Phase stability and ionic conductivity of spark plasma sintered scandia-zirconia containing additives

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Scandia-stabilized zirconia exhibits the highest ionic conductivity in zirconia-based solid electrolytes [1] and therefore is a candidate material for application in solid oxide fuel cell operating at intermediate temperatures (600–800 °C). However, the crystal structure of this system is complex [1] and several attempts have been made to stabilize the cubic (*c*) phase at room temperature. Recently, addition of minor amounts of Al_2O_3, CeO_2, Ga_2O_3, HfO_2 was investigated for that purpose [2,3]. In this work, the effects of 1 mol% additives (Dy_2O_3 and Nb_2O_5) on zirconia- 10 mol% scandia (10ScSZ) were investigated aiming to stabilize the cubic structure at room temperature and to suppress the characteristic cubic-to-rhombohedral β phase transformation. Compositions were prepared by the coprecipitation method. Consolidation of the solid electrolyte was accomplished by spark plasma sintering in the 1000–1400 °C range for 1 and 5 min at 65 MPa. The relative density for sintered samples was higher than 95% for temperatures of 1200 °C and higher. X-ray diffraction results show that full stabilization of the cubic phase was attained after sintering for both prepared compositions. Arrhenius plot of total ionic conductivity shows suppression of the reversible phase transformation. Activation energy for oxide ion conduction is approximately 0.80 eV in the high temperature range (>600 °C).

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