Synthesis and electrochemical characterization of the first-order Ruddlesden-Popper phase $La_2Ni_{0.9}Co_{0.1}O_{4+\delta}$

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One of the fundamental challenges of advancing the solid oxide electrolyzer cell (SOEC) and solid oxide fuel cell (SOFC) technology is the development of new air electrode materials with fast oxygen exchange kinetics and low area-specific resistance. Ruddlesden-Popper type solid oxides, such as rare earth nickelates, are promising candidates to achieve these goals. In the present work, cobalt-doped lanthanum nickelate $La_2Ni_{0.9}Co_{0.1}O_{4+\delta}$ (LNCO291) is investigated.

The powder was synthesized via the citrate/EDTA method. X-ray powder diffraction confirmed that the material crystallizes in the K_2NiF_4-type structure, which consists of alternating rock-salt AO- and perovskite ABO_3-layers, representing the first member of the $A_{n+1}B_nO_{3n+1}$ Ruddlesden-Popper series. The substitution of nickel with cobalt on the B-site offers the possibility of improving the material properties of LNCO291, e.g. with respect to the surface exchange kinetics and the electrical conductivity.

In order to evaluate the suitability of LNCO291 as air electrode material for SOFCs and SOECs, the oxygen exchange kinetics was studied using the dc-conductivity relaxation method. Furthermore, symmetrical cells with porous LNCO291 electrodes on $Ce_{0.9}Gd_{0.1}O_{2-\delta}$ electrolytes were characterized by means of electrochemical impedance spectroscopy and current-voltage curves. Post-test analyses of LNCO291 samples were performed using scanning electron microscopy with energy dispersive X-ray spectroscopy. The results indicate that $La_2Ni_{0.9}Co_{0.1}O_{4+\delta}$ shows promising properties for application as air electrode material in SOFCs and SOECs.