

# SYNTHESIS OF TECHNOLOGICALLY IMPORTANT ZIRCONIA NANOMATERIALS AS A VALUE ADDITION TO SRI LANKAN ZIRCON SAND

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Nano zirconia ( $ZrO_2$ ) is a technologically advanced ceramic material in a wide range of applications such as wear resistant rubber gloves, solid oxide fuel cells, cutting tools, solid state ionics, oxygen sensors and dental and other prosthetics. Sri Lanka has significant deposits of zircon sand, its primary source being beach sand. Extraction process of zirconia from Sri Lankan zircon sand had previously been studied at University of Peradeniya by Karunaratne et. al. 1993. The present study focuses on manipulation of the previous extraction process in order to synthesize zirconia nanoparticles and nanofibers from Sri Lankan zircon sand.

In this study, zircon sand was digested using a molten caustic solution and the fused mass was converted to zirconium oxychloride octahydrate ( $ZrOCl_2 \cdot 8H_2O$ ) using hydrochloric acid. To synthesize zirconia nanoparticles, a dilute sodium hydroxide solution was added dropwise to a dilute  $ZrOCl_2 \cdot 8H_2O$  solution. In separate trials, non-ionic, cationic and anionic surfactants (Triton X-100, cetyl trimethyl ammonium chloride, sodium dodecyl sulfate) and in-situ polymerization of methyl methacrylate (MMA) were used to inhibit particle agglomeration. The resulting hydroxide gel was decomposed at 650 °C to obtain zirconia nanoparticles. For the synthesis of zirconia nanofibers, a mixture of  $ZrOCl_2 \cdot 8H_2O$ , poly vinyl pyrrolidone (PVP) and ethanol was prepared and electrospun inside a home-made apparatus. The fibers were then fused at 650 °C to obtain zirconia nanofibers. The products were confirmed by scanning electron microscopy (SEM), x-ray diffractometry (XRD), energy dispersive x-ray spectroscopy (EDX), x-ray fluorescence spectroscopy (XRF) and dynamic light scattering particle size analysis (DLS-PSA).

Using in-situ polymerization of MMA, spherical and monodispersed zirconia nanoparticles of the smallest average particle size of 40 nm was obtained. Respectively the surfactants SDS, CTAC and Triton x-100 resulted in moderately

polydispersed zirconia particles with the average particle sizes of 311.1 nm, 473.5 nm, and 498.3 nm. Also, the diameters of nanofibers synthesized by electrospinning were all under 100 nm after calcination.

*Keywords: Nano zirconia, Particle agglomeration, Polymerization, Synthesized by electrospinning*