CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This study explored optimization method for scaffold designs in term of biomimetic which is represented the study and imitation of nature's methods, mechanisms and processes. Biomaterial-scaffold design is an important element for tissue engineering. Electrospinning is of interest in this study since it can produce non-woven nanofibers mat which unique three-dimensional structure that mimics the topographic features and biological function of collagen structure in natural ECM. In this work, special attention has been paid to Thai's domesticated silk fibroin which is widely available in Thailand which is well known in the textile industry for centuries. Silk fibroin from the silk cocoon is generally defined as an attractive biomaterial because of its unique characteristics such as high mechanical strength, excellent biocompatibility, controllable structure and morphology, and wide variety of constructive properties on tissue engineering

Electrospun SF fiber mat were successfully obtained by electrospinning of 40% (w/v) SF solution at 25 kV/10 cm with the average fiber diameter being in the range of 243.05 ± 37.6 nm without the present of beats and toxicity. The effect of surface topology was significantly effect to the cellular activities of fibroblast cells in term of attachment. However, the proliferation was also supported from the biocompatibility of silk fibroin proteins. The results suggested that the alteration of surface topography and biocompatibility has a significant impact on adhesion and proliferation of cells. The introduction of synthetic polymers was studied to reduce the electrospinning solution concentration of silk fibroin by using PEO at various relative humidity. The electrospun of blend silk and PEO was successfully fabricated from electropinning 70:30 weight ratio of SF:PEO, PEO with molecular weight of 600 kDa, in aqueous solution at RH<30%. These fibers mat had similar average diameters of the individual fibers as neat electrospun SF that were 290±46 nm via PEO extraction which did not affect the morphology of the fiber mat. The surface

immobilization of electrospun SF fibers was introduced with fibronectin by carbodiimide reaction for enhance cellular responses. Significantly, the surface-modified eSF fiber mat showed the greatest ability to support the attachment and proliferation of NHDF cells. The results indicated that the fibrous structure and bio-functional of substrate are highly effect to cellular activities of fibroblast cells.

Furthermore, to develop the potential used as practical wound dressing, the hybrid electrospun fibers of PCL and silk fibroin proteins were successfully obtained by lyophilization of silk fibroin onto the electrospun PCL fiber. The hybrid electrospun fibers are not only obtained excellent mechanical properties but also superior biocompatibility of silk fibroin. The layer of SF on the fiber surface has good durability and can be further immobilize by fibronectin. Because of their biocompatible surface, hybrid electrospun fibers exhibited superior support properties for cellular attachment and proliferation than neat PCL fibers. In conclusion, these results demonstrate the optimization process to fabricate fibrous structure of silk fibroin which is generally applicable to be further used and developed as wound dressing.

6.2 Recommendations

In selecting a biomaterial as a scaffold precursor for tissue engineering applications, excellent biocompatibility and cellular response are key prerequisite features. However, Biomaterials having a low yield of extraction are problematic, as this low availability complicates industrial scale production of the scaffold materials. Thus, the effective extraction methods have to be developed as well as fabrication processes.

In term of tissue engineering, there are many factors which have to be concerned for each type cells. There are no precisely effective scaffolding materials to fit all types of wound due to the complicate interaction between materials and biological system. However, surface properties such as hydrophilicity, biocompatibility and surface morphology are the important controllable parameters

for improve cellular responses. Furthermore, the *in vivo* or animal and clinical performances are also important to evaluate for a giving type of wound, prior to be considered as an effective wound dressing.