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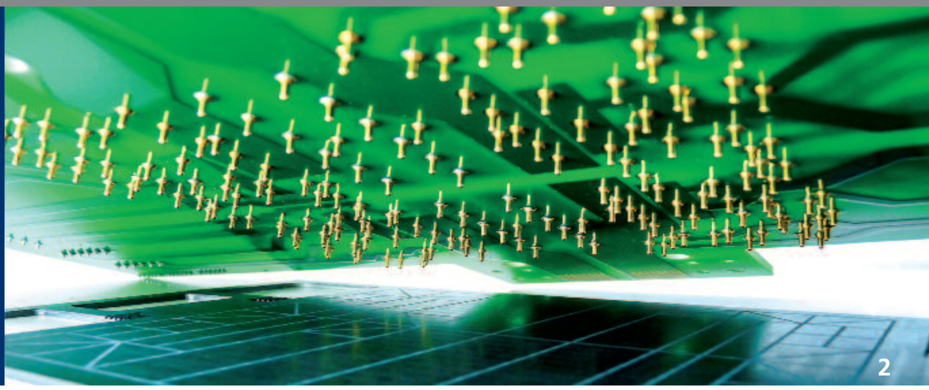
FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS ISE



1 Characterization of a PEM fuel cell stack under extreme climate conditions with single cell monitoring. The system oriented stack behavior is investigated by the integration of peripheral units.
2 Segmented flow field plate and current collector as well as sense pins for spatially resolved characterization of an automotive single cell.

SPATIALLY RESOLVED CHARACTERIZATION OF FUEL CELLS

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A detailed understanding of the coupled electro-chemical and thermo-dynamic processes in a fuel cell is a pre-requisite for a cost effective and, yet, reliable design.

We assist you through our scientifically based characterization of cell components, single cells, fuel cell stacks and system peripherals.

Our Offer

- spatially resolved characterization of customer specific individual cells up to 790 A
- system oriented stack characterization up to 20 kW_{el} with an integrated peripheral system also in the climate chamber

Characterization of Fuel Cell Stacks

In fuel cell stacks with large active areas and large number of cells, inhomogeneities are unavoidable. Aside from investigating these inhomogeneities, the performance, efficiency and the lifetime of each cell can be determined.

We measure your fuel cells stacks in our climate chamber under extreme operating conditions with our 20 kW_{el} test stand. We can include units for air and hydrogen supply, humidification, and cooling; thus, performing tests on the system level. In addition, we have the possibility to characterize up to 50 individual cells in a stack. At any given operation condition, we are able to obtain single cell voltages as well as the electrochemical impedance spectrum (EIS). The EIS allows us to differentiate the frequency dependent processes within the cells and to gain an understanding of the functionality of the stack.

We support you in developing your stack design, the selection of its components and the control strategy for your fuel cell system. Particularly, we highlight the stack's and system's operation at freezing temperatures as well as in hot or humid environments.

Spatially Resolved Characterization of Single Cells

At high current densities and large cell areas, the reaction gases can significantly deplete, resulting in a local increase of humidity and temperature. Large inhomogeneities within the cell can in return influence the performance and degradation of the fuel cell.

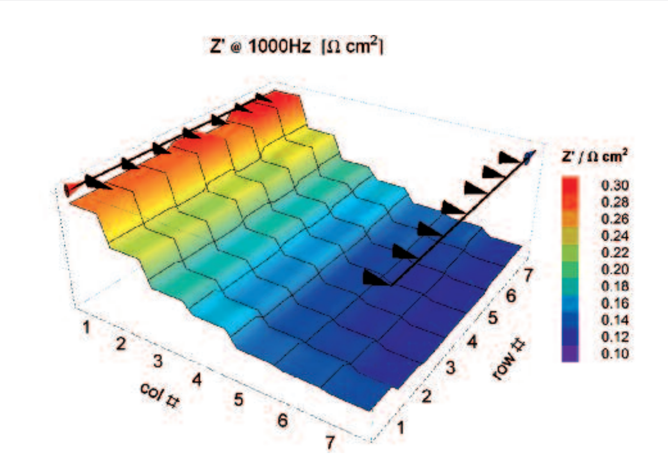
In order to characterize the local operation of the cells, we have a system with 68 independent potentiostats. Hence, customized single cells may be divided into up to 68 segments with their individiual electrical contact. In each segment, the operation can be characterized by electrochemical impedance spectroscopy and chronoamperometry. The cell current may be up to 790 A. The cell temperature is controlled with a cryostat.

Using this measurement technique, we evaluate your cell design, validate the combination of cell materials and investigate control strategies at the cell level. Thus, we provide feedback on your cell design, the selection of components, and your system development.

3 *Teststand for spatially resolved characterization of single cells with cell portal for a defined compression (right), a multi-channel system with 68 potentiostats and frequency-response-analyzers (left) as well as gas supply.*

4 *The high frequency resistance distribution in a segmented single cell illustrates the inhomogeneities on a cell level as a function of materials, construction and operation.*

5 *Parallel single cell impedance spectra recorded in a fuel cell stack to disclose differences in the operating behavior of individual cells depending on the ambient and operating conditions. (photos Rammelberg)*



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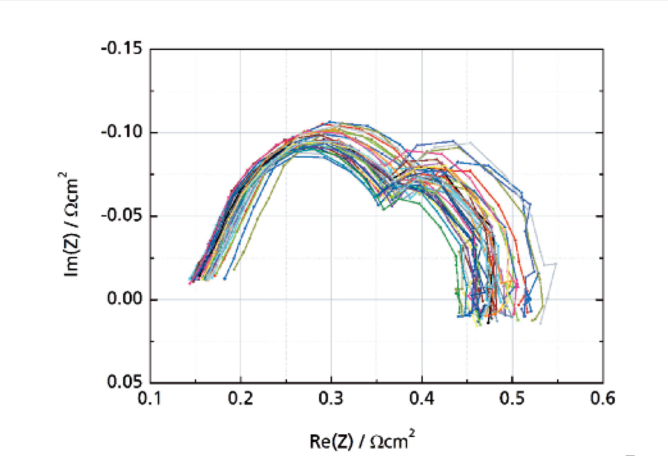

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