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Synthesis and characterization of lanthanum gallate electrolyte materials for the intermediate temperature solid oxide fuel cell

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Development of better oxygen ion conducting electrolyte materials with high electrical conductivity and stability is very essential for the electrolyte of Intermediate Temperature Solid Oxide Fuel Cell (IT-SOFC), which operates at 500 - 800 °C. Sr and Mg doped lanthanum gallate (LSGM) ceramic, having an appropriate preovskite structure, is considered as promising candidate for the electrolyte of the IT-SOFC. However, synthesizing of pure LSGM phase is still facing a challenge. Our work on development of LSGM electrolyte materials for the IT-SOFC, mainly focuses on finding appropriate synthesis procedures and the effect of dopents on the LSGM phase.

This paper presents the synthesis and electrical characterization of $La_{0.85}Sr_{0.15}Ga_{0.85}Mg_{0.15x}Ni_xO_{3-s}$ (x = 0 - 0.15) material compositions. The new materials in the form of fine powders were synthesized by stearic entrapment synthesis (SES) method by calcining at 1200 °C for 5 h in static air. The synthesized powders were then palletized and sintered at 1450 °C for 5 h in air, in order to get dense solid materials. The phase analysis on them was performed by X-ray diffractometry and the electrical conductivity measurements by the complex impedance method up to 700 °C.

All the prepared $La_{0.85}Sr_{0.15}Ga_{0.85}Mg_{0.15-x}Ni_xO_{3-s}$ (x = 0 - 0.15) materials in this study show the existing of only the appropriate lanthanum galete perovskite phase. Further the electrical conductivity of the x=0 material synthesized in this study is considerably higher than those prepared with other synthesis methods. Altogether, this study reveals the ability of SES method to synthesize pure LSGM materials with improved electrical conductivity. The new compositions prepared with doping LSGM with Ni, show the ability of increasing the electrical conductivity while preserving the appropriate preovskite crystal structure of the material. Further, the pure electronic nature of x=0.15 material together with its similar crystal and chemical structures as of LSGM (x=0) electrolyte material, indicate the potentiality of using x=0.15 as a candidate material to the IT-SOFC electrodes. With the expected minimal disparity at the interface between electrolyte and electrodes with these materials, this finding could open a new direction in the materials research on IT-SOFC.

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