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FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS ISE

1 *20 kW_{el} test bench, walk-in climate chamber, and 28 channel electro-chemical impedance spectroscopy system for stack and system characterization.*

2 *Solar hydrogen fueling station H2MOVE of Fraunhofer ISE together with the institute's fleet of fuel cell cars.*

CHARACTERIZATION OF PEM FUEL CELLS, STACKS AND SYSTEMS

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Qualified measurement data serve as the basis for successful product development, and objective test results as the basis for successful marketing.

Fraunhofer ISE supports clients by offering scientifically sound analyses in conjunction with application-oriented, as well as standardized, tests for PEM fuel cells, stacks, and systems.

Our customers make use of the experimental results to optimize cell, stack, and system designs as well as operation strategies.

In-situ characterization of single cells

- sensitivity analysis of cell designs and operation strategies with respect to load, operating temperature, humidification, composition and pressure of reactant gases
- durability evaluations with respect to operation strategy and components or materials
- accelerated stress tests of cell components according to international or customized test protocols
- operation strategy investigations under extreme climate conditions (e.g. freeze start) on single cell level
- testing contamination effects of air pollution, hydrogen contamination or corrosion need for cleanroom conditions or other costly infrastructure

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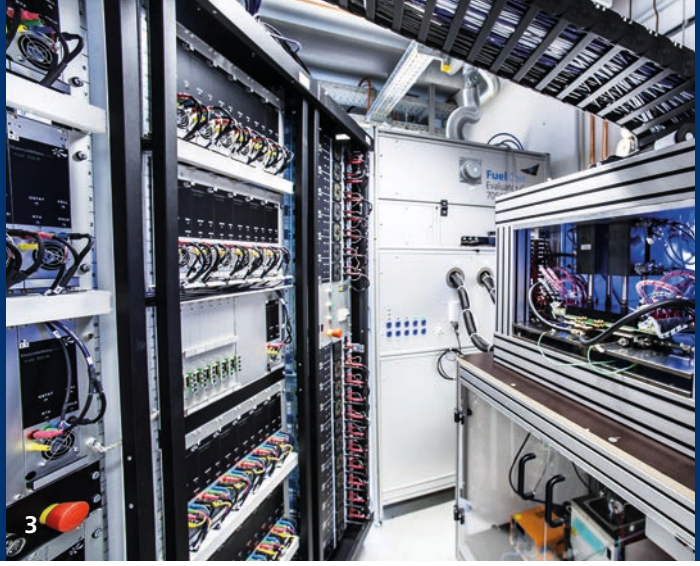


In-situ characterization of stacks and systems

- sensitivity analysis of stack as well as system designs and operation strategies with respect to load, operating temperature, humidity of gases, gas composition, pressure
- analysis of gas flow distribution within a stack by simultaneous single cell impedance spectra
- durability evaluations considering operation strategy and components or materials. Stack testing up to 20 kW_{el} or 1000 A, system testing up to 30 kW_{el} nominal power or 50 kW_{el} peak power
- sensitivity analysis and operation strategies tested in a walk-in climate chamber under extreme conditions from -40 °C to 80 °C and from 5 to 95 % relative humidity
- analysis and development of freeze start strategies down to -40 °C
- testing contamination effects of air pollution, hydrogen contamination or corrosion
- implementation of balance-of-plant-components to evaluate the fuel cell stack performance in a system environment

Model-based analysis of experimental results

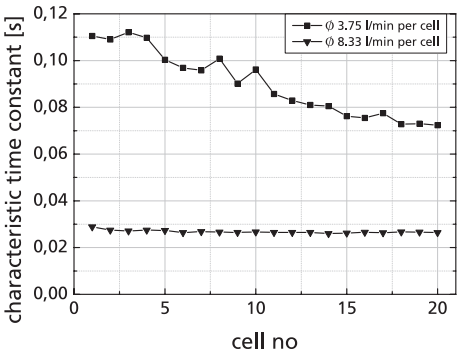
We have developed scientific and thoroughly validated models to extract and analyze properties that are difficult to measure directly like flow distribution in single cells and stacks.

Testing of balance-of-plant components

- cyclic load testing of valves, compressors, humidifiers, etc.
- leakage tests, also with pressurized hydrogen
- temperature stability tests from -40 °C up to +150 °C
- climate tests from +5 °C up to +95 °C and relative humidities from 10 up to 95 %
- power consumption measurements under different operating modes or cyclical operation
- tests of a fuel cell stack or system

3 *Test stand for spatially resolved characterization of single cells.*

4 *Laboratory for performance and degradation analyses of cell components.*



5 *The analysis of the electrochemical impedance spectra of single cells within an automotive short stack reveals the gas flow distribution at two different air stoichiometries.*