# Grain size effect on the conductivity of nanocrystalline gadolinia-doped ceria.

A.Rainer[a], V.Esposito[a], C.Trakanprapai[a], M.Trombetta[b], S.Licoccia[a], E.Traversa[a]

*a) Department of Chemical Science and Technology, University of Rome "Tor Vergata"*
*Via della Ricerca Scientifica, 00133-Rome, Italy*
*b) Interdisciplinary Center for Biomedical Research (CIR), Biomaterials Laboratory, Università "Campus Biomedico"*
*Via E. Longoni 83, 00155-Rome, Italy*

Gadolinia-doped ceria (GDC) is a very promising material for solid oxide fuel cells operating at intermediate temperatures. Tailoring the microstructure of GDC allows to enhance its performance either in electrode or electrolyte applications. In fact GDC 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 GDC nanopowders. This "direct condensation" method allows to obtain crystalline, single phase GDC at room temperature using low cost reagents (metal salts) in the presence of a polyfunctional amine. Acid-base reaction between the amine and coordination water causes precipitation of hydroxo-species. Further base induced deprotonation leads to condensation of the oxide at room temperature. ATR-FTIR spectroscopy was used to monitor all the synthetic steps. The calcination treatment was performed to eliminate volatile residuals. The powders prepared in this way were formed into pellets 13 mm in diameter using cold isostatic pressing. Those pellets were sintered at selected temperatures in the range 1000-1600 °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.