Preparation and Characterization of $La_{0.9}Sr_{0.1}Ga_{0.8}Mg_{0.2}O_{3-\delta}$ Thin Film Electrolyte Prepared by Spray Pyrolysis Deposition for Low-temperature Operating μ-SOFC

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Introduction

For many potential mobile robot applications, current power supply technology (such as the lithium ion battery technology) is in fact a key limiting factor due to its low energy density. Solid oxide fuel cells (SOFC) is a promising alternative and can overcome limitations of current battery technology. Especially, μ-SOFC with thin film electrolyte[1,2)] is promising due to lower ohmic resistance.

Doped lanthanum gallate ($La_{0.9}Sr_{0.1}Ga_{0.8}Mg_{0.2}O_{3-\delta}$, LSGM) is a promising electrolyte material in an operating temperature range of 500–600 ^{o}C due to its high ionic conductivity at this temperature range[3)].

Spray pyrolysis deposition (SPD) is a film formation technique by spraying precursor solution onto a heated substrate[4)]. SPD enables us to control the composition of the film easily and to reduce the process cost of film formation.

The objective of this research is to demonstrate thin film electrolyte fabrication by SPD. Therefore, the effects of cation concentrate in precursor solution, substrate temperature and post annealing temperature on the properties of the LSGM thin film electrolyte for the μ-SOFC were investigated.

Thin film preparation

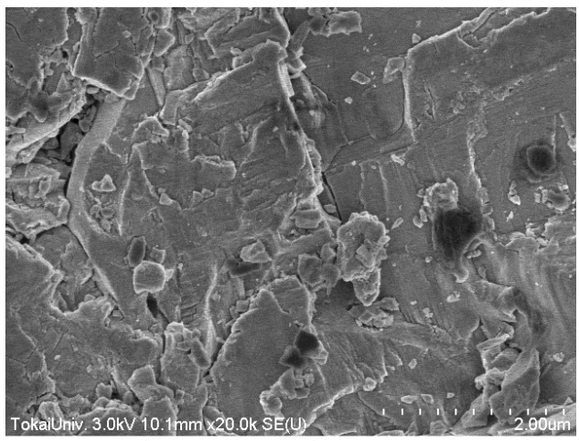
Precursor solutions were prepared by dissolving $La(NiO_3)_3 \cdot 6H_2O$, $Sr(NO_3)_2$, $Ga(NO_3) \cdot xH_2O$ and $Mg(NO_3)_2 \cdot 6H_2O$ into dilute nitric acid at cation concentration of 0.1mol/l and 0.5 mol/l. Substrate temperature was controlled at the range of 350 ^{o}C and 530 ^{o}C. Post annealing was conducted at the temperature range of 700 ^{o}C and 1000 ^{o}C for 1 h in air.

Characterizations

Morphology of the prepared thin films was analyzed by SEM. Oxide ion conductivity of the prepared thin films was measured by ac impedance method. Impervious property of the thin films was verified by open circuit voltage under a full-cell configuration.

Results

LSGM thin film density, flatness, morphology and crystallinity were systematically investigated. Dense LSGM electrolyte thin films which consist of single phase of perovskite structure were successfully fabricated on porous NiO anode supports by SPD and post annealing at low temperature in air. The high quality LSGM electrolyte thin film was obtained under the optimum operating conditions. The electrochemical property are also reported.



SEM image of the LSGM thin film prepared by SPD at the substrate temperature of 530 ^{o}C.

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