SOFC Single Cell Test Setup
for the use of various hydrocarbons

Daniel Fouquet, Daniel Klotz, Eric Dannhäuser,
Axel C. Müller, André Weber, Ellen Ivers-Tiffée
Universität Karlsruhe (TH)
Institut für Werkstoffe der Elektrotechnik,
Adenauerring 20, 76131 Karlsruhe, Germany

In order to investigate the use of gaseous and liquid hydrocarbons, like propane, butane, isooctane, gasoline or diesel as fuels for the SOFC anode, a single cell test setup has been modified. The electrochemical characterization of state of the art single cells, operating with higher hydrocarbons, will be done and compared to methane and hydrogen as fuels.

The reformation of the hydrocarbons takes place, depending upon fuel, externally by an external reformer or directly (internally) at the anode.
By the use of modified anode materials and investigating the reaction equilibrium and kinetics it is the target to avoid carbon deposition.

For analyzing the utilization and the internal reforming of the fuel passing the anode, gas extraction points have been integrated in the Al_2O_3-housing. The local gas composition can be analyzed by mass spectrometry at different spots at the anode (gas inlet, center of the cell, gas outlet). Additional thermocouples have been implemented in the housing to measure the temperature gradient of the flow field (gas inlet, beside the center of the cell, gas outlet) (Fig.1).
A complex gas controller unit (software controlled) was set up for adjusting gas mixtures and reformats for the anode. For operating single cells with liquid fuels and water for internal reforming, high precision flow controllers for liquids (fuels, water) were installed (Fig.2). An optional prereformer, which might be necessary for higher hydrocarbons, is under construction.
With the redesigned testing setup, it will be possible to operate single cells with gaseous and liquid hydrocarbons and to characterize the cells by impedance spectroscopy and I/V characteristics. Fuel processing can be carried out in a conventional way (preliminary steam reforming and/or partial oxidation in a reaction chamber) or by internal reforming respectively direct oxidation at the anode. First results of state of the art single cells (Ni/YSZ anode) operating with higher hydrocarbons are presented.

Fig 1: Gas extraction points and thermocouples in the anode side of the Al_2O_3-housing.

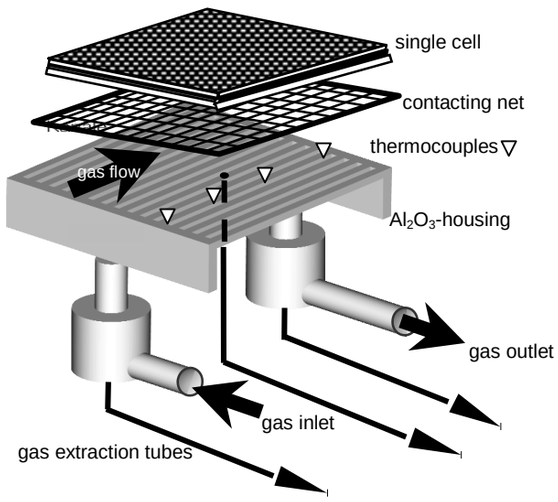

Fig 2: Modified fuel supply.