CHAPTER I
INTRODUCTION

Tissue Engineering has emerged as a promising alternative approach in the treatment of malfunctioning or lost organs. It combines materials engineering, cellular biology, and genetic engineering. With this approach, porous three-dimensional scaffolds play an important role in manipulating cell function and guidance of new organ formation. The scaffolds must support and maintain the normal state of differentiation within the cellular compartment. Ideally, a scaffolding candidate should mimic the structure and biological function of native extracellular matrix (ECM) proteins, which provide mechanical support and regulate cellular activities (Rho *et al.*, 2006). Due to the high surface area to volume or mass ratio and the vast possibilities for surface functionalization, fibers as obtained by the process known as electrospinning (e-spinning) have recently become the most studied form of tissue engineering scaffolds (Suwantong *et al.*, 2007).

Biodegradable polyesters such as polycaprolactone (PCL), poly(lactic acid) (PLA), poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV), etc. are paid more attentions in tissue engineering because they not only provide the necessary substance on which cells can adhere, but also guide and regulate the proliferation and activities of the supported cells (Wutticharoenmongkol *et al.*, 2007; Chen *et al.*, 2008; Sombatmankhong *et al.*, 2006). However, their hydrophobicity and poor cytocompatibility lead to the inefficiency of the scaffolds in constructing a friendly interface with living cells.

Because the initial response of cells to the biomaterials mostly depends on the surface properties, surface modification of polyesters to improve their cytocompatibility is necessary. Hydrophilic and protein-containing surfaces are known to promote cellular growth, therefore, many researches have been focusing on immobilizing biomolecules, such as, gelatin (Zhu *et al.*, 2002a; Zhu *et al.*, 2004c), laminin (Matsuda *et al.*, 2005; Satiago *et al.*, 2006; Koh *et al.*, 2008), chitosan (Cui *et al.*, 2003; Wang *et al.*, 2003; Ding *et al.*, 2004), Arg-Gly-Asp (RGD)-containing peptide (Hersel *et al.*, 2003; Hsu *et al.*, 2004; Sun *et al.*, 2004), collagen (Ma *et al.*,

2002; Zhu *et al.*, 2002b; Yang *et al.*, 2003; Cheng & Teoh 2004) etc., on the surface of polymeric scaffolds.

In this work, the surface hydrophobicity of electrospun (e-spun) PLA fibrous membranes was improved by aminolysis with 1,6-hexamethylenediamine (HMD) to introduce free amino groups onto ester-containing polymer surface. Type-I collagen was subsequently immobilized with *N, N'*-disuccinimidyl carbonate (DSC) as a coupling agent. Indirect cytotoxicity evaluation of the aminolyzed, activated, collagen-immobilized PLA e-spun fiber mats based on mouse fibroblasts (L929) and pre-osteoblasts (MC3T3-E1) was investigated. The potential for use of these e-spun fiber mats as bone scaffolds was further evaluated *in vitro* with MC3T3-E1 in terms of attachment, proliferation, and alkaline phosphatase (ALP) activity of the cells that were cultured directly on the scaffolds, in comparison to those of the cells on a tissue-culture polystyrene plate (TCPS).