Electrochemical characterization of SOFC and SOEC stacks

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Many research facilities and industrial companies worldwide are engaged in the development and the improvement of solid oxide fuel cells/stacks (SOFC) and also of solid oxide electrolysis cells/stacks (SOEC). However, the different stacks cannot be easily compared due to non-standardized test programs. Therefore the EU-funded project "SOCTESQA" which started in May 2014 has the aim to develop uniform and industry wide test modules and programs for SOC cells/stacks. New application fields which are based on the operation of the SOC cell/stack assembly in the fuel cell (SOFC), in the electrolysis (SOEC) and in the combined SOFC/SOEC mode are addressed. This covers the wide range of power generation systems, e.g. stationary SOFC µ-CHP, mobile SOFC auxiliary power unit (APU) and SOFC/SOEC power-to-gas systems.

In order to optimize the test programs, which consist of different test modules, several testing campaigns have been performed. The project partners apply the developed test procedures on identical SOC stacks. In this project 5-cell short-stacks with anode supported cells (ASC) are used, which are provided by an established stack supplier. Altogether 10 pre-normative test modules were developed: Start-up, current-voltage curve, electrochemical impedance spectroscopy, reactant utilization, reactant gas composition, temperature sensitivity, operation at constant current, operation at varying current, thermal cycling and shut-down.

The presentation compares the results of the test modules of the different project partners. Important aspects are the evaluation of the results in terms of repeatability of the different testing campaigns and the reproducibility of the results among the partners. Electrochemical properties, e.g. open circuit voltage (OCV), area specific resistance (ASR), power density, fuel utilization (FU) and impedance values of both stack and repeat units (RU) are presented . Moreover, the results are discussed in context to the test input parameters. Another important issue is the reproducibility of the different test methods, e.g. jV-characteristics and EIS-spectra. Finally, important aspects for the determination of reproducible degradation rates of SOC stacks will be presented and discussed.