

Synthesis of Ceramic Cell Materials from Polymer Precursors for Electrolytic decomposition of NO

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INTRODUCTION

The self-energizing NO_x purification device integrated with electrochemical cell reactors and thermoelectric elements has been developed [1]. To achieve the performance requirements of the reactor, e.g., low temperature of 400-600°C, an anode-supported thin-film type cell consisting of La_{1-x}Sr_xCo_{1-y}Fe_yO₃ (LSCF) electrodes and Gd₂O₃-doped CeO₂ electrolyte was proposed. The porous LSCF anodes were synthesized by *in-situ* solid state reaction sintering [2]. In this work, the formation of the dense Ce_{1-x}Gd_xO_{2-δ} (CGO) electrolyte and porous LSCF cathode thin films on the porous LSCF substrates was investigated by using polymer precursor solutions [3].

EXPERIMENTAL

The starting polymer precursor solution with cation molar ratio of Ce:Gd = 0.9:0.1 for CGO thin films was prepared by mixing Ce(NO₃)₃·6H₂O and Gd(NO₃)₃·6H₂O with ethylene glycol, distilled water and small amount of nitric acid at room temperature. The resulting parent solution was heated on a hot plate at 60-90°C until it turned to a viscous liquid due to polymerization. In similar way, another precursor solution with cation molar ratios of La:Sr:Co:Fe = 0.6:0.4:0.2:0.8 for LSCF thin films was prepared. The structure development and reactions of the polymer precursors were characterized by FTIR and TG-DTA. A conventional dip-coating technique was used to form wet films on various substrates such as dense YSZ substrates or porous LSCF substrates, followed by drying at about 150°C and heat treatments at 300-800°C in air. The thin films deposited from the polymer precursors were characterized by XRD, SEM, and AFM.

RESULTS AND DISCUSSION

The effect of the organic solvents and polymerization of the precursor solutions on the morphology and crystallization of the derived thin films was investigated. It is indicated that the polymerization of the precursor solution would promote the crystallization of the coated thin films at lower temperature. Fig. 1 shows the surface morphology of a CGO thin film deposited on a YSZ substrate from a polymerized precursor solution. A dense CGO thin film deposited on a porous LSCF substrate is shown in Fig. 2. When changing the organic solvent from ethylene glycol to polyethylene glycol, porous LSCF thin films were formed, as shown in Fig. 3. The polymerization and structure development of the heat treated precursor solutions were demonstrated by FTIR spectra. The crystalline morphology of the thin films was observed further by AFM. The cells consisting of the dense CGO and porous LSCF thin films are being fabricated and evaluated.

References:

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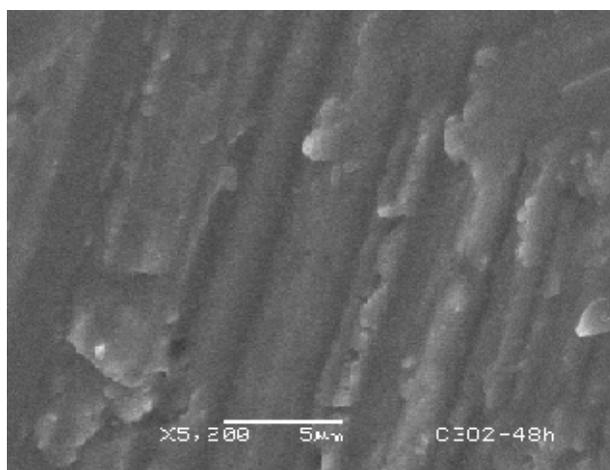


Fig. 1 A typical surface morphology the CGO thin films dip-coated on a YSZ substrate from the polymerized precursor solution.

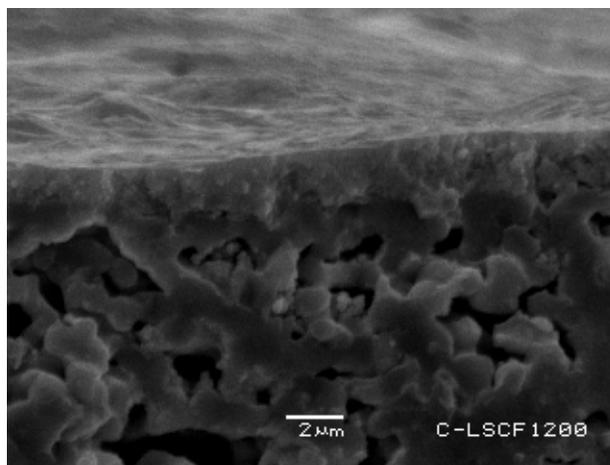


Fig. 2 Cross-section microstructure of a dense CGO thin film coated on a porous LSCF substrate.

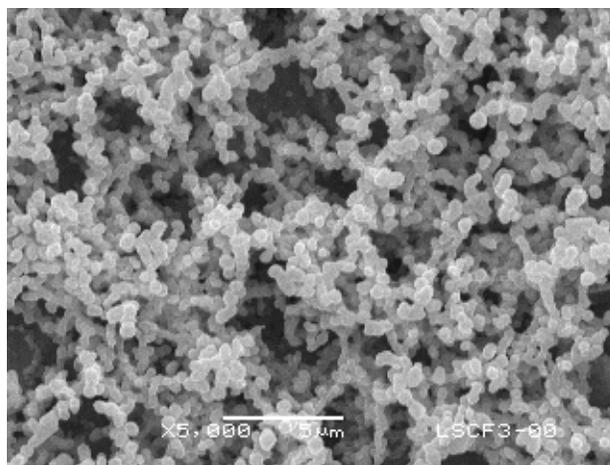


Fig. 3 SEM micrograph of a porous LSCF thin film coated on a YSZ substrate from the polymer precursor solution.