Grain size effect on the conductivity of nanocrystalline samaria-doped ceria

Robert Freer Cost 525
University of Manchester/UMIST - UK

Abstract

Alberto Rainer, Vincenzo Esposito, Nicola Scuor∗ , Silvia Licoccia and Enrico Traversa.

Dipartimento di Scienze e Tecnologie Chimiche, Università di Roma Tor Vergata, Via della Ricerca Scientifica, 00133 Roma (Italy) ∗ Dipartimento di Ingegneria dei Materiali e Chimica Applicata (DIMCA), Università di Trieste, Via Valerio 2, 34127 Trieste (Italy)

Samaria-doped ceria (SDC) is a very promising material for solid oxide fuel cells operating at intermediate temperature. Tailoring the microstructure of SDC allows to enhance its performance either in electrode or electrolyte applications. In fact SDC is attractive as electrolyte for IT-SOFCs and its mixed conductivity can be favourably exploited in anodic applications. To reduce anodic polarization it is necessary to promote the charge transfer and ionic absorption/desorption, thus maximizing the triple phase boundary (TPB). Nanocrystalline porous systems represent the best solution for TPB tailoring to reduce power losses. Several chemical routes have been developed for the synthesis of ceria-based oxide powders; most of them, however, start from expensive reagents or require high calcination temperatures. We have developed a novel chemical route for SDC nanopowders. This direct condensation method allows to obtain crystalline, single phase SDC at room temperature using low cost reagents (metal salts). The calcination treatment was performed to eliminate volatile residuals (about 25 wt%). The powders prepared in this way were formed into pellets 5 mm in diameter using cold isostatic pressing. Those pellets were sintered at selected temperatures in the range 1000-1500 °C. The density, pore and grain size distribution were characterized using Hg porosimeter, FE-SEM observation and image analysis. Electrochemical impedance spectroscopy (EIS) analysis was performed on the pellets in the temperature range between 150-800 °C, at different values of oxygen partial pressure. Electrodes were made of platinum paste deposited on both sides of the pellets. EIS results were correlated with the measured microstructural parameters to evaluate the grain size effect on the electrical properties.