ADVANCES IN MATERIALS ENGINEERING

Volume 2

Edited By:
Md Abdul Maleque
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Table of Content

Chapter 015

Foam Impregnation Method for Artificial Bone Graft Application: Study on the Effect of Sintering Temperature

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Keywords: TCP, PU foam, Foam impregnation method, Sintering temperature.

Abstract. Artificial bone graft has become a favourable solution for bone substitute, replacing the function of autograft and allograft. Due to this, study on the development of porous artificial bone graft has risen rapidly in line with the demand. The critical part of this development falls on the issues of fabricating porous structure with high interconnectivity while maintaining its mechanical strength. The purpose of this study is to develop porous tricalcium phosphate (TCP) by utilising low-cost PU foam as template for bone graft substitute. Foam impregnation method was selected based on its ability to form three-dimensional porous bodies with a simple procedure. The results obtained showed that increasing sintering temperature from 1000 to 1200 °C added the mechanical strength to porous TCP ranging from 0.19-4.72 MPa. The porosity however, dropped from 36.0 to 25.4% with the increment of sintering temperature. The porous TCP block also possessed a highly interconnected pore which is suitable to be applied as artificial bone graft.

Introduction

In life, our body is inadvertently exposed to danger, even in engaging simple activities such as cleaning and exercising. An injured bone needs to be healed in order for it to function normally. Generally, bone defects are overcome by autograft, allograft, artificial bone graft or a combination of these materials [1]. The "gold standard" in replacing the wounded bone however, is an autogenous bone graft. It is a process using the bone taken from the patient's body, which is ideal but also has disadvantages including increased blood loss, operative time and pain [2]. Allograft, on the other hand, is the bone taken from cadaver source and is an alternative to autograft. Unfortunately, cases such as viral transmission and hepatitis limit its application [3]. Due to the limited natural bone availability, the procedure becomes expensive, thus making the application of artificial bone graft ideal and increasingly popular nowadays.

The artificial bone grafts are produced from various types of materials including metals, ceramics, polymers and composites. Bioceramics however, are chosen based on its salient properties such as nontoxic, nonimmunogenic, easy to sterilise and available in unlimited supply [3]. In recent years, study on calcium phosphate has increased as it exists in human body as inorganic elements of the hard tissues [4]. This had included hydroxyapatite (HA) and tricalcium phosphate (TCP). Between HA and TCP, TCP is preferable because it shows a good resorbable property. TCP can exist in three allotropic forms, which are α-, α'- and β-TCP. In addition, for artificial bone material selection, β-TCP is preferred compared to α- and α'-TCP because of its high bioresorption rate and chemical stability.