

Nanostructured tetragonal zirconia ceramics for IT-SOFCs

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At present, efforts are focused on lowering the operating temperature of solid oxide fuel cells (SOFC) from 900°C to 700°C (IT-SOFC). Tetragonal zirconia (TZP) is considered as a promising candidate to be used as electrolyte in IT-SOFC, because of its good mechanical and electrical properties compared to cubic zirconia. However, the major drawback of TZP is the low temperature degradation caused by tetragonal to monoclinic phase transition accompanied by microcracks.

This work presents new experimental data on an aging study of nanostructured and tetragonal single-phased 2.5 mol. % Y_2O_3 -doped ZrO_2 ceramics in the IT-SOFC operating conditions (at 700°C in water vapour for 1000 hours) and at 250°C, at the temperature of the largest transition kinetic (for 1000 hours in steam atmosphere). Excellent results were obtained: at 700°C, only a weak decrease of conductivity was measured due to the appearance of less than 2 mol % of monoclinic zirconia. An excellent stabilization of TZP was obtained contrary to the present literature, probably because of favorable microstructural characteristics of the materials. In-situ impedance and Raman spectroscopies have been coupled to correlate the electrical properties and phase content in order to bring new insight in the mechanism of monoclinic degradation at 250°C.

Keywords: IT-SOFC, tetragonal zirconia, monoclinic zirconia, nanometric, destabilization, aging, impedance spectroscopy, Raman spectroscopy, water molecules.

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