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1 *Test set-up in the fuel cell laboratory.*

INLINE MASS SPECTROMETRY AND GAS COMPOSITION VARIATIONS IN PEMFC

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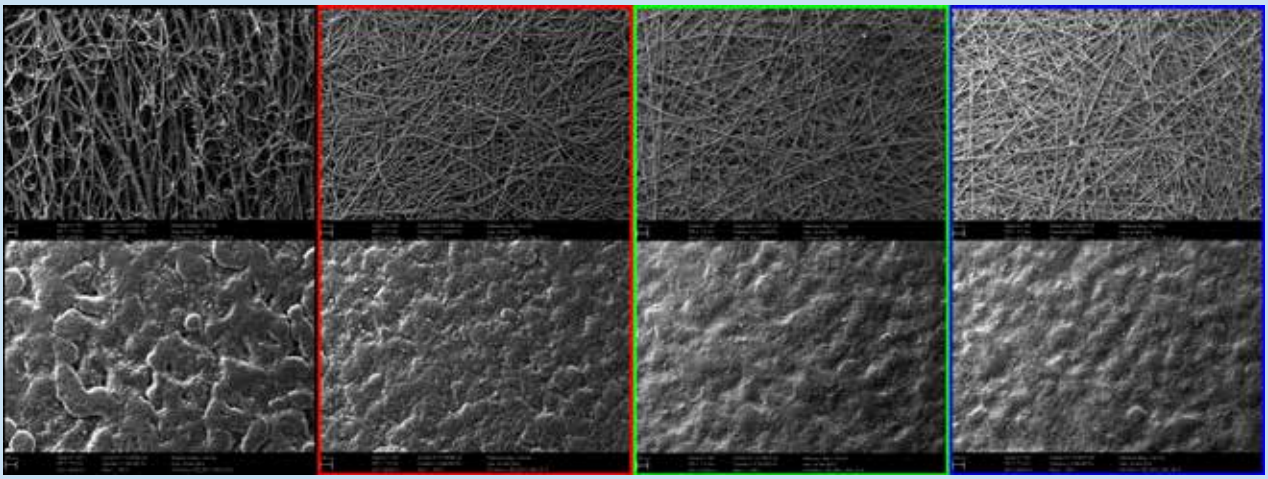
Challenge

The polymer electrolyte membrane fuel cell (PEMFC) is currently considered as an almost market-ready technology. However, for an efficient application, in particular in the automotive sector, it is very important to further decrease costs and increase the lifetime of PEMFCs. In addition performance limitations, which are predominantly caused by mass transport limitations at the fuel cell cathode under high load conditions, should be further reduced.

Our solution

Drawing on our significant expertise in the field of electrocatalysis we have developed a set-up allowing the measurement of degradation and performance limitation effects.

The set-up allows single cell measurements to be conducted with the possibility to rapidly alter the gas composition. Additionally the gas composition at the fuel cell outlet can be monitored by an in line mass spectrometer.



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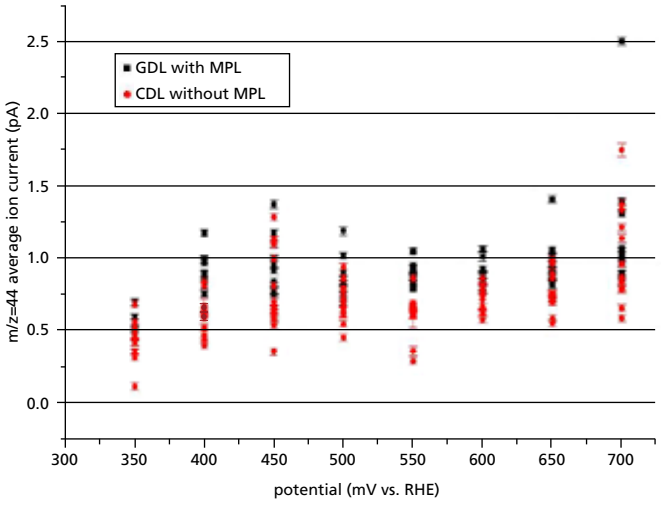
Lifetime limitations and inline mass spectrometry

Different mechanisms limit the lifetime of PEMFCs. These can be classified as membrane degradation, catalyst degradation and carbon corrosion (C-corrosion). During degradation/corrosion processes different substances (reaction products of corrosion reactions) are generated in a fuel cell, and some are released into the gas phase pass through the exhaust system of the fuel cell. For example, during membrane degradation and C-corrosion reaction products are released into the gas phase and can, in principle, be detected by inline mass spectrometry (MS). Inline MS can therefore help to identify critical fuel cell conditions at which degradation processes are accelerated.

Performance limitations and gas composition variations

Mass transport limitation in the cathode of a PEMFC is the main cause of performance limitations. Transport limitations can in general have different causes, such as fuel starvation or water flooding of an electrode. The rapid variation of the gas composition can help to understand the causes of mass transport limitations or to discriminate between different possible causes. For this purpose, a home-made single cell test-bench set-up was developed as part of the GECKO project at the Fraunhofer ICT. The set-up allows for very fast transitions of the cathode gas composition and online monitoring by means of inline MS.



GDL-C-corrosion & CO_2 detection in the cathode exhaust.

Our offer

- Investigations of carbon corrosion rates in membrane electrode assemblies (MEAs)
- Catalyst layer (CL)
- Gas diffusion layer (GDL)
- Experimental evaluation of polymer membrane and/or binder corrosion in MEAs
- Discrimination between different mass transport limitations
- Performance tests
- Accelerated stress tests

Project partners

The German partners of the GECKO project are:

- Fraunhofer Institute for Solar Energy Systems ISE
- Fraunhofer Institute for Chemical Technology ICT
- IMTEK, University of Freiburg
- Max Planck Institute for Dynamics of Complex Technical Systems MPI-DktS
- Centre for Solar Energy and Hydrogen Research Baden-Württemberg ZSW

The Canadian participants can be found via www.carpe-fc.ca.

GECKO

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2 *SEM images of different GDLs: uncoated (above) and coated (below).*