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Microwave sintering of ceria-doped scandia stabilized zirconia as electrolyte for solid oxide fuel cell

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ABSTRACT

In this work, the effect of microwave sintering on the properties of 1 mol% ceria-doped scandia stabilized zirconia (10Sc1CeSZ) was investigated. The sintering was carried out at temperatures 1300 °C and 1350 °C for 15 min using a 2.45 GHz microwave furnace. The sintering behavior of the microwave sintered ceramics was compared with that obtained via the conventional sintering at temperatures ranging from 1300 °C to 1550 °C with 2 h holding time. It was found that both sintering processes yielded highly dense samples with minimum density of 98% theoretical value. Phase analysis by X-ray diffraction revealed the presences of only cubic phase in all sintered samples. All sintered pellets possessed high Vickers hardness (13–14.6 GPa) and fracture toughness (~3 MPa $m^{1/2}$). Microstructural examination by using the scanning electron microscope showed that the grain size varied from 2.9 to 9.8 μm for the conventional sintered samples whereas the grain size of the microwave sintered ceramics was below 2 μm. Electrochemical Impedance Spectroscopy study recorded the maximum ionic conductivity of 0.280 S/cm at 800 °C for the conventional-sintered sample at 1550 °C whereas a high value of 0.314 S/cm was measured for the microwave-sintered sample at 1350 °C.

Introduction

Solid Oxide Fuel Cell (SOFC) is an electrochemical device that produces electricity cleanly and efficiently from the reaction of the hydrogen and air. It uses metal oxide solid ceramic electrolytes to allow the transport of oxygen vacancy (O^{2-}). The O^{2-} ionic conduction requirement for the ceramic electrolyte necessitates high operating

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