Acta Microscopica, Vol. 8 Supplement A October 1999
Proc. XVII Congress of the Brazilian Society for Microscopy and Microanalysis and X Congress of the Brazilian Society for Cell Biology

FRACTURE SURFACES OF NANOPHASE Y-TZP CERAMICS

Tadokoro, S. K & Muccillo, E. N. S.

Materials Engineering Department
Energy and Nuclear Research Institute
CP 11049, Pinheiros - 05422-970, S. Paulo, SP, Brazil

There is a growing interest in ultra-fine grained powders for processing ceramic components. This is motivated by the promise of improved sinterability allied to special ceramic properties such as superplasticity, giant magnetoresistance, transparency in opaque ceramics and enhanced homogeneity. These special properties of the so-called nanostructured materials are directly related to their unusual microstructure that features very small grains (< 100 nm) and a large fraction (up to 40 vol% depending on grain size) of highly disordered interfaces[1, 2].

There are several techniques to produce nanosized ceramic powders[3]. In this work, the coprecipitation technique was used to prepare nanosized zirconia-3 mol% yttria (Y-TZP) with high sinterability and small average grain size. Zirconyl chloride (> 99%) and yttria (> 99%) were used as starting materials. The conventional experimental procedure for coprecipitation experiments was improved by introducing an azeotropic distillation step. Microstructural characterization has been carried out on fractured surfaces of sintered specimens with a scanning electron microscope (LEO440i, Oxford).

Results of powder characterization show the agglomeration degree after calcination. However, these agglomerates are not hard so that they could be broken during pressing giving rise to a powder compact easily densified by firing at temperatures lower than 1200 °C.

Figure 1 shows the fracture surfaces of a specimen sintered at 1185 °C for 5 h with progressively increasing magnification. For the lower magnification (top) a smooth surface is observed without rough imperfections like large voids or inclusions. For a higher magnification (middle) a homogeneous distribution of grain sizes is seen. This specimen has an estimated average grain size of ~ 100 nm. The hydrostatic density reached 98.5% of the theoretical value. Fracture is typically intergranular (bottom). These results demonstrate the high degree of microstructural homogeneity of Y-TZP sintered specimens prepared by this technique.

Acknowledgements: to FAPESP (95/05635-4, 97/14238-4 and 98/09976-9).

References

1. Shull, R. D., NanoStructured Materials 2, 213 (1993).
2. Hahn, H., NanoStructured Materials 2, 251 (1993).
3. Savage, S., Grinder, O., *in* Adv. Powder Metallurgy & Particulate Materials 92 v. 7, ed. J. M. Capus, R. M. German, 1992, pp. 1.

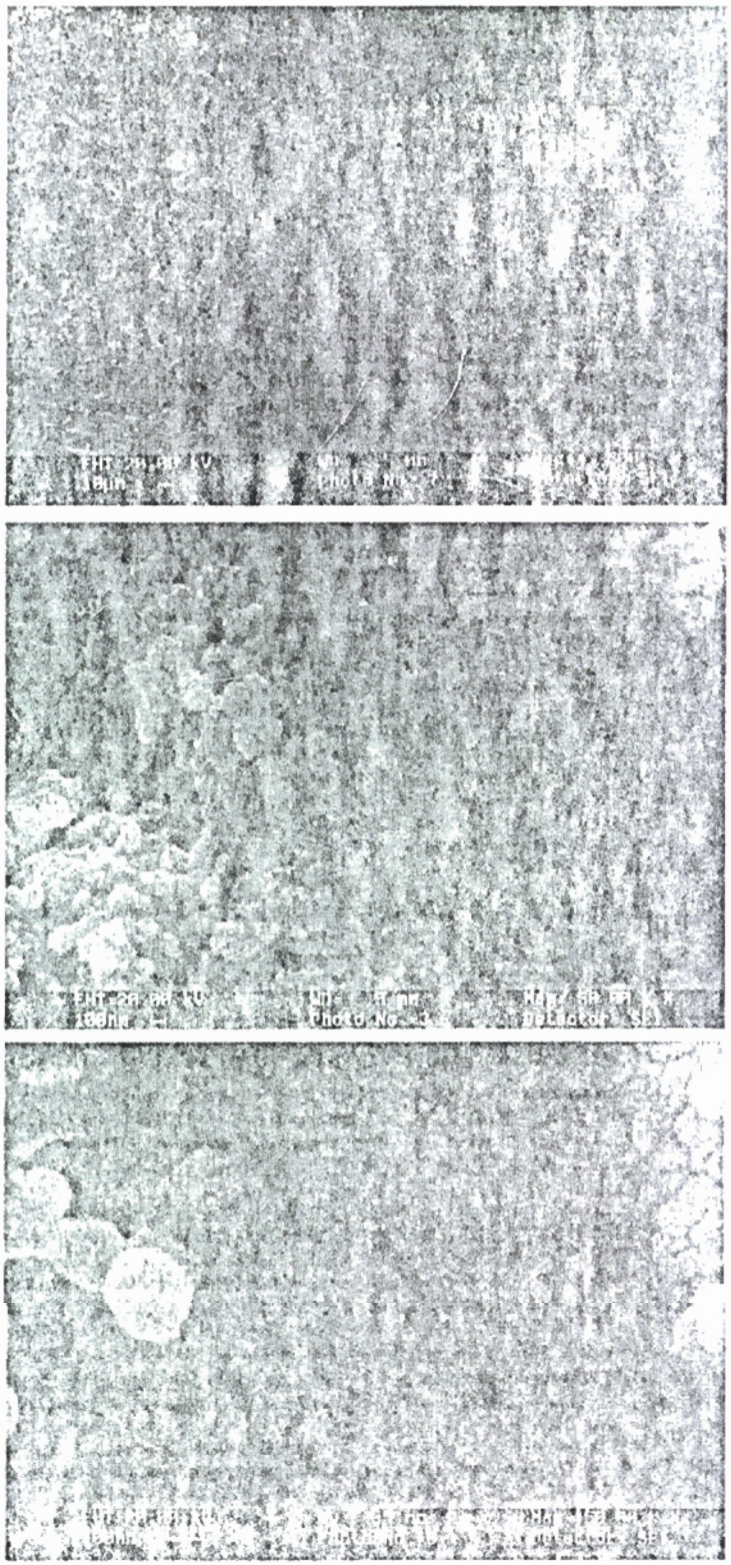

Figure 1: Scanning electron micrographs of fractured surfaces of a nanosized Y-TZP sintered specimen.