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Tri-doped Ceria ($M_{0.2}Ce_{0.8}O_{2-\delta}$, M= $Sm_{0.1,}$ $Ca_{0.05,}$ $Gd_{0.05}$) electrolyte for hydrogen and ethanol-based fuel cells

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Abstract:

In recent scientific research, an interest has been gained significantly by rare earth metals such as cerium (Ce), samarium (Sm) and gadolinium (Gd) due to their use in fuel cells as electrolyte and catalysts. When used in an electrolyte, these materials lower the fuel cell's operating temperature compared to a conventional electrolyte, for example, yittria-stablized zirconia (YSZ) which operates at a high temperature (≥800 ^{o}C). In this paper, the tri-doped ceria, $M_{0.2}Ce_{0.8}O_{2-\delta}$ (M=$Sm_{0.1,}$ $Ca_{0.05,}$ $Gd_{0.05}$) electrolyte powders was synthesized using the co-precipitation method at 80 ^{o}C. These dopants were used for CeO_2 with a total molar ratio of 1M. Dry-pressed powder technique was used to make fuel cell pellets from the powder and placed them in the furnace to sinter at 700 ^{o}C for 60 minutes. Electrical conductivity of such a pellet in air was 1.2×10^{-2} S.cm^{-1} at 700 ^{o}C measured by the ProboStat-NorECs setup. The crystal structure was determined with the help of -ray diffraction (XRD), which showed that all the dopants were successfully doped in CeO_2. Raman spectroscopy and UV-VIS spectroscopy were also carried out to analyse the molecular vibrations and absorbance, respectively. The maximum open-circuit voltages (OCVs) for hydrogen and ethanol fuelled at 550 ˚C were observed to be 0.89 V and 0.71 V with power densities 314 mW.cm^{-2} and 52.8 mW.cm^{-2}, respectively.

Keywords: solid oxide fuel cells, tri-doped, hydrogen, ethanol