CERAMIC RAW MATERIALS AND PROCESSING

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The role of the physical characteristics of starting powders in the ceramic properties are well supported by the literature, then dense ceramics can be achieved by using nanosized powders, free from hard agglomerates. Hydrometallurgical or pyrometallurgical processes such as coprecipitation, synthesis from a polymeric precursor, hydrothermal synthesis, vapor phase reaction and combustion synthesis can be used to prepare such powders. In this sense, the focus of this research is the preparation of zirconia based ceramics, silicates and silicon tetrachlorides, using some of these techniques.

Zirconia based ceramics related to the systems ZrO2-Y2O3-R2O3, ZrO2-MgO, ZrO2- Y2O3-MgO, ZrO2-Y2O3-TiO2 and ZrO2-Y2O3-Al2O3 (FIG.1) have been synthesized by the coprecipitation route through out solutions prepared from chemical processing of zircon and monazite ores, as well as titanium oxide and magnesium and aluminum chlorides. Nanosized powders were obtained controlling metallic ions concentration and hydroxyls groups. The use of organic liquids to dehydrate the gels and wet milling have been regarded to control the agglomeration powder state.

Calcination, milling, pressing and sintering were also studied to improve ceramic density. Results showed that yttria concentrates are effective for doping zirconia and for the production of ceramics with mechanical and electrical properties as good as those of zirconia-yttria ceramics. Titania has limited solubility in stabilized zirconia and can form titanates as second phase that can improve mechanical properties without changing the electrical behaviour. The addition of yttria to zirconia-magnesia ceramics enhances mechanical properties by nucleation of tetragonal phase into cubic grains.

Alumina is also a good additive for tetragonal zirconia ceramics as it can improve hardness and elastic modulus despite the reduction of fracture toughness. When added to cubic zirconia, alumina enhances its mechanical properties without significant change of electrical conductivity.

The binary disilicates, and specially the rare earth disilicates have been widely studied by conventional solidstate reaction of yttria and silica. The pressureless hydrothermal method developed in this research allows a strict control of rare earth additions, resulting in a maximum efficiency of fluorescence emission, 40% of the best commercial phosphor (Eu:Y2O3). Amorphous silicon nitride has been synthesized by gaseous reaction of silicon tetrachloride and ammonia, using rice husk as silicon source, that is a cheap and abundant raw material for the production of structural ceramics.

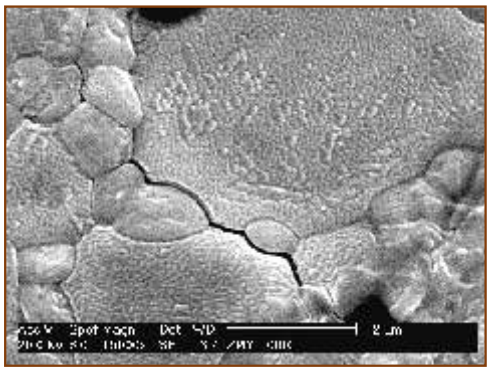

FIGURE 1 - SEM micrograph of ZrO2-Y2O3-MgO ceramic.