

ADVANCES IN MATERIALS ENGINEERING

Volume 1

Edited By:
Zahurin Halim
Iskandar Idris Yaacob
Md Abdul Maleque



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Morphological Analysis of Mechanochemically Synthesized Nanohydroxyapatite Bioceramics

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Abstract. In this chapter, nanosized hydroxyapatite (HA) powder was synthesized via mechanochemical method by a dry mixture of calcium hydroxide $\text{Ca}(\text{OH})_2$ and di-ammonium hydrogen phosphate $(\text{NH}_4)_2\text{HPO}_4$ powders. The effect of mechanochemical processes on the as synthesized powder and the sintered compact properties were investigated. Three rotation speeds of 170, 270 and 370 rpm were used with 15 hours milling time respectively. Characterization of nanopowders was accomplished by transmission electron microscopy (TEM) analysis. The green bodies with 200 MPa cold pressed were prepared and sintered under atmosphere condition at various temperatures ranging from 1150°C - 1350°C. Agglomerated powders with irregular shapes were found in all milled powders. Thus, the particle sizes were found decreased as the rotation speed increased as resulted from TEM and SEM analysis.

Introduction

Hydroxyapatite (HA) is usually used for a number of biomedical applications in the forms of granules, blocks, coatings and dense bodies [1-6] for bone augmentation. HA also useful for drug delivery and antibiotics [5-7]. It is naturally contained in human bone as the crystals within collagen. The high strength is necessary for the reliable work of an implant in the body [8]. Many improvements have been made earlier to overcome the limitation of HA in loading application by controlling microstructures via novel sintering technique or utilization of nanopowders [9]. Development of dense HA ceramics with superior mechanical properties is possible if the starting powder is stoichiometric with better powder properties such as crystallinity, agglomeration, and morphology. Nano scale grain size in dense sintered materials is a desired parameter to enhance the mechanical and biological properties of HA-based bioceramic materials [10]. There are several methods have been applied in synthesized HA nanocrystalline powder comprising wet precipitation [11], sol-gel [12], hydrothermal [13] and mechanochemical [14].

Mechanochemical ball milling has been used since 1922 where the materials components are synthesized by deformation process through ball-particle, particle-wall, and particle-particle collisions [15] at a particular time, leading to the chemical reaction between particles to form new nanosize composites or powders. Mechanochemical is a simple and low cost method compared to others. Besides, it has been recently receiving attention as an alternative route in preparing materials characterized by better biocompatibility with natural bone [5, 6, 14]. Thus, there are two ways can be implemented through mechanochemical milling whether in a wet medium [16] or in a dry condition [14]. The dry mechanochemical has been reported to be more benefits than the wet mechanochemical due to faster reactions without water addition and a very low level of pollution by the milled material, whereby powders obtained can be use directly without filtering and drying stage [17]. Some studies have used dry mechanochemical method in producing calcium phosphate