CHAPTER 1
INTRODUCTION

1.1 Background

The number of people with osteoporosis worldwide continues to increase along with the increasing number of accidents and aging. Statistical data, in the last 20 years, stated that there were 200 million people with osteoporosis worldwide. The survival rate of a person due to fracture exceeds 20% with the highest risk rate in women [1]. In this case, the treatment that must be taken immediately is to carry out medical surgery by requiring bone implants. Implants certainly require careful preparation before direct contact with living tissue or cells. Bone implants generally use metal materials, but metal has the disadvantage that this material will corrode when in contact with body fluids. Several studies reveal that corrosion, the process of material degradation, especially metal implants Ti-6Al-4V ELI and TNTZ, is caused by material contact with electrolytes in the human body, electrolytes grow corrosion as triggering substances such as chlorine ions, plasma, and amino acids [2]. Therefore, it is necessary to do a method to make a layer on the metal surface of the implant in order to protect the implant from the corrosion process because corrosion itself is the main enemy of the metal.

Experiments to prevent corrosion from occurring on implant material can be done by coating it with hydroxyapatite and it has been widely reported that the hydroxyapatite layer can cover the implant surface so that it does not come into direct contact with body fluids, not only protects the metal surface from corrosion but also increases the metal's biocompatibility against tissue growth and surrounding cells. The favorable in vivo behavior of recent studies suggests that hydroxyapatite films promote increased bone bonding ability and prolong the service life of metal prostheses.

A new problem that arose in its application is it the hydroxyapatite coating on the metal surface of the implant generally not fully cover on implant surface. Fernanda research explained that Ti-6Al-4V ELI coating with hydroxyapatite by Electrophoretic method Deposition(EPD) produces a layer which is not evenly distributed throughout the surface of Ti-6Al-4V ELI and there is accumulation of HA in some areas surface [3]. So that, we need a new method to answer this problem.

Several previous studies have also overcome to this problem by making this hydroxyapatite layer into 2 layers or a bilayer. So that, it can make the metal surface coated more perfectly and evenly. Several methods are used to form this bilayer layer, such as: hydroxyapatite coating bilayer using dip-coating was combined with Electrophoretic Deposition (EPD) method [4]. The another example is hydroxyapatite coating bilayer using dip-coating was combine with spin-coating [5]. However, in its application it takes a lot of tools to produce a bilayer coating, while the dip-coating method is the simplest technique for film disposition and is generally used in coating production [6]. Previous research using this method to produce a bilayer coating has been achieved, but the drawback is that the two layers of coating used are nano-scale, showing that in vivo studies have obtained a longer time for the osseointegration process with the surrounding bone tissue. This happens because the growth of tissue around the implant will be easier for a rougher surface structure of the implant to grade N4 to N10 [7]. So that, on this occasion a simplest method is proposed to produce a bilayer coating on implants with the dip-coating method which is carried out both on the first with nano-scale of hydroxyapatite and second layer with micron-scale of hydroxyapatite on the implant surface. This research has the potential to produce implant materials with better biocompatible and has good osseointegration than previous studies by relying on the difference in the size of the crystallin hydroxyapatite used so that it is expected to full cover the widerange of implant surfaces.

1.2 Problem Formulation

Based on the information from the background above, problem formulation for this study is: how to improve the surface properties of a bilayer coating of hydroxyapatite on TI-6Al-4V ELI and TNTZ to estabilish more osseointegration of implant through dip-coating method.

1.3 Research Objective

This research trying to cover the shortcomings the previous research of the hydroxyapatite bilayer coated on TI-6Al-4V ELI and TNTZ in order to obtain better osseointegration according to suitable thickness and surface roughness, has fully covered surface, and good adhesive bonding between implant and coating material.

1.4 Benefit

The advantage of this research is obtained implant material that is more osseointegration. The criteria that refer to the good quality of osseointegration are:

1. The implant surface fully covered by hydroxyapatite material.
2. Surface roughness after coating in range of N4 to N10 based on the Ra grade number of surface roughness.
3. The thickness of hydroxyapatite bilayer in range of 100 µm to 150 µm based on last research.
4. The bilayer coated on implant has good adhesive bonding with minimal porosity between the layer and the implant metal.

1.5 Research Scope

The problem limitations of this research are :

1. The hydroxyapatite used is sigma-aldrich with nano HA(50 nm) for first layer and micron HA(10µm) for second layer.
2. This experiment is only carried out to in vitro studies.