CHAPTER I
INTRODUCTION

Neurological disease and injury disable a lot of people due to the loss of functioning neural circuits in either peripheral nervous system (PNS) or central nervous system (CNS). Nerve cells, unlike most other biological tissues, when damaged, the part of the neuron downstream of the injury typically dies off and has little capacity for self-repair and proliferating in their native environment after injury whereas the central nervous system lacks the capacity to regenerate. Peripheral nerve injury repair strategies have been attempted for several hundred years. In short nerve injuries, this is facilitated by using the end-to-end fascicular suture whereas autograft technique works well for extensive nerve injuries [Belkas JS. et al., 2004].

Autograft is a standard strategy for peripheral nervous restoration by taking nerve tissue from a donor site and grafted into the injured site [Gregory RD. et al., 2000]. However, grafting method works well for other tissue such as skin, it is not the best way for nerve tissue because of loss of nerve function where the donor tissue is removed and the difficulty in getting the nerve cells to line up and reconnect. One possible solution has been into the development of synthetic grafts by using axonal guidance channels to bridge the gap between transected nerves. A synthetic graft technique involves the introduction of both ends of injured nerve stumps into a tubular chamber which aids guidance of growing fibers along appropriate paths by mechanical orientation and confinement and helps enhancing the precision of stump approximation, minimizing invasion and scarring of the nerve [Laura S. et al., 2004].

Recently, artificial nerve guides are nowadays widely studied for nerve tissue repairing. Several materials, either nondegradable or biodegradable, have been used as a nerve conduit. The disadvantage of nondegradable conduits is that they remain in situ as foreign bodies after the nerve has regenerated and need second surgery to remove the conduits, causing possible damage to the nerve. Therefore, biodegradable conduits seem to be a more important material to reconstruct nerve gaps.

Chitosan (CS) is a natural polysaccharide obtained from N-deacetylation of chitin and it is a copolymer of D-glucosamine and N-acetyl-D-glucosamine. Chitosan is an interesting biopolymer because of it has several distinctive biological properties including good biocompatibility, biodegradability, antimicrobial activity, antitumor effect and wound healing properties. Moreover, it has a similar molecular structure to the glycosaminoglycans in the basal membrane and extracellular matrix; therefore, it can provide the interaction between the extracellular adhesive molecules such as laminin, fibronectin and collagen [Gianluca C. et al., 2005]. These suitable properties provide it into many applications such as wound dressing, wound healing, drug delivery system and various tissues engineering application [Vasudev SC. et al., 1997].

Due to the constituents of the natural extracellular matrix (ECM) exhibiting collagen fibers with diameters in the range of 50-150 nm which far smaller than the fibers that can be fabricated using conventional processing techniques, the electrospinning technique seems to be the process of choice for making fibrious scaffolds comprising fibers in the sub-micrometer and nanometer scale that could mimic the ECM of native tissue. The principle of electrospinning process is the use of electrostatic force for producing polymer filaments. When a high electrsostatic field is introduced in a polymer solution, the polymer filaments were formed between two electrodes. When the solution ejected out of a metal spinneret, the charged jet of the solution evaporated to become fibers which were collected on a collector. By adjusting the processing parameters, the fiber diameters and morphology can be controlled [Ramakrichna et al., 2003].

In this study, an attempt was made to fabricate chitosan scaffolds for nerve regeneration application via an electrospinning technique. In the electrospinning experiment, the effects of processing parameters including applied potential, polymer concentration, and distance between two electrodes (i.e. collection distance) on fiber morphology were investigated using scanning electron microscopy. At the optimum condition for preparing electrospun chitosan fibers, the potential to use chitosan fibers in nerve regeneration application will be evaluated in vitro by investigating the response of selected nerve cells on the as-spun fibers obtained.