) and power density curves; B – U-I curves obtained on the cathode (5 mV/s, N_2 on the cathode, H_2 on the anode). Temperature 80 °C, H_2-O_2 operation, overpressure 0.5 bar. Active area 25 cm^2, 100 % relative humidity of gases.

Reference CCM and performance measurements were done by Department of Inorganic Technology, University of Chemistry and Technology, Prague, Czech Republic.

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More about Printed Functionalities

Fraunhofer ENAS is part of
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