ALUMINA-ZIRCONIA NANOCOMPOSITES: MICROSTRUCTURE, SINTERING, AND MECHANICAL PROPERTIES

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Nowadays, orthopaedic implants such as hip and knee prostheses have an average lifetime of about 10 years. However, considering an aging population and the growing demand for performing orthopaedic surgery on younger patients, implants should exhibit a lifetime over 30 years. Ceramic materials are now becoming an acceptable alternative to the common metal-polyethylene or metal-metal bearing devices. These materials appear to be ideally suited for joint prostheses, because of their hardness, which in turn implies low wear rates and an excellent biocompatibility. However, ceramic materials are known to be brittle and susceptible to slow crack growth. Currently, monophase alumina or zirconia ceramics are widely used as femoral heads [1,2]. There are many reports on fracture rates; important references have been compiled elsewhere [3]. Also, a great progress in dental restorations technique has been established by the use of ceramic materials since the 70's. In some application fields, the trend is to eliminate the metallic substructure, including implant restorations. These materials show relative advantages, like aesthetic, biocompatibility and chemical resistance.

In this work, dense Al_2O_3 - ZrO_2 (0 – 2.5 wt%) nanocomposites were formed, starting from nanoalumina powders, the surface of which was modified by using a zirconium alkoxide, following a colloidal route. Slip casting was done in alumina molds in order to obtain the green bodies that were further sintered in air atmosphere following different thermal treatments. The different sintering conditions, as well as the green body processing, led to different final densities and microstructures, studied by SEM and TEM, which were reflected in the mechanical properties.

It will be shown how, by adding ZrO_2, it is possible to modify the mechanical and microstructural properties. Finally, it will be also discussed how the mechanical properties are modified by using a nanoalumina matrix vs. a micron sized alumina matrix.

References:

[1] G.Willmann, Adv. Eng. Mater. **114**, 2, 2000.
[2] C. Piconi, G. Maccauro, Biomaterials **20**, 1, 1999.
[3] R. Heros, G.Willmann, Seminars of Arthroplasty **114**, 9, 1998.

Figures:

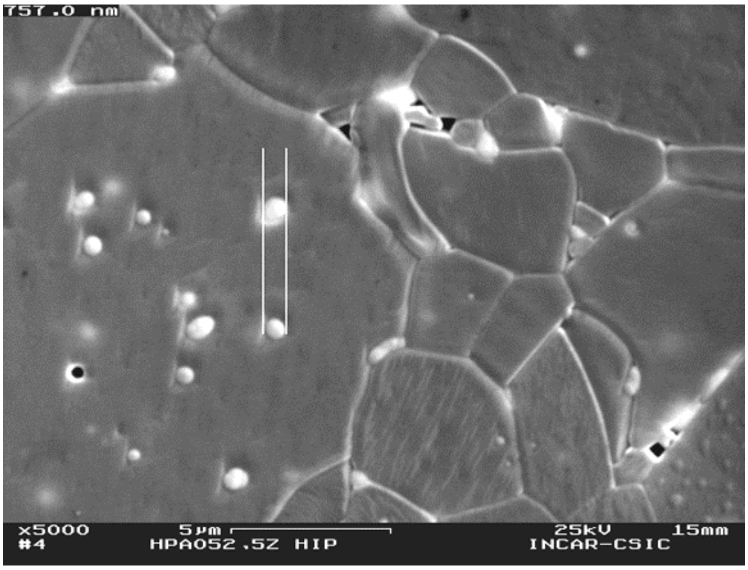

Figure 1.- SEM image of an Al_2O_3-ZrO_2 (2.5%) nanocomposite.