Oxygen exchange kinetics of Ruddlesden-Popper-type phases $Pr_2(Ni,Co)O_{4+\delta}$ as SOFC/SOEC air electrodes

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Ruddlesden-Popper-type phases of rare earth nickelates $Ln_{n+1}B_nO_{3n+1}$ (with Ln=La, Nd, Pr and B=Ni) show high oxygen diffusivities, high oxygen exchange rates, and good electronic as well as ionic conductivities. They have therefore attracted considerable interest as air electrodes for high temperature fuel cells (SOFCs) and electrolyser cells (SOECs). In a recent study high oxygen surface exchange rates were demonstrated with the first order (n=1) RP-type rare earth nickelate $Pr_2NiO_{4+\delta}$ [1]. Electrochemical and structural properties of the third-order Ruddlesden-Popper phase $Pr_4(Ni_{0.9}Co_{0.1})_3O_{10-\delta}$ will be reported during this conference.

In the present study, oxygen surface exchange coefficients of $Pr_2Ni_{0.9}Co_{0.1}O_{4+\delta}$ were obtained from microelectrode measurements. Thin film microelectrodes of $Pr_2Ni_{0.9}Co_{0.1}O_{4+\delta}$ were prepared by pulsed laser deposition and characterised by electrochemical impedance spectroscopy (EIS) between 550 and 850°C in the oxygen partial pressure range of $pO_2 = 1\times10^{-3} - 1$ bar. Is was found that the oxygen surface exchange coefficient k^q increased with increasing Co-substitution and the dependence of k^q on temperature and pO_2 could be established for both $Pr_2NiO_{4+\delta}$ and $Pr_2Ni_{0.9}Co_{0.1}O_{4+\delta}$. The chemical surface exchange coefficient of oxygen k_{chem} was calculated from chemical capacitances of the microelectrodes. The values showed good agreement with the results from dc-conductivity relaxation experiments [1,2].

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[1] C. Berger, E. Bucher, A. Egger, A.T. Strasser, N. Schrödl, C. Gspan, J. Hofer, W. Sitte, Solid State Ionics, 316, 92 (2018).

[2] C. Berger et al., in preparation.