ADVANCES IN MATERIALS ENGINEERING

Volume 1

Edited By:
Zahurin Halim
Iskandar Idris Yaacob
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Sodium Doped Nanohydroxyapatite Bioceramics through Mechanochemical Synthesis

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Abstract. Monovalent metal ion, sodium (Na) was doped into HA structure via mechanochemical method by a dry mixture of calcium hydroxide $Ca(OH)_2$, di-ammonium hydrogen phosphate $(NH_4)_2HPO_4$ and sodium hydroxide (NaOH) precursors at 370 rpm in 15 h. The characterizations of the as synthesized Na free HA and Na-doped HA powders were accomplished by X-ray diffraction (XRD) and Fourier transform infra red (FTIR) analysis. The resultant powders showed that Na was successfully substituted into HA and affected the crystallite size, lattice parameters and unit cell volume. The increment of lattice parameters and unit cell volume were limited until 8% Na-doped HA and the enlargement of crystallite size was achieved until 4% Na-doped HA whereby the size decreased as the Na concentration increased.

Introduction

The close chemical similarity to minerals found in calcified tissues has made one of calcium phosphate types, hydroxyapatite (HA) as the most widely studied material. However, insufficient mechanical qualities such as low strength and brittleness have restrict HA's application as bone implants in load-bearing condition [1]. Other drawbacks such design limitations [2] and high degree of crystallinity could result in the nondegradability of pure HA when implanted in an organ [3]. The slow degradation of HA makes in vivo experiments in physiological conditions impractical, unless the degradation process can be accelerated. Bone tissue engineering is a specific area in nanotechnology where the development of nanostructured biomaterials may be able to replace hard and soft skeletal tissue, and biocompatible materials for tissue genesis. In spite of calcium, phosphate and carbonate, bone mineral contains a great number of other inorganic compounds such as sodium, fluoride, chloride, magnesium, strontium, zinc, copper and iron in varying quantities. These elements are known to affect bone mineral characteristics, such as crystallinity, degradation behavior and mechanical properties [4]. There has been a substantial effort devoted by numerous researchers to improve synthetic HA physical and mechanical properties. One of the strategies is to dope HA with metal ions such as magnesium (Mg) [5-7], manganese (Mn) [8 -10] and strontium (Sr) [11-13]. Those traces of ions have an effect on the lattice parameters, the crystallinity, the dissolution kinetics and other physical properties of apatite [14].

Sodium (Na) is known to have an important effect in biological apatites since it plays a potential role in a cell adhesion as well as in the bone metabolism and resorption process. Na has been traced as an abundant element in natural bone and tooth mineral after calcium and phosphorous [15]. For instance, previous studies have worked with the processing of sodium substituted HA through several synthesis methods such as hydrolysis of monetite, double decomposition and aqueous