J Nanomater Mol Nanotechnol 2018, Volume 7
DOI: 10.4172/2324-8777-C11-051

2nd International Conference on
Nanostructured Materials & Nanochemistry
November 02-03, 2018 | San Francisco, USA

High-temperature electrical conductivity and electrochemical investigation of La_2-xSr_xCoO_4 nanoparticles for IT-solid oxide fuel cells cathode

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Single-phase Ruddlesden popper of $La_{2-x}Sr_xCoO_4$ nanopowders with x=0.7, 0.9, 1.1 and 1.3, were successfully synthesized by a modified sol-gel method. Structural stability and morphology of the prepared samples were examined using HT-XRD analysis, FE-SEM and SEM techniques. HT-XRD analysis of the samples, in the range of room temperature to 650°C, revealed that the structure of all samples was tetragonal. The electrical conductivity measurements, in the range of room temperature to 850°C, indicated that by increasing the temperature the electrical conductance mechanism changes from variable range hopping to the nearest-neighbor hopping of small polarons. In addition, it was found that by increasing Sr concentration the structure of the sintered samples becomes more stable. The electrochemical characterization was carried out using the impedance spectroscopy (EIS) measurements on symmetrical cells at three different temperatures, 650˚C, 750˚C and 850˚C. The area-specific polarization resistance (ASR) of La_2-$_x$$Sr_xCoO_4$-CGO-La2-$_x$$Sr_x$CoO4 symmetrical cell, in oxygen flow, was obtained about 1.07, 0.35, 0.33 and 0.43Ωcm2 at 850˚C for the samples with x=0.7, 0.9, 1.1 and x=1.3, respectively. According to our EIS results, the main rate-limiting step for La_2-$_x$$Sr_xCoO_4$ cathode performance is the dissociation process of oxygen at the surface of the cathode at 650˚C and the charge transfer limiting in the cathode/electrolyte at 750˚C and 850˚C. Our results showed that the samples with Sr contents of x=0.9 and x=1.1 can be the promising cathodes for IT-SOFC applications.

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