

Tailoring the ceria properties by lanthanide and transition metal co- doping

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Ceria compounds can be used as anode materials in Solid Oxide Fuel Cells to improve their catalytic performance and stability in alternative fuels. In this work the properties of five different ceria compounds co-doped with elements from lanthanide and transition metal groups were investigated. The following compositions: $\text{Ce}_{0.9}\text{La}_{0.05}\text{Ni}_{0.05}\text{O}_{2-\delta}$, $\text{Ce}_{0.9}\text{La}_{0.05}\text{Cu}_{0.05}\text{O}_{2-\delta}$, $\text{Ce}_{0.9}\text{La}_{0.05}\text{Co}_{0.05}\text{O}_{2-\delta}$, $\text{Ce}_{0.9}\text{La}_{0.05}\text{Fe}_{0.05}\text{O}_{2-\delta}$ were synthesized using the Pechini method and reduced in dry H_2 to verify the possibility of forming metal nanoparticles on the surface of the material. The microstructure of the compounds was characterized with a Scanning Electron Microscopy and the phase composition of synthesized materials was analysed with the X-ray Diffraction method. BET analysis was also performed to determine the specific surface area for each compound, as well as the reducibility of particular compositions was investigated using the TPR/TPO method. Additionally, the compounds were examined at the National Center of Synchrotron Radiation on the PolyX line, where the X-ray microimaging and X-ray microspectroscopy were performed.

The SEM analysis of as prepared samples confirms their porous structure and fine crystallinity. After reduction, the formation of round-shape nanoparticles is visible on the surface of grains and in the grain boundaries. They may act as catalytic centers in SOFC anodes. Furthermore, the XRD analysis before reduction showed the presence of NiO phase and after reduction in H_2 , the signal from the metallic Ni phase was present. Depending on the type of dopant, there is a clear difference in the amount, shape and distribution of forming particles. This work aims to compare the properties of these compounds and also to determine if the metal is built into the ceria lattice or it rather deposits in the form of oxides on the lattice and/or in the grain boundaries.

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