SIMULTANEOUS *OPERANDO* ELECTROCHEMICAL X-RAY DIFRACTION STUDY OF Ni-$Ce_{0.9}Gd_{0.1}O_{2-\delta}$ SOLID OXIDE FUEL CELL ANODE

O. Korjus[1], J. Aruväli[2], I. Kivi[1], M. Kodu[3], E. Lust[1] and G. Nurk[1]
[1] *Institute of Chemistry, University of Tartu, Ravila 14a Str., Tartu 50411, Estonia*
[2] *Institute of Ecology and Earth Sciences, University of Tartu, Ravila 14a Str., Tartu 50411, Estonia*
[3]*Institute of Physics, University of Tartu, W. Ostwald 1 Str., Tartu 50411, Estonia*
e-mail of presenting author: ove.korjus@ut.ee

A novel *operando* measurement cell has been used in this work for simultaneous monitoring of electrochemical (EC) properties using electrochemical impedance spectroscopy and crystallographic structure using high temperature (HT) X-ray diffraction analysis (XRD) of solid oxide fuel cell (SOFC) anodes at working conditions.

The influence of oxide ion flux on GDC and Ni in Ni-$Ce_{0.9}Gd_{0.1}O_{2-\delta}$ (GDC) cermet anode as well as impact of Ni ⇌ NiO redox cycles on the performance of anode has been studied. At 800 °C, GDC lattice parameter diminished, due to electrode potential change from OCV to -0.9 V. The decrease was equal to lattice parameter change corresponding to 50 °C decrease in temperature. This means that changes in electrode polarization might cause significant changes in GDC structure and reversible quick changes of potential might have destructive influence on the Ni-GDC anode.

Using electrochemical measurements, it was shown that Ni re-oxidation takes place at low hydrogen containing atmospheres. This process was dependent on anode microstructure – in porous anode, where there is good gas exchange, Ni is less likely to be re-oxidized, and in less porous anode Ni has higher affinity towards re-oxidation. It could also be seen from the analysis of redox cycle's impact on the cell's performance that during the redox cycle the pores were filled with Ni, so the gas transport properties of anode worsened and the Ni re-oxidation was seen at higher hydrogen concentration atmosphere (5% of H_2). We could not see any changes in Ni crystal structure in XRD diffractograms as a function of SOFC load conditions at any measured temperature or fuel gas atmosphere.

Euroopa Liit
Euroopa
Regionaalarengu Fond

Eesti
tuleviku heaks