

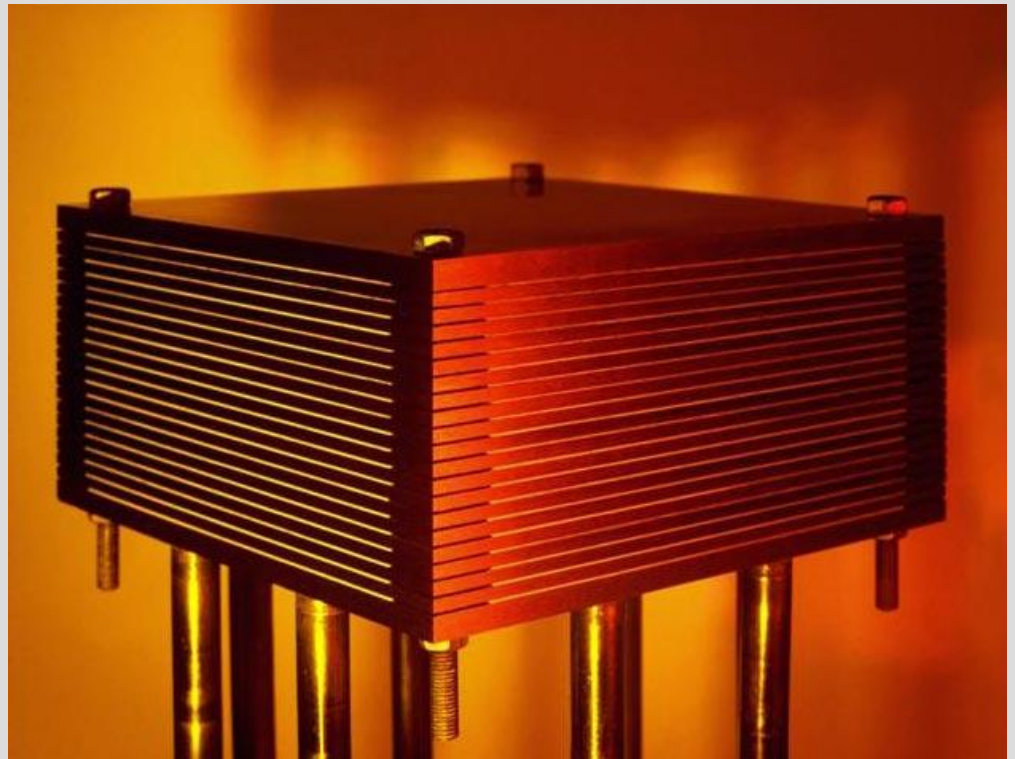


Solid Oxide Steam Electrolysis – activities recently going on at ICT Prague

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Outline

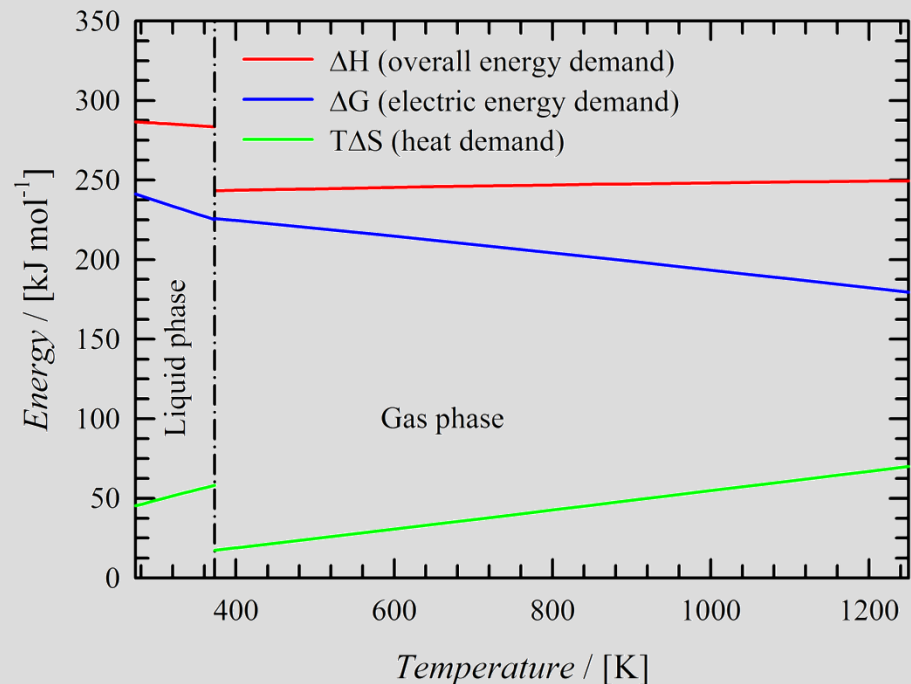
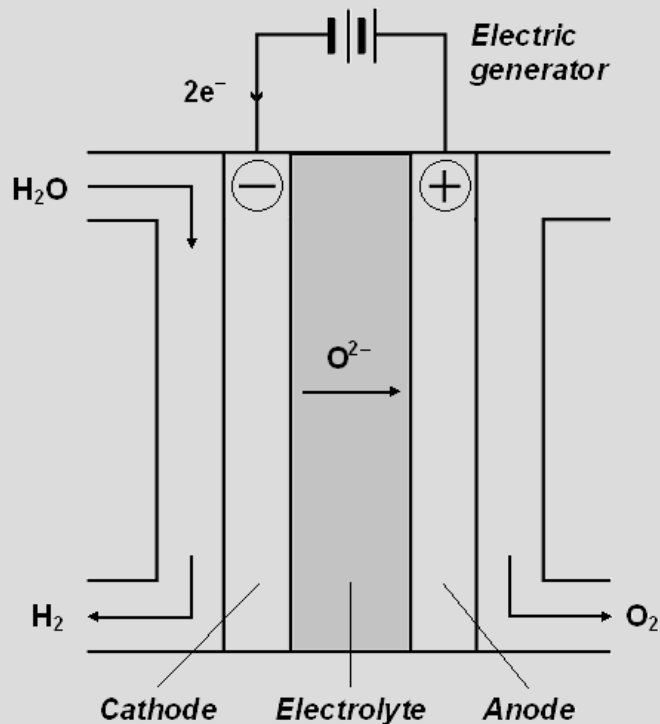
- Introduction
- Material Synthesis
- Cell Preparation
- Testing
- Prospective



<http://www.kerafol.com/>

Introduction to SOSE

- Promising technology for large scale hydrogen production
- Effective utilization of high potential waste heat
- Rapid electrode kinetic -> no need of platinum metal catalysts
- Material demanding due to the high operational temperature (about 800 °C)

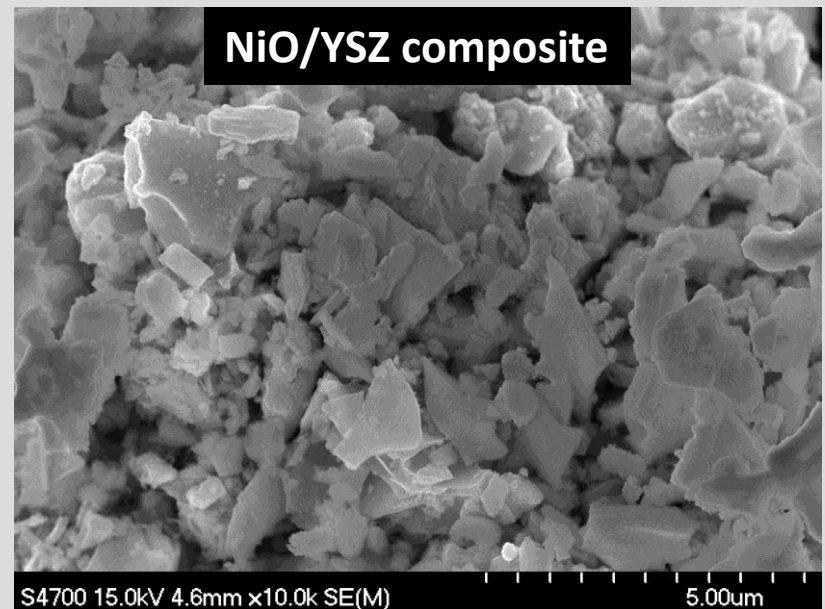


Cell components materials:

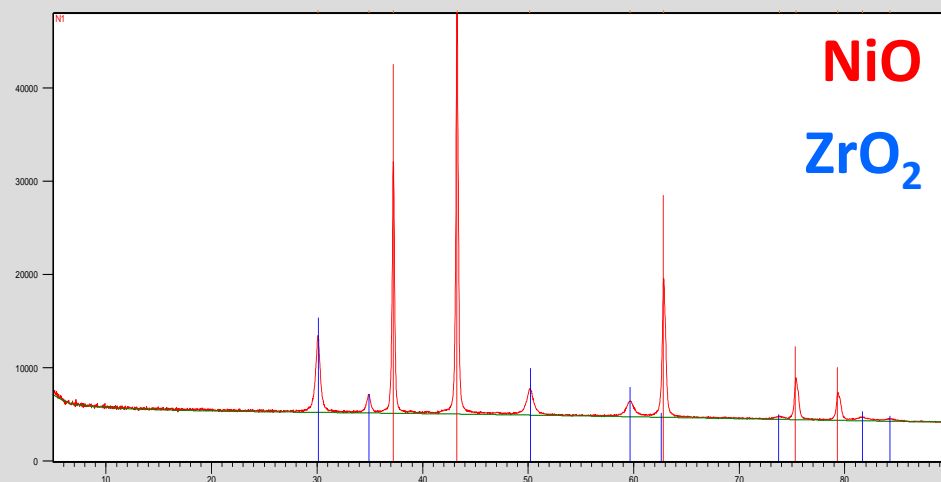
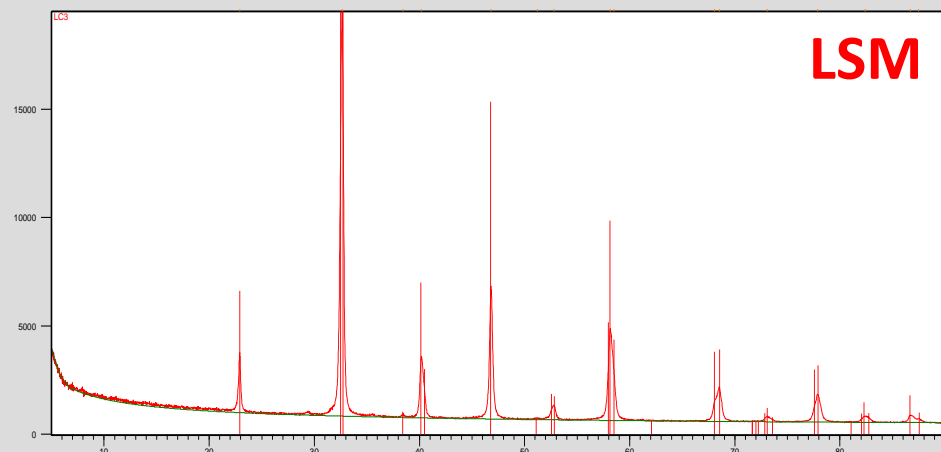
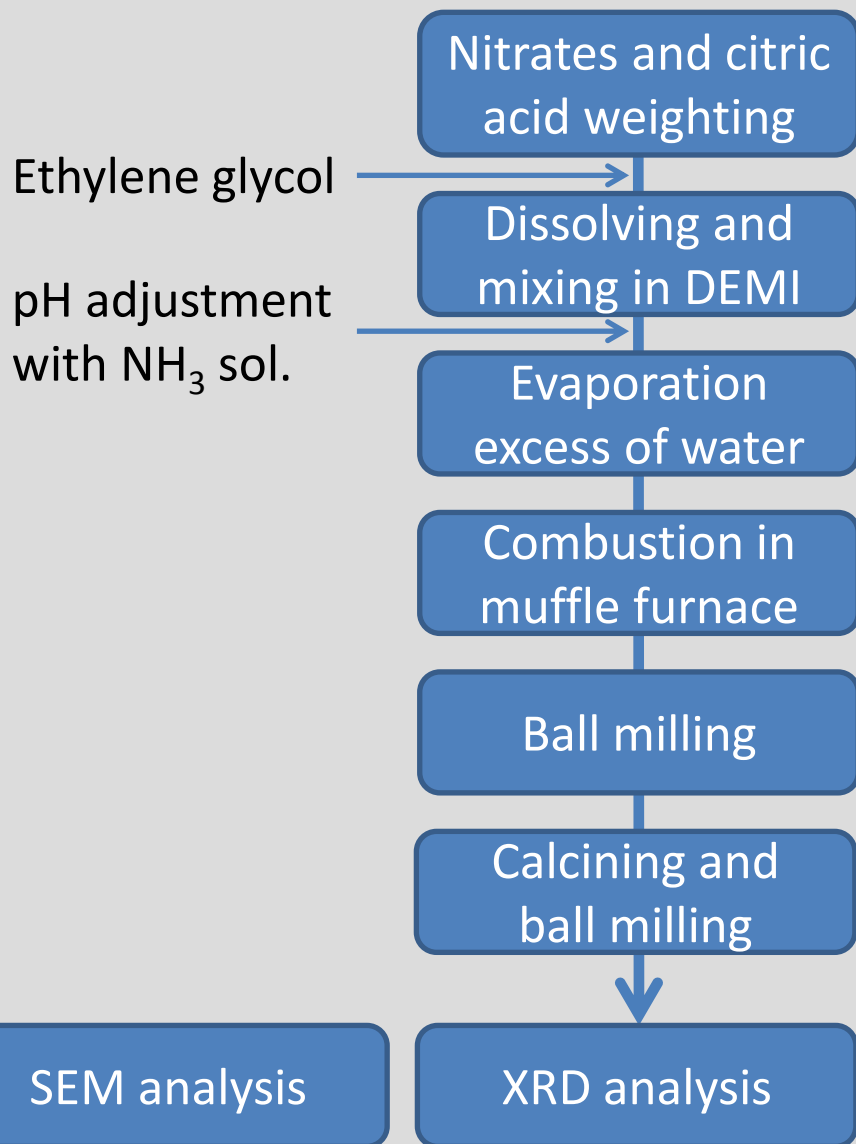
- Electrolyte – ZrO_2 doped with 8 % mol of Y_2O_3 (**YSZ**)
- Cathode – **Ni/YSZ** composite
- Anode – $\text{La}_{1-x}\text{Sr}_x\text{MnO}_{3-\delta}$ perovskite (**LSM**)

Gel Combustion Synthesis:

- Nitrate precursors
- Citric acid as a gelling agent



■ Material Synthesis ■ Cell Preparation ■ Testing



Membrane electrode assembly (MEA) preparation:

Electrolyte-Supported Cells

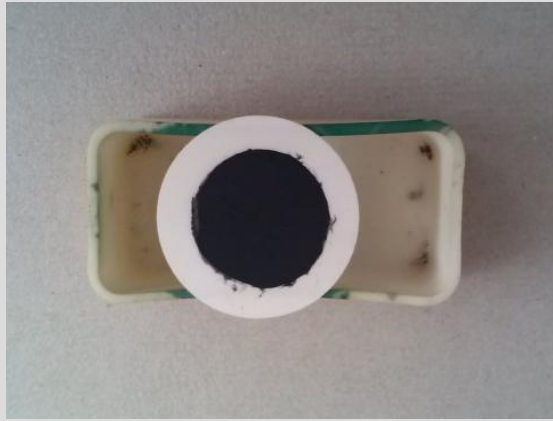
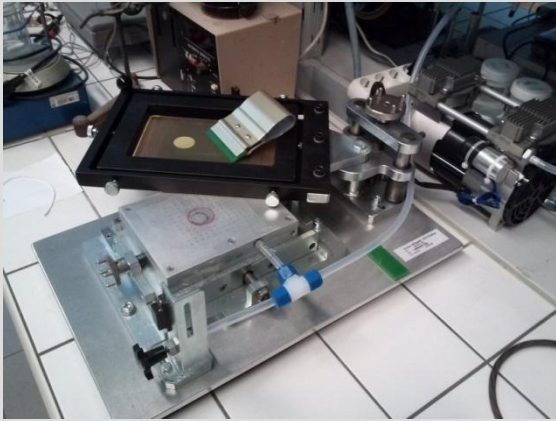
- Electrodes deposited on commercial electrolyte (NexTech)
- Screen-printing method
- Mainly for symmetrical cell testing
- Determination of kinetic parameters
- Optimization of electrodes materials composition

Cathode-Supported Cells

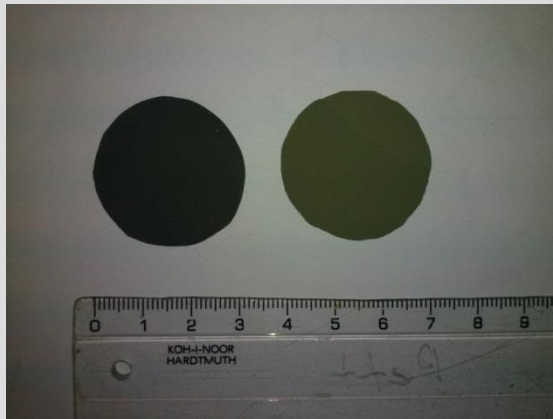
- Fully in-house prepared cells from commercial materials (NexTech)
- Preparation of cathode and electrolyte half-cells by doctor blade technique
- Co-sintering of the half-cells
- Deposition of anode by screen-printing

- Material Synthesis ■ **Cell Preparation** ■ Testing

Screen-printing

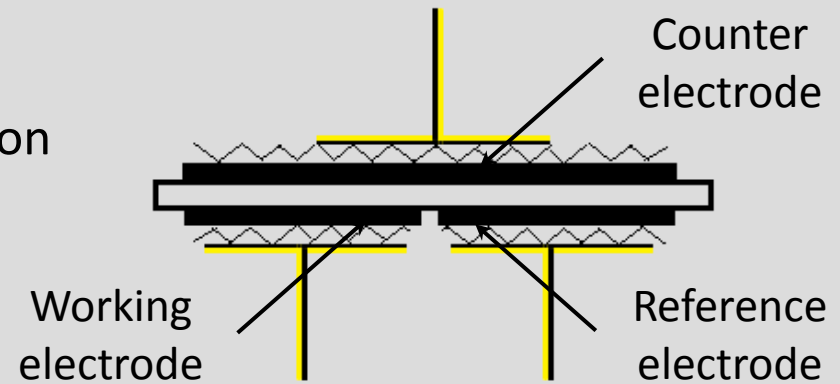


Doctor blade

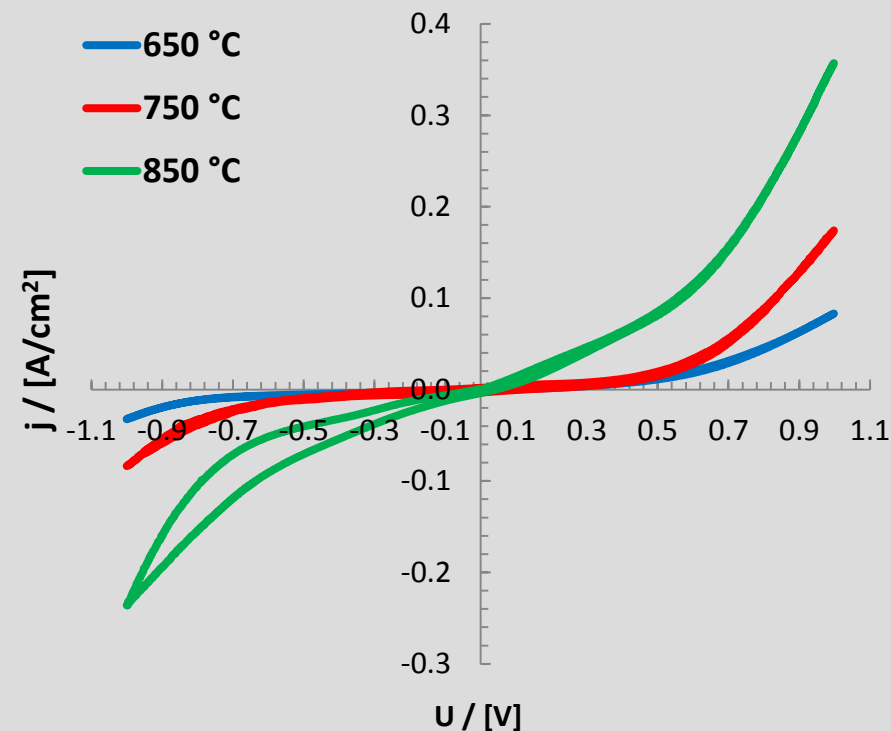


Symmetrical cell testing

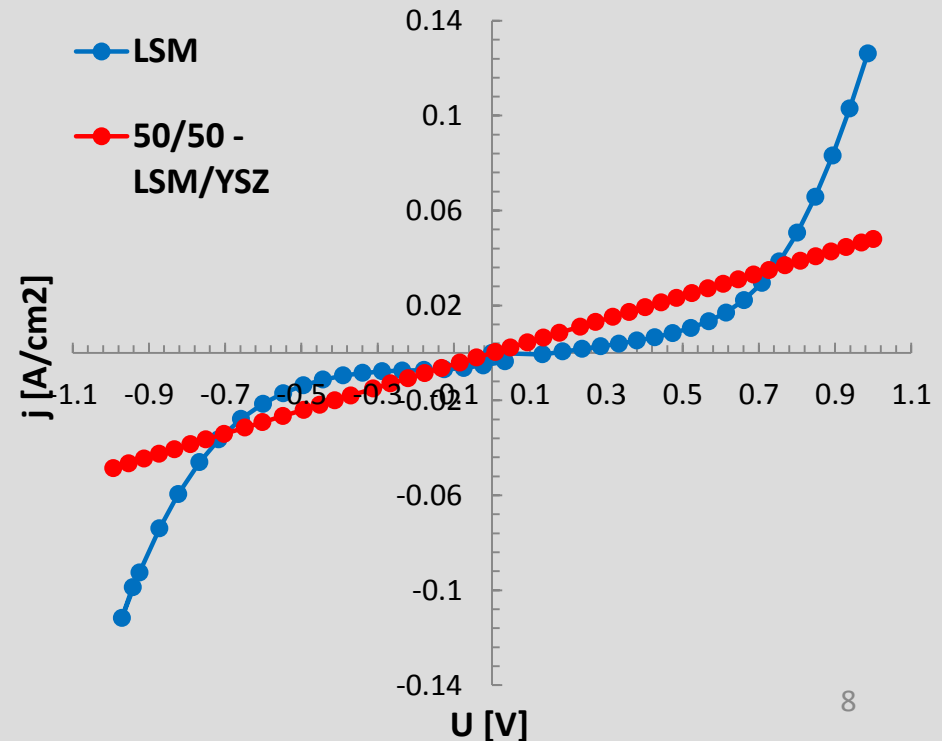
- Testing of electrode materials – composition
- Determination of kinetic parameters
- Cyclic or constant polarization



LSM electrodes, air on both sides



800°C, air on both sides



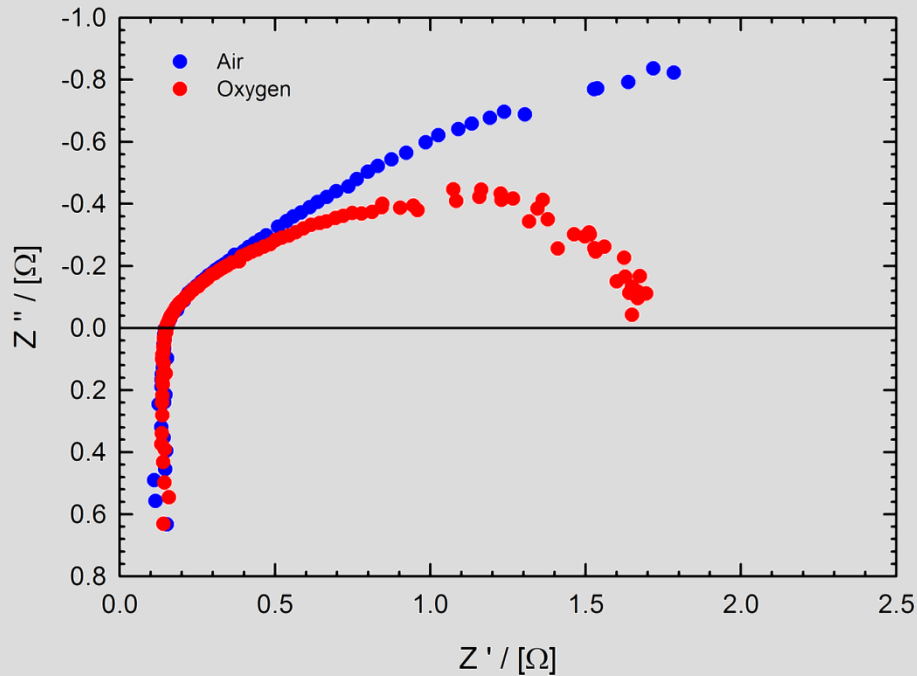
Full cell testing

Cathode-supported cells

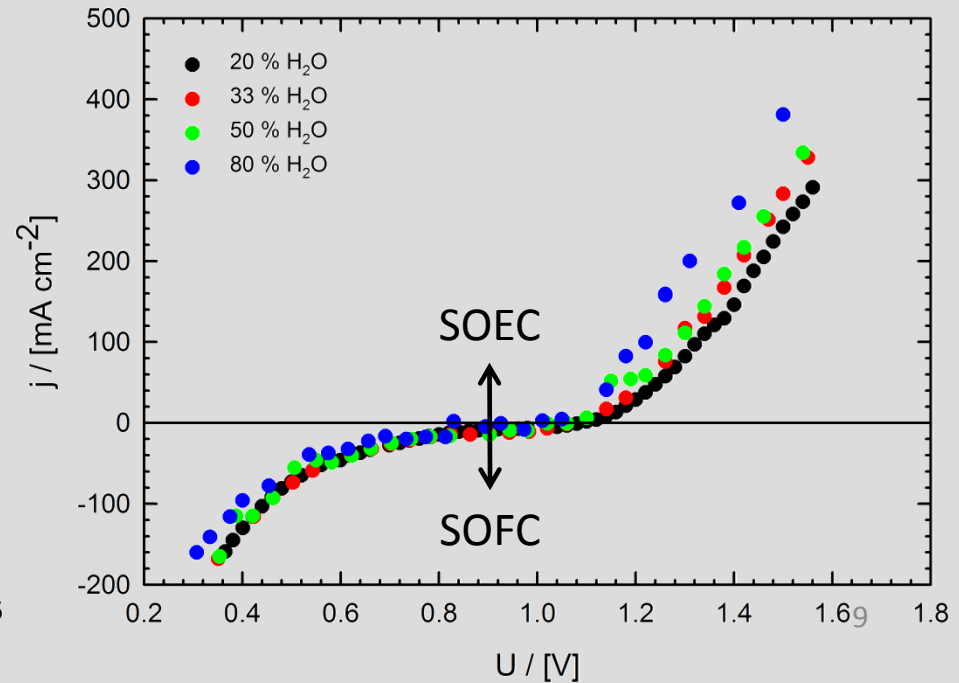
Initial testing:

- Recording of CV and EIS

800 °C, 20 % H₂O in H₂, OCP



800 °C, air to the oxygen electrode



Full cell testing

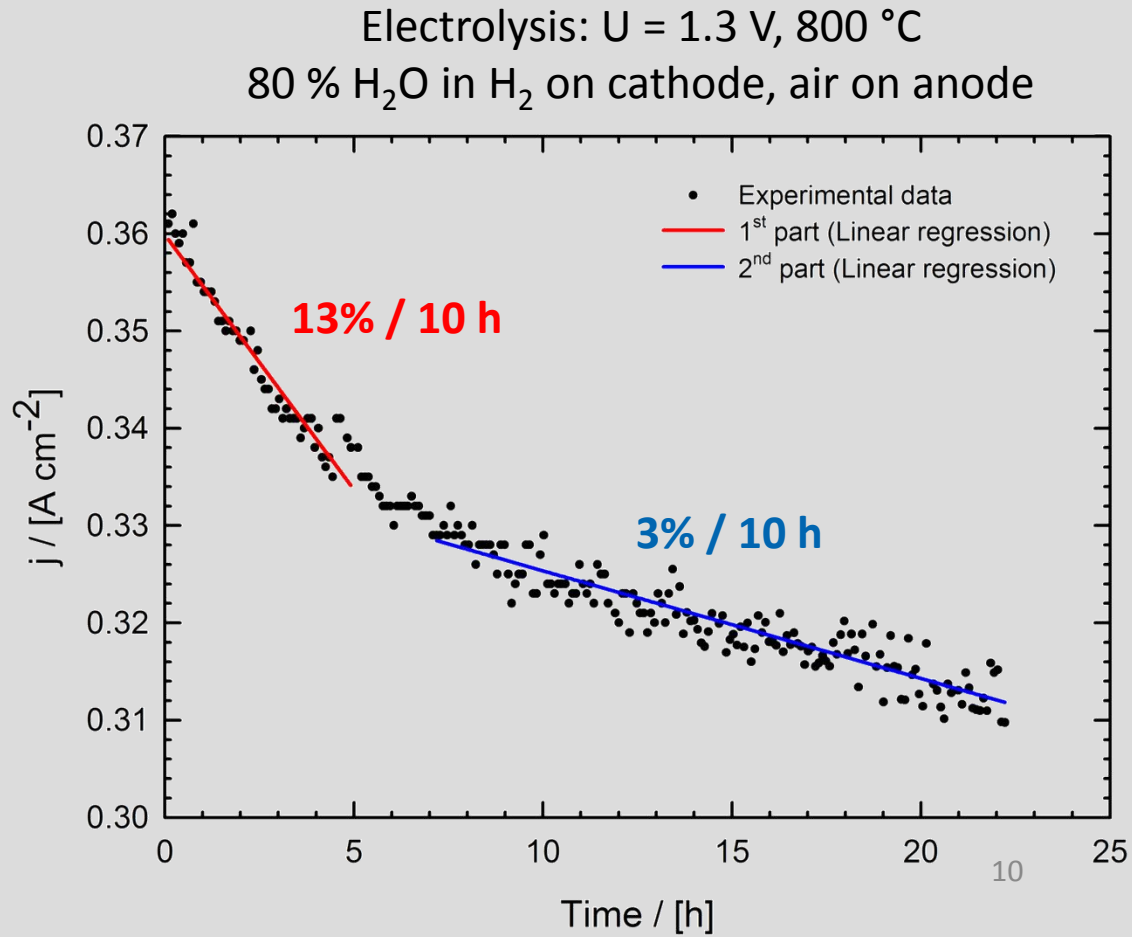
Cathode-supported cells

Initial testing:

- Recording of CV and EIS
- Measured at OCV

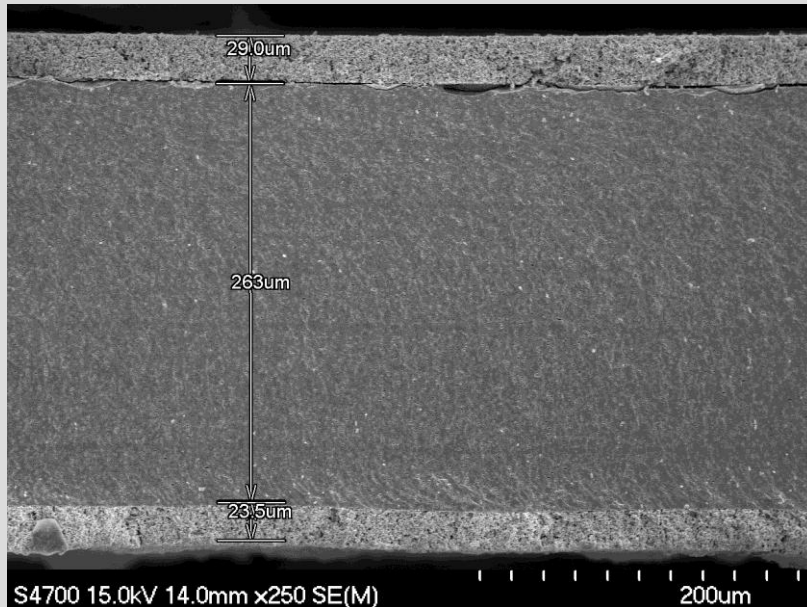
Durability testing

- Water electrolysis
- Potentiostatic operation



Post mortem analysis by SEM

- Determination of layers thickness
- Morphological changes

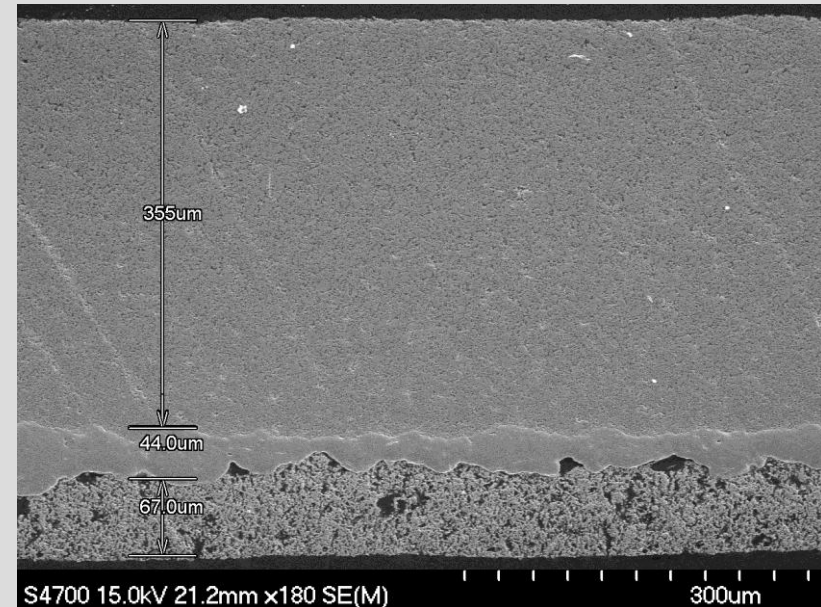


Electrolyte-supported cell

Ni/YSZ

YSZ

LSM



Cathode-supported cell

Prospective

- Increase reproducibility of the cell manufacturing procedure
- Find the optimal electrode composition
 - > increase lifetime of the cells
- Improve the testing rig
 - Interconnections
 - Sealing
 - Water supply

The background features a series of overlapping, semi-transparent blue rectangles of varying sizes. Superimposed on these are numerous thin red lines that originate from points on the left and right edges and converge towards the center, creating a sense of dynamic movement and depth.

Thank you for your kind attention!