



COMPREHENSIVE SINTERING AND CONDUCTIVITY STUDY OF 10% Sc_2O_3 AND 1% CeO_2 CO-DOPED ZrO_2

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ABSTRACT

Due to their high ionic conductivity compared to conventional yttria stabilized zirconia, solid electrolytes based on scandia doped zirconia are attractive materials for applications in fuel cells operating at intermediate temperatures with relaxed requirements on sealants and structural materials. Sintering properties of the powder are an important consideration determining its viability for commercial applications, while the resultant ceramic's ionic and electronic conductivities determine its performance as an electrolyte. This work is aimed at comprehensive characterization of commercial 10% Sc_2O_3 and 1% CeO_2 co-doped ZrO_2 powder with respect to the above mentioned parameters. The sintering behavior of the powder was determined by non-isothermal dilatometry as well as thermogravimetric analysis. This data was then used to determine appropriate treatment of the powder to obtain dense ceramic pellets. XRD was performed on as-received powder and at appropriate stages of the ceramic preparation process. The microstructure properties of the powder and ceramic pellets were investigated by SEM. Total conductivity of the obtained ceramic was measured in frequencies of 10 Hz to 3 GHz and temperatures between 300 K and 700 K. The electronic contribution to total conductivity of the pellets in reducing and oxidizing atmospheres was determined using a modified Hebb-Wagner technique over an oxygen activity range of 10^{-35} to 10^3 and temperatures between 673 K and 1023 K, which correspond well to the operating temperature and oxygen activity ranges in intermediate temperature fuel cells.

Keywords: Doped Zirconia, Solid Electrolyte, Ionic Conductivity, Electronic Conductivity, Sintering