ADVANCES IN MATERIALS ENGINEERING

Volume 2

Edited By:
Md Abdul Maleque
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IIUM PRESS
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Md Abdul Maleque, Iskandar Idris Yaacob & Zahurin Halim: Advances in Materials Engineering

ISBN: 978-967-418-168-0

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
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Chapter 024

Silicone Doped Calcium Phosphate Powder Synthesized via Hydrothermal Method

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Keywords: Hydroxyapatite, Octacalcium Phosphate, Silicone, Hydrothermal, Synthesis.

Abstract. Synthetic pure hydroxyapatite have excellent biocompatibility and a little osseous inductivity, however, there are still some shortcomings such as the high degree of crystallinity and the quite stability of the structure. It is known also that Si is incorporated in biological body and improved bone remodeling. 0.5, 1, 2, 5 and 10% mol Si dope have been attempted to incorporate in calcium phosphate trough hydrothermal synthesis method. After calcination of 700°C Ca-deficient hydroxyapatite transformed to octacalcium phosphate for 2 and 5% Si only while the others transformed to β-tricalcium phosphate. Crystallinity of the samples reduced with Si mol increases and calcination temperature increases as well.

Introduction

A standard strategy applied when a bone loss occur is bone grafts which include autografts, allografts, and xenografts. However those are with some critical disadvantages, with such critical arguments on applications of naturally derived bone grafts, development of artificial bone substitution materials made from metals, ceramics, polymers, and composites are of a great importance [1]. It is important to note that the synthetically produced hydroxyapatite and other calcium phosphates have long been considered as potential bioceramics due to the similarity to the inorganic component of bone [2]. Amongst bioceramics, hydroxyapatite, HA ($Ca_{10}(PO_4)_6(OH)_2$), is the most important calcium phosphate used for bone replacement [3]. It was reported that hydroxyapatite (HA) has excellent biocompatibility due to its similarity to the inorganic tissue of the matrix of bone and its chemical and crystallographic structure. Moreover, HA is a bioactive material which means it can be integrated into bone structures, supporting bone in-growth without breaking down or dissolving, and it interacts with the living tissue due to the presence of free calcium and phosphate compounds. This property makes HA extremely attractive and widely used as a material for bone implants [4].

The synthetic pure HA have excellent biocompatibility and a little osseous inductivity, however, there are still some shortcomings such as the high degree of crystallinity and the quite stability of the structure. From the point of view of the biocompatibility, HA shows an excellent performance, due to its similarity with the mineral component of the bone. However its bioactive behavior, that is, the ability to join to the living bone when they are implanted, is lower compared to other biomaterials such as bioactive glasses. One of the alternatives to improve the bioactivity of HA is to incorporate silicon into the apatite structure [5]. Silicon (~5 wt%) was observed in active growth areas, such as the osteoid of the young bone of mice and rats and that silicon deficiency in a rat model led to skull deformations, resulting in nodular poorly defined mineral crystals, indicative of a primitive type of bone. Studies have also demonstrated a relationship between the level of