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The effect of nickel doping on the microstructure and conductivity of Ca(Ti,Al)O3–δ for solid oxide fuel cells

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Abstract

The ABO_3 type perovskite oxide-based ceramic membranes are one of the most important classes of materials for high-temperature solid oxide fuel cell applications. The acceptor-doped calcium titanate ($CaTiO_3$) perovskite has attracted considerable attention as an oxide ion-conducting membrane due to its potentially high ionic conductivity and excellent stability. Nonetheless, the ionic conductivity of the material must still be improved. Following the strategy of the substitution of dopants on the B-site, the current work is focused on exploring the effect of Al and Ni additions on electrical properties, by studying the nominal compositions $CaTi_{0.7}Al_{0.3-x}Ni_xO_{3-\delta}$ (x = 0, 0.1, 0.2 and 0.3). The materials were synthesized by the sol–gel method and studied as a function of phase composition, microstructure, and electrical properties. The results demonstrate an increase of both total and specific grain boundary conductivity with increasing Ni content, while predominant p-type behavior is shown under oxygen-rich atmosphere.

Keywords:

Spin coating, Transparent conducting oxides, Optical transmittance, Band gap energy, Figure of merit

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