CHAPTER I

INTRODUCTION

Nanosized materials have been attractive in their potential uses for both interconnect and functional units in fabricating electronic, optoelectronic, elechemical and electromechanical nanodevices. In the past few years, many efforts have been devoted to develop various nanoscaled materials. The changes in electrical and optical properties are targeted for wide varieties of potential applications (Ruangsanam, 2005).

Zinc oxide (ZnO) is a polar inorganic crystalline material with many applications, mostly as electronic and photonic materials, because of its wide direct band gap of 3.37 eV (Liu et al., 2003). Potential applications of ZnO include UV photodetection, transparent electronics, humidity sensor, gas and chemical sensor, microlasers, memory array, coating, catalysts, and biomedical applications (Zhang et al., 2005). For these applications, it is preferred that size and shape of ZnO are controlled (Fan et al., 2004).

Because of wide range of applications, ZnO has been attracting attention in both fundamental and practical studies. A variety of micro/nanoscale building blocks of ZnO, e.g. crystal, rod, tube, created by different methods have also been reported in recent years (Abdullah et al., 2003). One important form of the nanostructures is nanofiber, which can have surface area approximately 1 to 2 orders of magnitude higher than that of continuous thin film (Gibson et al., 2001). It is expected that this large amount of available surface area has the potential to provide unusually high sensitivity and fast response time in optical properties (Viswanathamurthi et al., 2003).

Nanofibres have great potential for a wide range of applications due to the small diameter providing very large surface area-to-mass ratio. Electrospinning, which was patented by Formhals in 1934, is a simple and quick technique for producing fibers with nanoscaled diameter applicable for wide range of materials.

The electrospinning technique has been a unique and cost-effective approach to fabricate fibers with large surface area for various applications (Viswanathamurthi et al., 2003). The technique relies on electrostatic charging of a polymer solution droplet and subsequently drawing of the solution in form of a jet by means of electric field (Hui and Pan, 2006). In the continuous operation, the number of fibers can be formed within short period of time, as short as a few seconds. Electrospinning has also been used to synthesize inorganic/organic composite fibers from polymer solution containing inorganic species. These composite fibers can be further used to synthesize inorganic oxide nanofibers, by removing polymer matrix in the composite fibers at high temperature. Removal of polymer reduces elasticity of the composite fibers (Hong et al., 2006). Improved properties may be resulted if the inorganic precursors inside the composite fibers can be converted into inorganic oxides while the polymer inside the composite fibers can be retained.

Another useful technique to synthesize nanostructured materials is the solvothermal method. It is a wet chemical route, in which a solvent acts as a reaction medium that allows crystallization of inorganic materials to be achieved at relatively low temperature. Solvothermal synthesis is one of the most powerful tools for providing distinct morphologies of nanomaterials (Kunjara et al., 2006). There have been many adaptations of this simple process to control size and shape of nanoparticles. Single crystal ZnO with small diameter and high crystallinity has been successfully prepared, in one step, by this method as well (Ehrentraut et al., 2006).

In the present work, the electrospinning technique and solvothermal technique are combined to synthesize ZnO nanofibers. This study intends to obtain product which combines the advantage of elasticity and mechanical strength. Detailed study will be conducted to investigate morphology of the product as well as mechanism for the synthesis and crystal growth.

The present study is arranged as follows:

Chapter I is the introduction.

Chapter II describes the basic theory involved in this work such as electrospinning process and solvothermal technique. Furthermore, literature survey of the previous works related to this research is also presented in this chapter.

Chapter III shows materials, the experimental equipments, the preparation procedures of zinc oxide nanostructure and characterization techniques.

Chapter IV describes the experimental results and expanded discussion of the research.

In the last chapter, the overall conclusions of this research and some recommendations for future work are given.