Optimization of LSCF-GDC Composite Cathodes for Thin Film GDC Electrolyte Solid Oxide Fuel Cells

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ABSTRACT

The electrochemical properties of porous $La_{0.8}Sr_{0.2}Co_{0.2}Fe_{0.8}O_3$ (LSCF) cathodes and LSCF-$Gd_{0.1}Ce_{0.9}O_{1.95}$ (GDC) composite cathodes on dense GDC electrolytes were evaluated at intermediate temperatures of 500-700°C using ac impedance spectroscopy. It was found that sintering temperature, microstructure and composition have great effects on the cathode performance. After sintering at 900°C for 2 h, pure LSCF cathode produced an optimum polarization resistance of 2.54 Ωcm^2 at 600°C. SEM examination shows that the microstructure well explains the difference in the cathode performance due to different sintering temperature. The addition of GDC phase further substantially enhances the electrochemical properties of LSCF cathodes. The polarization resistance is decreased to 0.26 Ωcm^2 at 600°C, a reduction by a factor of 9, as a result of 50 wt% GDC addition to LSCF, implying that the triple phase boundary (TPB) makes a great contribution to the electrochemical properties of LSCF-GDC composite cathodes. With this optimized LSCF-GDC composite as cathode, a single anode-supported cell was prepared based on a 22-µm-thick GDC film as electrolyte and Ni-GDC cermet as anode, which generated excellent performance with the maximum power density of 1004, 595, 316 and 152 mW/cm^2 at 650, 600, 550 and 500°C, respectively.

Keywords: Composite cathodes, Solid oxide fuel cells, Impedance spectroscopy, Thin film electrolyte, Gadolinia-doped ceria

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