CHAPTER I
INTRODUCTION

Tissue engineering is a new technique to repair tissue defects and regenerate new tissue which connected with the development of suitable scaffold materials. Scaffolds should be three dimensional structures and providing the mechanical stability to tissue constructs prior to formation of a new extracellular matrix by the cell. Therefore, it is desired to have the materials, which can match the mechanical properties of the tissue. Tissue engineering can be used for ophthalmic, skin, blood vessels, cartilage and bone regeneration. In bone tissue engineering need to develop a suitable bone scaffold with sufficient porosity and mechanical strength to allow cell adhesion, migration, growth and proliferation results in good integration with surrounding tissue.

The technique used to create a scaffold for tissue engineering must give a scaffold with an interconnected structure of well distributed pores with appropriate sizes for guide cell attachment, proliferation and tissue regeneration which without affecting the biocompatibility of the material. Solvent casting and particulate leaching is a method for producing the porous structures which can be used for bone tissue engineering. In the leaching of soluble particulates, porosity can be controlled by variation of the amount of leachable particles and the pore size of the porous structure can be adjusted by using particles of different sizes.

Polycaprolactone (PCL) is a biodegradable, biocompatible and semi crystalline polymer that suitable for tissue engineering. PCL has a very low glass transition temperature of -60°C and melting point ranging between 59 and 64°C, depending upon its crystalline nature of PCL. The number average molecular weight of PCL samples may vary from 10,000 to 42,500. It has a high solubility in chloroform, dichloromethane, carbon tetrachloride, benzene, toluene, cyclohexanone and 2-nitropropane at room temperature, and is insoluble in alcohol, petroleum ether and diethyl ether. Due to its slow degradation, PCL is ideally suitable for long term implant over a period of more than one year.

Hydroxyapatite (HAp: $Ca_{10}(PO_4)_6(OH)_2$) is a class of calcium phosphate based bioceramic which has the same chemical composition (Ca/P = 1.67) as bone

mineral. Its bioactive and biocompatible properties which means it is osteoconductive and forms a strong bond to natural bone. Natural bone is a composite of collagen (polymer) fibrils and bone mineral (mainly apatite). The collagen acts as the matrix of the composite and the bone mineral act as a filler to reinforce the collagen. HAp cans enhance osteoblast differentiation as well as osteoblast growth. However, alone HAp applications have been limited because of their brittleness, difficulty of shaping and slow degradation rate. This problem can be solved by using the polymer and HAp composite. The addition of biodegradable polymers to HAp can allow for better manufacture and control in shaping composites to fit bone defects. Biodegradable polymer is used to reduce the brittleness of HAp. HAp is the reinforcing material to improve the mechanical properties and osteoconductivity of the composite without the effect of an immune reaction. However, inhomogeneous distribution of HAp with biodegradable polymer might result in poor mechanical properties of the composite.

The purpose of this work was to produce three dimensional structures of polycaprolactone, hydroxyapatite and ipriflavone composite for bone regeneration application via a solvent casting and particulate leaching technique. Ipriflavone was used to stimulate the osteoblast proliferation and alkaline phosphatase for better bone tissue engineering application. The effect of processing parameters will be investigated in order to find the adequate properties for bone tissue engineering application. In addition, compressive modulus, chemical structure, crystal structure and thermal properties, apparent melting temperature ($T_{m,o}$ and $T_{m,s}$), crystallization temperature ($T_{m,c}$) of the porous scaffold, were investigated by universal testing machine (Lloyd), fourier transform infrared spectroscopy (FT-IR), X-rays diffraction (XRD) and differential scanning calorimeter (DSC), respectively. The morphology of porous scaffolds was obtained by a scanning electron microscope (SEM). Water absorption, porosity, density and weight loss were also investigated. Lastly, biofunctionality of osteoblasts in contact with porous scaffold were evaluated.