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

Chapter 018

Effect of Dispersant on Protein Foaming-consolidation Porous Alumina Containing Hydrothermal Derived Hydroxyapatite Nanopowder

Iis Sopyan[1] and Ahmad Fadli [1,2]
[1]Faculty of Engineering – International Islamic University Malaysia
[2] Department of Chemical Engineering, Faculty of Engineering – Riau University, Indonesia
✉ : sopyan@iium.edu.my; fadliunri@yahoo.com /

Keywords: Porous alumina, hydroxyapatite, composites, protein foaming-consolidation.

Abstract. Present chapeter reports the effect of dispersant loading on physical properties of porous alumina-hydroxyapatite composite bodies fabricated using protein foaming-consolidation method. Hydrothermal derived hydroxyapatite powder was used as bioactive ceramic. Alumina and HA powders were mixed with yolk, starch and darvan 821 A at an adjusted mass ratio to make slurry. The slurries were cast into cylindrical shaped molds and then dried for foaming and consolidation process. Subsequently, the dried bodies were burned at 600°C for 1 h, followed by sintering at temperatures of 1400°C for 2 h. The porous alumina-HA composites with pore size in the range of 50-500 μm and densities of 2.23 – 2.83 g cm^{-3} were obtained. Porosity of bodies decreased from 43.9 to 28.6% when dispersant amount increased from 0 to 7.0 g. The compressive strength of sintered bodies was found in the range of 20.3 to 104.8 MPa showing depends on porosity.

Introduction

Orthopaedic implants become an important thing in the biomedical implant market due to all of the problems arise in the medicine today. It is expected to increase 15-18% annually which will lead to market duplication [1]. Metals, polymers and ceramics are the candidate materials for application of bone graft [2]. Calcium phosphate is used in implantation because it can initiate a rapid biological response and able to improve the adhesion between bone and implant. Calcium phosphate will also provide scaffold for bone growth. It has been widely used as an alternative to these biological grafts in various types of bone surgery. Because of its good biocompability, bioactivity and osteoconductivity, calcium phosphate gets more attention to be applied as bone graft. The main constituent of bones from calcium phosphate is hydroxyapatite, $(Ca_{10}(PO_4)_6(OH)_2)$ [1]. However, due to its poor mechanical properties, HA ceramics cannot be used for heavy loading application, but most commonly used in bone graft substitution and coating on metallic implants.

Porous HA exhibits strong bonding to the bone where the pores provide a mechanical interlock leading to a firm fixation of the material. However, too many or too large pores will reduce the strength of implant significantly. That is why, HA can only be used for small bone defects. Porous volume and interconnection between pores and size will affect the characteristics of development bioceramics [3]. To improve the mechanical strength while maintaining the bioactivity of the scaffold, porous alumina-hydroxyapatite have been shown to have higher strength than the HA porous implant. It will exhibit implant that enables positive biological or chemical material connections [4]. Alumina is used to make implantable orthopaedic devices, is a very well tolerated material with minimum tissue reaction after implantation. It exhibits high mechanical strength and