

Microstructure characterization and mechanical properties of ceramic composites based on zirconia and alumina

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The objective of this work is to present a investigation on microstructures, crystalline phases and mechanic parameters of ceramics based on Al₂O₃ and 3Y-ZrO₂. The initial powders were α -Al₂O₃ submicroparticulated (particle average size of 0.4 μ m) and 3Y-ZrO₂ nanoparticulated (particle average size of 50 nm). Nanoparticulated ZrO₂ was stabilized with 3 mol% Y₂O₃, containing 90 % of tetragonal phase and 10 % of monoclinic phase. It was selected two compositions based on alumina (70 wt % of Al₂O₃ and 30 wt % of 3Y-ZrO₂) and zirconia (81.5 wt % of 3Y-ZrO₂ and 18.5 wt % of Al₂O₃). The powder mixtures were compacted by uniaxial pressing at 80 MPa and isostatic pressing at 300 MPa. The samples were sintered at 1600 °C for 3 hours.

XRD analyses indicate that the Al₂O₃ - ZrO₂ ceramic composites presented zirconia tetragonal phase (Figure 1). The fractured surface of the ceramics showed that the microstructures had few pores (Figure 2). These pores were related to the flaws of powder particle packing during the compaction step. The rich-zirconia composite presented microstructure composed by smaller particle sizes that the rich-alumina composite. Theses grain sizes are coherent with the particle sizes of the initial powders. Vickers hardness values were $16,22 \pm 0,10$ and $15,04 \pm 0,07$ MPa, fracture toughness values were $6,21 \pm 0,24$ and $7,20 \pm 0,16$ MPa, for rich-alumina and rich-alumina composites respectively. These mechanical parameters indicate that they were influenced by the particle sizes of the initial powders and tetragonal zirconia contents in the sintered ceramics.

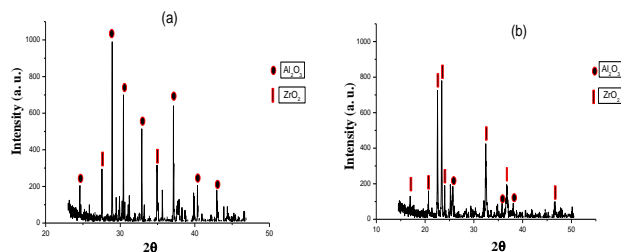


Figure 1 X-ray diffraction patterns of sintered ceramics: a) 3Y-ZrO₂ - Al₂O₃ (81.5 and 18.5 wt%) and b) Al₂O₃ - 3Y-ZrO₂ (70 and 30 wt%).

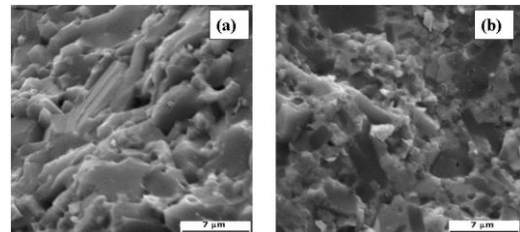


Figure 1 SEM images of sintered ceramics composed by: a) 3Y-ZrO₂ - Al₂O₃ (81.5 and 18.5 wt %) and b) Al₂O₃-3Y-ZrO₂ (70 and 30 wt%)

Keywords: Alumina – zirconia composites, microstructure, mechanical properties.

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[1] INÁCIO, M. A. Desenvolvimento de compósitos cerâmicos de Al₂O₃ e ZrO₂ para confecção de ferramentas de corte para torneamento (Development Al₂O₃ and ZrO₂ ceramic composites to applications as cutting tools). Dissertação de Mestrado, INPE, 2010.

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