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Semi-solid Processing of Porous Magnesium Using Titanium Wire Space Holder (TWSH) for Biodegradable Bone Scaffold Application

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Abstract. Porous magnesium is one of the materials that can be used as a bulk bone implant (Scaffold) because it can be used in human body tissues and is biodegradable, non-toxic and resembles natural bones. The shape of the pore in magnesium with interconnections that resemble the original bone is a challenge in the manufacture of porous magnesium for bone scaffold material. Therefore, research activities to make porous magnesium using Titanium Wire Space Holder (TWSH) with a semi-solid process to produce bone scaffold material that is biodegradable. The process carried out in this study is to compact and sinter the powder magnesium material with titanium wire using a squeeze casting tool in a semi-solid process, then dissolved using a solution of hydro fluoride acid to form porous magnesium. The tests performed are corrosion rate, density and porosity, hardness and SEM-EDX. This study succeeded in fabricating porous magnesium, which has the potential to be a bone scaffold material where the variation of the test material that approaches bone properties is a specimen with a sintering temperature of 570 °C with composition of Ti:Mg = 2:3.

Keywords: Porous magnesium, bone scaffold, titanium wire, squeeze casting, biodegradable

INTRODUCTION

Currently, the use of biomaterials as bone implants is undergoing rapid development. Recent developments in biomaterials include toxic or non-toxic materials, biodegradable with temporary implant function [1]. High-strength metal materials, such as titanium and stainless steel along with alloys, have Young's modulus value that is too high compared to human bones. While biopolymer and bioceramic materials have mechanical strength that is still under human bones [2]. Magnesium and its alloys have been studied as biometallic materials that have mechanical properties in the form of high strength and Young's modulus that is close to the original bone, good biocompatibility, osteoconductive, and easy to control in production process and sterilization [3]. Furthermore, the level of magnesium degradation may be controlled and has been proven in vitro and in vivo does not contain toxins or non-toxic in the human body [4,5].

Magnesium and its alloy have a density of about 1.74-2.0 gr/cm3 [6] that is very close to human bones (1.75 gr/cm3) [7], cortical bone (1.8-2.1 gr/cm3) [8] or cancellous bone (1.0-1.4 gr/cm3) [6,8]. In addition, the properties of magnesium can avoid the protective effect of burden (stress shielding effect) [9]. Characteristics of mechanical properties and the ability of degradation in magnesium are very suitable to be applied as bone implants, one of which is a bone scaffold. Pore structure (pore size and porosity) is an important morphological trait in Scaffold in bone

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