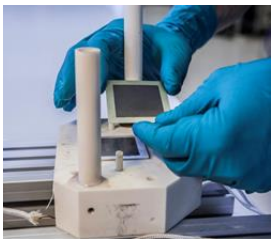
# Reversible solid oxide Electrolyzer and Fuel cell for optimized Local Energy miX



## WP on cells and stack development

In REFLEX it is planned to optimize cells and stack design for reversible Solid Oxide Cell (rSOC) operation. By targeting high fuel utilization (85 %) at high current densities (0.6 A $cm^{-2}$ in SOFC and -1.2 A $cm^{-2}$ in SOEC), the right balance between mechanical strength, fuel diffusion properties and durable electrochemical performance must be obtained.

## Results: Cell development

Standardized cell performance evaluation at open circuit voltage (OCV) and targeted operating conditions of various microstructure modifications, i.e. fuel electrodes, oxygen electrodes and barrier layer, have been conducted. In total more than 10 different microstructures and cell layouts have been produced and compared.

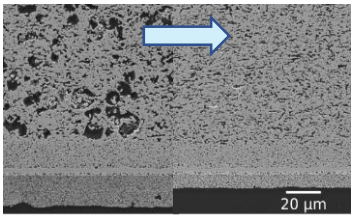



Fig 1. Secondary electron microscopy images of two modified cell microstructures.

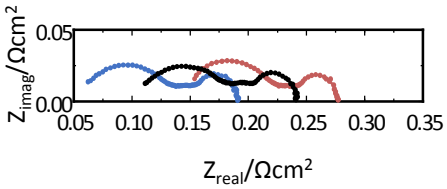



Fig 2. Electrochemical Impedance spectra at T = 700 °C at 50/50 $H_2/H_2O$ and air of 3 types of barrier layer modified cells.

## Results: Long-term testing under reversible operation

Cells which show initially high performance are further durability tested under reversible operating conditions. The cells were operated galvanostatically over 1000h with cycles made of 16 h in fuel cell and 8 h in electrolysis mode. Thereby it could be shown that the most critical cell degradation evolves under electrolysis mode conditions during the initial (approx. 400 h) of testing.

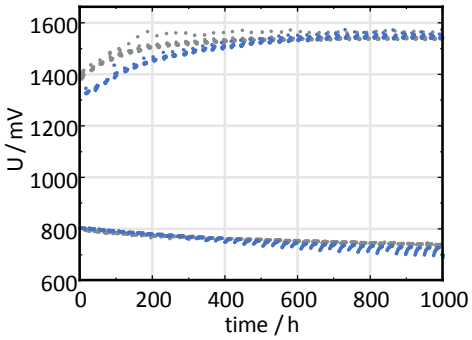



Fig 3. 1000 h durability tests of two modified cell structures at T = 700 °C, 0.6 A $cm^{-2}$ (SOFC) and -1.2 A $cm^{-2}$ (SOEC) and 85 % FU.

## Results: Stack development

For rSOC operation, stack design has been optimized. A minimization of the internal air pressure drop (by a factor of 2) and an improvement of the sealing resistance towards higher pressure could be achieved while maintaining the electro-chemical performance.

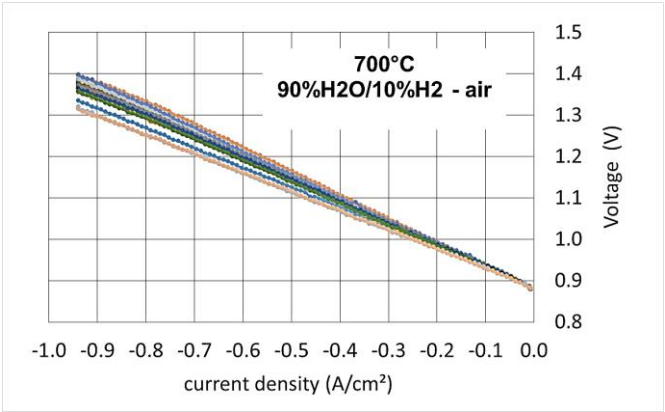



Fig 4. i-V curves at 700°C of the 25-cell short stack

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