In-situ Study of Residual Strain in Solid Oxide Fuel Cells

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Solid Oxide Fuel Cells (SOFC) are electrochemical devices converting the chemical energy of a fuel directly to electricity. Due to the high efficiency of the process they are considered as one of the most promising power production technologies of the future.

Among various designs of SOFCs, the so called flat cell design is subject to extensive research at the Risø National Laboratory and presently produced there in a pre-pilot cell production plant. The flat cell is a 3-layer structure consisting of a ~300 μm thick supporting anode layer of NiO-YSZ (Yttria Stabilized Zirconia, YSZ), a ~10 μm thick solid YSZ electrolyte, and a ~24 μm thick LSM-YSZ cathode (Strontium doped Lanthanum Manganite, LSM). The NiO in the anode is reduced to Ni under operating conditions.

In-situ diffraction experiments were performed on SOFC under standard operating conditions, more specifically during successive cycles of reduction and reoxidation at ~ 850 °C.

The experiment was performed with the spiral slit set-up at beamline ID15 at the ESRF and an X-ray wavelength of $\lambda = 0.173$ Å.

The strain distribution within the three constituent layers of the SOFC was determined from the distortion of the monitored Debye-Scherrer-rings.

Keywords: solid oxide fuel cell, residual stress measurement, in-situ observation