ADVANCES IN MATERIALS ENGINEERING

Volume 1

Edited By:
Zahurin Halim
Iskandar Idris Yaacob
Md Abdul Maleque

IIUM PRESS
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

ADVANCES IN MATERIALS ENGINEERING VOLUME 1

Edited By:

Zahurin Halim
Iskandar Idris Yaacob
Md Abdul Maleque

IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

ISBN: 978-967-418-167-3

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN. BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan

Table of Content

Effect of Milling Time on Mechanochemically Synthesized Nanohydroxyapatite Bioceramics

Iis Sopyan [1], S. Adzila [2,3], M. Hamdi [2]
Faculty of Engineering-International Islamic University Malaysia[1]
Faculty of Engineering-University of Malaya[2],
Faculty of Mechanical and Manufacturing Engineering-University of Tun Hussein Onn Malaysia[3]
✉ : sopyan@iium.edu.my; adzila@uthm.edu.my / ✉ :

Keywords: Mechanochemical, rotation speed, nanohydroxyapatite, sintering, morphology.

Abstract. This chapter presented nanosized hydroxyapatite (HA) powder synthesized via mechanochemical method by a dry mixture of calcium hydroxide Ca $(OH)_2$ and di-ammonium hydrogen phosphate $(NH_4)_2HPO_4$ powders. The effect of mechanochemical processes on the sintered compacts properties were further investigated by prolonged milling times from 15 hours to 30 hours and 60 hours at 370 rpm respectively. Powders with uniaxially compacted at 2.5 MPa and cold pressed at 200 MPa were sintered from 1050-1350°C. The maximum hardness and density were achieved by powders milled in 60 hours with 5.31 GPa and 98.6% respectively. 1250°C is the optimum sintering temperature to produce higher density and hardness compared to other sintering temperatures.

Introduction

Hydroxyapatite (HA) is clinically used numerously in dentistry, orthopaedic and maxillofacial surgery area [1]. There are two types of HA that have been studied earlier such as in porous [2] and in dense form [3]. 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 [4]. Powder properties depend on the types of synthesis method used which comprising of wet precipitation [3], sol-gel [5], hydrothermal [6] and mechanochemical [7-9].

Mechanochemical milling has been used since 1922 where the materials components are synthesized by deformation process through ball-particle, particle-wall, and particle-particle collisions [10] 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 [7-9]. Dry mechanochemical was reported to be more benefits compared to wet mechanochemical due to faster reactions without water addition and a very low level of pollution by the mill material, whereby powders obtained can be use directly without filtering and drying stage [11]. Some studies have used dry mechanochemical method in producing calcium phosphate bioceramics in various milling times [9], fluoride substituted HA [12] and nanocomposite HA [13]. Although there were a lot of investigations on milling times in mehanochemically synthesized powder [9, 14-15], but the powders conversion to dense bodies and the effect of sinterability on various milling time powders