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Khagesh Tanwar, Nandini Jaiswal, Pulkit Sharma, Devendra Kumar, Om Parkash

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Structural Analysis of $Ce_{0.83}Dy_{0.14}Ca_{0.03}O_{1.90}$ (CDC) and Enhanced Electrical Conductivity of its Composites with Alkali Carbonates for LT-SOFCs

Khagesh Tanwar[a,1], Nandini Jaiswal[a], Pulkit Sharma[a], Devendra Kumar[a] and Om Parkash[1]
[a,1] Department of Ceramic Engineering, Indian Institute of Technology
(Banaras Hindu University), Varanasi- 221005, (India)

Abstract

Present work mainly deals with two important aspects of co-doped ceria based solid electrolytes. First, the occurrence of micro-strain or structural distortions in ceria lattice on doping of Dy^{3+} and Ca^{2+} at the place of Ce^{4+}. Second, an enhancement in electrical conductivity by formation of nano-composites of $Ce_{0.83}Dy_{0.14}Ca_{0.03}O_{1.90}$ (CDC) and eutectic mixture of sodium and lithium carbonates [$(Li_{0.52}Na_{0.48})_2CO_3$] (LNCO). CDC ceramic powder was synthesized by citrate-nitrate auto-combustion route. Nano-composites were prepared by mixing the CDC powder with LNCO using a ball mill. X-ray diffraction studies were carried out to analyze the crystal structure of CDC and to study the amorphous nature of carbonates in the nanocomposites. Thermal behavior of the nanocomposites was studied by differential scanning calorimetry (DSC). XRD data of CDC were refined by Rietveld analysis to determine the lattice parameters, atomic positions, bond lengths, bond angles, oxygen deficiency and possible micro-strain. Microstructures of the specimens were studied using scanning electron microscope. Electrical conductivity of the nanocomposites was investigated by using complex plane impedance analysis. A significant improvement in electrical conductivity was observed in nanocomposites with varying concentration of carbonates. Maximum conductivity, 1.05×10^{-1} S cm^{-1} at 500 ºC, was observed in the composite with 30 wt.% (CDC/30LNCO) of carbonates content.

[1]Corresponding author Tel:+91-542-6701791; Fax:+91-542-2368428
Email address: oprakash.cer@itbhu.ac.in