CHAPTER I

INTRODUCTION

Silk is a natural biopolymer produced by silkworm. It can be classified into cultivated silk as the *Bombyx mori* and wild silk like the *Samia cynthia ricini* or *A. pernyi.*, etc. Silk composes of two types of proteins, sericin and fibroin. Both of their molecular weights range from about 10,000 to over 300,000 Da. Sericin constitutes 25-30% of silk protein and it envelops the fibroin fiber with successive sticky layers that help in formation of cocoon. Sericin ensures the cohesion of the cocoon by gluing silk threads together. Sericin, called silk gum, is a globular protein and water soluble glue, due to its amorphous structure. Sericin also has some impurities such as waxes, fats, and pigments. Fibroin is the continuous fibrous protein which has crystalline structure, and water insoluble characteristic. It contains a variety of amino acids such as glycine, alanine, and serine. Fibroin can be regenerated into several forms such as gel, powder, fiber, or membrane. Fibroin is considered an important biomaterial that has been used in biomedical applications because of its various characteristics, such as good biocompatibility, good oxygen and water vapor permeability, and minimal inflammatory reaction. Additionally, fibroin has been utilized in food additive and cosmetic.

Electrospinning has recently established as a very beneficial and effective technique for the production of fibers with extremely small diameters, from several micrometers down to tens of nanometers, depending on the types of the polymer, solvent, and the processing conditions. In the process, a strong electric field is applied to a droplet of a polymer liquid to generate a continuous, charged stream of the liquid, i.e., the charged jet. Once ejected, the jet accelerates towards a screen collector, during which is elongated, simultaneously thins down and, finally solidifies, leaving ultrafine fibers as a non-woven mat on the collector. These fibers exhibit considerable interest for a broad range of applications because of their several useful properties such as high specific surface area, high surface area-to-volume ratio, and high porosity. Examples of applications are fibrous membranes for filter, reinforcements for composites, specialty protective clothing and templates for the formation of hollow fibers with inner diameters in the nanometer range, biomedical applications including tissue engineered scaffold that has been used to culture many types of cells such as fibroblasts, bone cells, nerve cells, and Schwann cell, etc.

The objective of this research was to determine the appropriate condition for the electrospinning process of native *Bombyx mori* silk to produce silk fibroin fibers with extremely small diameters in the range of nanometers, using formic acid as a solvent at the different concentrations of the silk fibroin solution and applied voltages. The thermal properties, structural characteristics, and morphology of the electrospun silk fibroin nanofibers were investigated through thermogravimetry analysis (TGA), Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM). In addition, two types of scaffolds, electrospun fibrous mats and films, were fabricated for the Schwann cell culture. The cytotoxicity, the attachment, and the proliferation between Schwann cells and scaffolds were examined by the MTT assay. The determination of Schwann cell morphology on the scaffolds was also examined by SEM.