ADVANCES IN MATERIALS ENGINEERING

Volume 1

Edited By:
Zahurin Halim
Iskandar Idris Yaacob
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Chapter 020

Investigation of the Effect of Starch Addition on Protein Foaming-Consolidation Porous Alumina Containing Hydroxyapatite Nanopowder

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Abstract. The object of this study was to produce porous alumina-hydroxyapatite (HA) composite bodies via protein foaming-consolidation method. Egg yolk was used as a pore creating agent. Alumina and HA powders were mixed with yolk, starch and Darvan 821 A dispersant 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 temperature of 1400°C for 2 h. The starch addition was selected as the variable factor. The density of porous bodies increased from 2.40 to 2.81 g cm^{-3} when starch amount increased from 1.0 to 3.0 g. The compressive strength was found 18.0 MPa at 38.3% porosity and it increased to 102.3 at 29.1% porosity. The pores of 50-600 μm size illustrating the rough enough internal surfaces, were obtained for potential use in hard tissue engineering.

Introduction

Hydroxyapatite (HA) with the chemical formula $Ca_{10}(PO_4)_6(OH)_2$ has been widely used extensively in medicine and dentistry for implant fabrication because of its biocompability with human bone and teeth [1]. Porous hydroxyapatite exhibit strong bonding to the bone where the pores provide a mechanical interlock leading to affirm fixation of the material. Bone tissue can growth well into the pores, increasing the strength of the HA implant. The minimum pore size required to enable ingrowth of the surrounding bone together with blood supply is about 100- 150 micron meter while for colonization of osteoblast in the pores, fibrovascular ingrowh and the deposition of new bone the pore size should be 200- 500 micron meter [2]. Porous HA cannot be heavy loaded because it usually possesses very low strength and toughness as its porosity increase. Compression strength of porous human bones vary between 2-12 MPa for cancellous bone and between 100-230 MPa for cortical bone while porous HA only have mechanical strength as low as 1.3-16 MPa [3].

On the other hand, porous alumina is relatively strong and tough, but has problem of biological inertness to bone tissue [4]. Therefore, it is interesting to manufacture alumina-hydroxyapatite composite of porous shape.

In the previous study, porous alumina ceramics were fabricated by a protein foaming-consolidation method and the control in slurry composition and drying processes resulted in the porosity of 40 – 71% [5]. In this paper, porous alumina-HA porous bodies were fabricated using this method and the effect of starch addition is investigated.