ADVANCES IN MATERIALS ENGINEERING

Volume 1

Edited By:
Zahurin Halim
Iskandar Idris Yaacob
Md Abdul Maleque

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Effect of Yolk Addition on Protein Foaming-consolidation Porous Alumina-Calcium Phosphate Composites

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Abstract. Porous alumina-calcium phosphate composites have been prepared through protein foaming-consolidation method using egg yolk as the pore creating agent. The effect of yolk addition on physical and mechanical properties of porous bodies was investigated. The slurries were made by mixing alumina and calcium phosphate powders with yolk and starch. After drying, green bodies were burned at 600°C for 1 h, followed by sintering at temperatures of 1400°C for 2 h. The porous alumina-CaP bodies with pore size in the range of 50 – 600 μm was obtained. Both density and shrinkage of sintered bodies increased from 2.23 to 2.78 g/cm^3 and 78.8 to 95.6 vol% respectively when yolk amount increased from 24 to 64 g. The compressive strength was found in the range of 20.3 – 68.5 MPa at 30 - 43.9% porosities.

Introduction

During the last decade, calcium phosphate ceramics have been widely used as an alternative to these biological grafts in various types of bone surgery [1]. Hydroxyapatite (HA) is most preferable because it is a suitable material for body implantation and chemically close to calcium phosphate that is a mineral phase of bone [2]. Porous hydroxyapatite acts as a scaffold for the rapid ingrowths of vascularized connective tissue and bone. Porous HA exhibits strong bonding to the bone, because the porosity and bioactivity allows the in-growth of bone tissue to achieve full integration with the living bones. Thus porous HA have been applied in many applications such as for cell loading, drug releasing agents, chromatography analysis and most extensively, for hard tissue scaffolds [2, 3]. The porous HA are usually very brittle and prone to fracture upon sudden impact, particularly during the healing stage.

On the other hand, porous alumina has been attracting considerable attention for cell loading and bone grafts due to biocompatibility, inertness and chemical stability. Porous alumina allows ingrowth of bone thereby stabilizing the implant [4]. Because of bioinert of nature of alumina, it has lack of bioactivity properties even though provides a very high mechanical properties [3]. Therefore, it is desirable to develop scaffold implant materials with both reliable mechanical properties and porous structures, similar or superior to natural bones [5]. A possible way of finding a material both string and bioactive is to use a composite which combines the higher strength of the alumina scaffold with the biological advantages of the calcium phosphate surface.

In a previous study, we have reported a protein foaming-consolidation method to produce porous alumina ceramics [6]. In this chapter, porous alumina-calcium phosphate composites were fabricated using this method. The effect of yolk addition on physical and mechanical properties of porous body is investigated and discussed.