

Effect of starting powders on the sintering of nanostructured ZrO₂ ceramics by colloidal processing

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Abstract. The effect of starting powders on the sintering of nanostructured tetragonal zirconia was evaluated. Suspensions were prepared with a concentration of 10 vol.% by mixing a bicomponent mixture of commercial powders (97 mol.% monoclinic zirconia with 3 mol.% yttria) and by dispersing commercially available tetragonal zirconia (3Y TZ, Tosoh). The preparation of the slurry by bead-milling was optimized. Colloidal processing using 50 µm zirconia beads at 4000 rpm generated a fully deagglomerated suspension leading to the formation of high-density consolidated compacts (62% of the theoretical density (TD) for the bicomponent suspension). Optimum colloidal processing of the bicomponent suspension followed by the sintering of yttria and zirconia allowed us to obtain nanostructured tetragonal zirconia. Three different sintering techniques were investigated: normal sintering, two-step sintering and spark plasma sintering. The inhibition of grain growth in the bicomponent mixed powders in comparison with 3Y TZ was demonstrated. The inhibition of the grain growth may have been caused by inter-diffusion of cations during the sintering.

Keywords: nanostructured zirconia, colloidal processing, two-step sintering, spark plasma sintering (SPS)

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