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Electrical Conductivity and Grain Growth of 12Ce-TZP

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Ceramic materials based on tetragonal zirconia polycrystals (TZP) with yttrium or cerium oxide have been thoroughly studied for a number of technological applications, due to their outstanding thermomechanical properties. In this work, tetragonal zirconia polycrystals containing 12 mol% cerium oxide (12Ce-TZP) were prepared by solid-state reaction using different sintering methods, to evaluate the influence of the final microstructure on the electrical conductivity. High purity zirconium oxide and cerium oxide starting chemicals were weighted in the stoichiometric proportion and ball-milled for 6 h for homogenization. Cylindrical specimens were prepared by pressing followed by sintering. Sintering experiments were carried out by the conventional and the two-stage methods. The mean grain size of specimens sintered by the conventional method achieved approximately 2.4 mm after sintering at 1450 ºC/5 h, whereas those sintered by the two-stage method exhibit less than 1.5 mm even after 10 h at 1350 ºC, in the second stage of sintering. The electrical conductivity determined by impedance spectroscopy shows the usual Arrhenius behavior for both the bulk (or intragrain) and grain boundary (intergrain) conductivities, with activation energies of ~0.97 (bulk) and 1.25 eV (grain boundary). The grain conductivity of specimens sintered by different methods does not depend on the grain size. In contrast, the grain boundary conductivity is higher for specimens sintered by the two-stage method, possibly due to dissolution of minor impurities located at grain boundaries into the bulk, during the long holding times of the two-stage method.