

Plasma Sprayed LSGM Electrolyte for Intermediate Temperature Solid Oxide Fuel Cells

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Yttria-stabilized zirconia (YSZ) is commonly used as the electrolyte material at present for SOFCs operated at a temperature of $\sim 1000^\circ\text{C}$ (1-3). Advantages of operation at such a high temperature include internal reforming of fuels such as natural gas, and high quality waste heat. However, these temperature operations of SOFCs lead to materials constraints, high stress from differential thermal expansion of the cell system, high cost of manufacture, and problems of long-term stability. Intermediate temperature SOFCs combining with appropriate processing techniques are expected to overcome the problems related to the high operating temperature.

The strontium and magnesium doped lanthanum gallate (LSGM) electrolyte was processed into thick film ranging from $100\ \mu\text{m}$ to $550\ \mu\text{m}$ using a plasma spray technique, followed by post heat-treatment at elevated temperatures (500°C to 800°C). The processed LSGM electrolyte were characterized in terms of its (1) physical properties including phase purity in Fig. 1, crystallinity, density in Fig. 2, and (2) electrochemical properties including open circuit voltage, ionic conductivity, and ac impedance spectroscopy Fig. 3. The electrochemical properties of the plasma sprayed LSGM were also compared with press-sintered LSGM pellets. The as-sprayed electrolyte exhibited a single LSGM phase in a mixture of amorphous and crystalline states. The amorphous phase can completely transfer into crystalline one at temperature up to 800°C as revealed by the XRD and impedance studies. The successful processing of LSGM using an industrial plasma spray technique offered a potential opportunity for fabrication of solid oxide fuel cells ("SOFCs") for intermediate temperature applications (500 to 800°C).

References:

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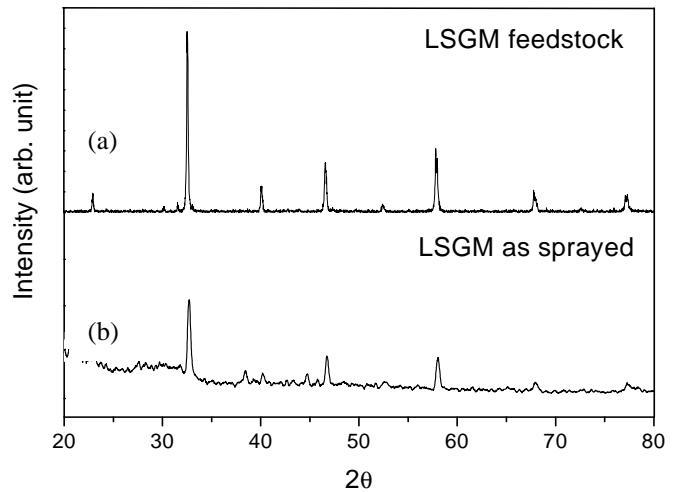


Fig. 1. XRD spectra for LSGM: (a) feedstock, (b) as-sprayed disc

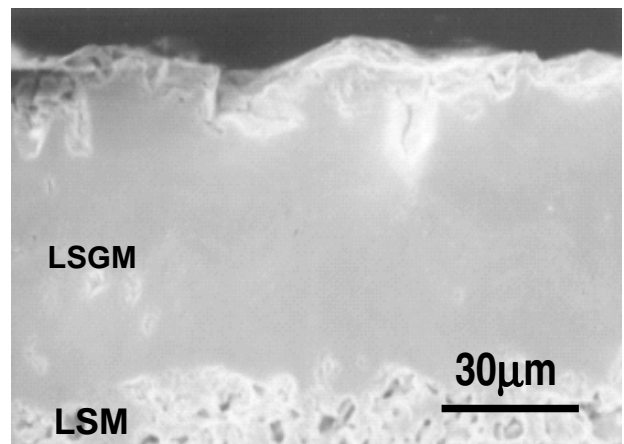


Fig. 2. SEM image for cross-section observation of as-sprayed LSGM disc.

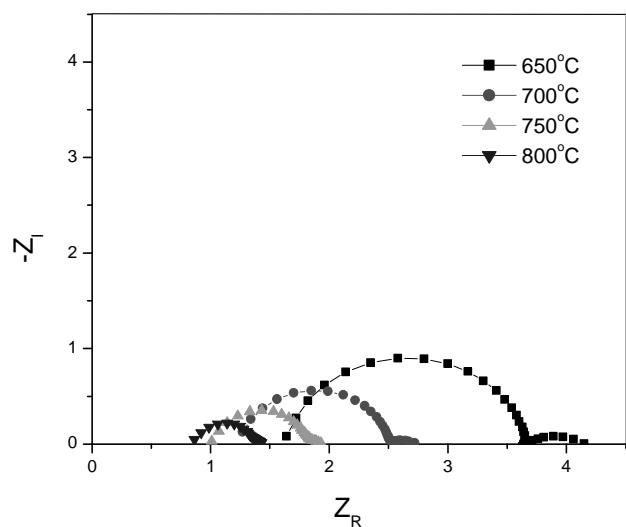


Fig. 3. The ac complex impedance plot at different temperatures for sprayed and heat-treated LSGM.