Preparation and characterization of Hydroxyapatite/Alumina NanoComposites by High Energy Vibratory Ball Milling

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Nano-composites have received much attention due to their superior mechanical properties in comparison to their large-grained counterparts. Nano-crystalline alumina is bio-active whereas alumina is bio-inert in conventional polycrystalline form [1]. For HA/aluminacomposites, α-Alumina powder was used because of its better sinterability than γ-Alumina[2].

Hydroxyapatite/alpha-alumina composites were prepared by high energy vibratory ball milling. The effect of alumina addition, from 5 to 25 weight percent, has been investigated. X-ray Diffraction (XRD) and Fourier transform infrared spectroscopy (FT-IR) results indicated that hydroxyapatite and alumina were the major phases after mechanical milling only small peak shifts were observed. Transmission electron microscope (TEM) photomicrograph revealed that obtained powder after mechanical milling treatment was composed of nanoparticles with size ~ 40 nm. After three hours of air sintering at 1000-1200°C, beta-tricalcium phosphate and alumina phases was founed. The additional calcium aluminum phosphate phase might be formed during the process of sintering at 1200°C. The mechanical properties (compressive strength and Rockwell hardness) of the hydroxyapatite/alumina composites were improved with sintering temperatures and concentrations of alumina and the maximum value was found with 15 wt.%alumina.

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2. Evis Z., Doremus R. "Coatings of hydroxyapatite — nanosize alpha alumina composites on Ti-6Al-4V." Materials Letters 59 (2005): 3824 – 3827.