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Investigation on La^{3+} and Dy^{3+} co-doped ceria ceramics with an optimized average atomic number of dopants for electrolytes in IT-SOFCs

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Abstract

In the present study, we investigate the fundamental properties of CeO_2 by selecting La^{3+} (57), and Dy^{3+} (66) as dopants with optimized average atomic number of 61.5, which lies in between Pm^{3+} (62) and Sm^{3+} (62) in accordance with the criteria for optimum doping. A system of co-doped ceria ceramics $\text{Ce}_{1-x-y}\text{La}_x\text{Dy}_y\text{O}_{2-\delta}$ ((x, y) = (0.00, 0.00), (0.025, 0.025), (0.05, 0.05), (0.075, 0.075), (0.10, 0.10), (0.00, 0.20) and (0.20, 0.00)) as electrolytes for intermediate temperature solid oxide fuel cells were successfully prepared by a well-known sol-gel auto-combustion route. In order to obtain dense samples, the prepared pellets were sintered in air at 1300°C for 4 h using conventional furnace and relative densities of all the samples were found to be higher than 95%. Single phase cubic structure, microstructural density and elemental composition analysis of all the samples were studied by powder X-ray diffraction, scanning electron microscope and energy dispersive spectroscopy techniques, respectively. Raman spectroscopy analysis confirmed the formation of concentrated O^{2-} -vacancies in the co-doped ceria system. Impedance spectroscopy measurements revealed the high value of total ionic conductivity and low activation energy for the composition $\text{Ce}_{0.85}\text{La}_{0.075}\text{Dy}_{0.075}\text{O}_{2-\delta}$ i.e., $2.08 \times 10^{-2} \text{ S cm}^{-1}$ and 0.58 eV, respectively. Linear thermal expansion analyses of all the samples revealed the matched thermal expansion

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