

CHEMICAL SYNTHESIS OF LSGM POWDERS FOR SOLID OXIDE FUEL CELL (SOFC) ELECTROLYTE

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ABSTRACT

Synthesis of LSGM ($\text{La}_{0.9}\text{Sr}_{0.1}\text{Ga}_{0.8}\text{Mg}_{0.2}\text{O}_{3-\delta}$), LSFM ($\text{La}_{0.9}\text{Sr}_{0.1}\text{Fe}_{0.8}\text{Mg}_{0.2}\text{O}_{3-\delta}$), and LSCM ($\text{La}_{0.9}\text{Sr}_{0.1}\text{Cr}_{0.8}\text{Mg}_{0.2}\text{O}_{3-\delta}$) powders were achieved via organic precursor method. Different organic "carrier" molecules were used for powder synthesis. Citric acid, tartaric acid, Pechini precursors, polyvinyl alcohol, and ethylene diaminetetraacetic acid were selected as organic carriers for their ability to stabilize the metal ions. Each organic carrier material exhibited a different degree of effectiveness in the synthesis of the mixed oxide powders. One of the main factors affecting the phase purity appears to be the interaction of the functional groups with the constituent cations. The effectiveness of the organic carrier with varying number and type of functional groups is evaluated and discussed in terms of the phase distribution in the powders after the calcination step.

INTRODUCTION

Solid oxide fuel cells are regarded as the energy production systems for 21st century due to their high efficiency, utilization of a variety of the fuel resources, and environmental friendliness. Strontium and magnesium-doped lanthanum gallate (LSGM, e.g. $\text{La}_{1-x}\text{Sr}_x\text{Ga}_{1-y}\text{Mg}_y\text{O}_{3-(x+y)/2}$) is a perovskite-type oxide and one of the most promising electrolyte materials for Intermediate Temperature-SOFC applications. Its ionic conductivity values are much higher than the one of YSZ electrolyte, and comparable to that of ceria-based electrolytes in the high and intermediate temperature ranges. Ionic conductivities of YSZ, LSGM, and CGO electrolytes at temperatures 600°C, 800°C, and 1000°C are tabulated in Table 1.

Table 1. Ionic conductivities of YSZ, LSGM, and CGO for 600°C, 800°C, and 1000°C.

Electrolyte	600°C	800°C	1000°C
YSZ	0.003 S/cm ⁽¹⁾	0.03 S/cm ⁽¹⁾	0.1 S/cm ⁽¹⁾
LSGM	0.02 S/cm ⁽²⁾	0.12 - 0.17 S/cm ⁽¹⁾	0.25 S/cm ⁽²⁾
CGO	0.025 S/cm ⁽¹⁾	0.1 S/cm ⁽²⁾	0.25 S/cm ⁽¹⁾

Each electrolyte material in SOFC construction is designed to exhibit the best performance under SOFC operating conditions. Small discrepancies in the composition results in a poorer performance of SOFC. For example, excellent ionic conductivity was achieved with Sr and Mg-doped LaGaO_3 electrolyte material of the following composition ($\text{La}_{0.9}\text{Sr}_{0.1}\text{Ga}_{0.83}\text{Mg}_{0.17}\text{O}_{3-\delta}$)³. Small deviations from composition resulted in a decrease in the ionic conductivity. Therefore, it is important to produce pure and single-phase SOFC components with the desired compositions.

The organic precursor technique is a method widely used in mixed oxide powder synthesis^{4,7}. The predicted mechanism in organic precursor method for achieving a stable precursor is the

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