CHAPTER I

INTRODUCTION

Polymer nanocomposite containing metal nanoparticles can be prepared by several methods. One of common methods is the mechanical mixing of a polymer with metal nanoparticles, the in situ polymerization of a monomer in the presence of metal nanoparticles, or the in situ reduction of metal salts or complexes in a polymer. These polymer nanocomposites have attracted a great deal of attention, due to their unique optical, electrical, catalytic properties (Ottaviani *et al.,* 2002; Sarma T. K., 2002; Shiraishi & Toshima, 2000), and biomedical device (Schierholz *et al.,* 1998). The main biomedical device that based on the polymer nanocomposite containing metal nanoparticles is antimicrobial wound dressing that composed of polymer and metal nanoparticles, which is a mostly silver nanoparticle (Sangaraju Shanmugam *et al.,* 2005).

Silver metal and its compound have been known to have strong inhibitory and bactericidal effects as well as a broad spectrum of antimicrobial activities (Thomas S *et al.,* 2003). Silver ions work against bacteria in a number of ways; silver ions interact with the thiol groups of enzyme and proteins that are important for the bacterial respiration and the transport of important substance across the cell membrane and within the cell (Kyung-Hwan Cho *et al.,* 2005) and silver ions are bound to the bacterial cell wall and outer bacterial cell, altering the function of the bacterial cell membrane thus silver metal and its compounds were the effective preventing infection of the wound (Wright J. & Burrell R., 1998). Silver metal was slowly changed to silver ions under our physiological system and interact with bacterial cells, thus silver ions will not be so high enough to cause normal human cells damage. Silver nanoparticles have a high specific surface area and a high fraction of surface atoms that lead to high antimicrobial activity compared to bulk silver metal (Kyung-Hwan Cho *et al.,* 2005).

The scientific basics of moist environmental healing were created by G.D. Winter in 1962. His pioneering research initiated the concept of active wound dressing, which creates and maintains the optimum conditions required for the regeneration of broken tissue. Occlusive wound dressing may come in form of form, gel, hydrogel and aerosol. They maintain the proper moisture level and constant temperature of the wound bed, accelerate healing, activate autolytic debridement of the wound, protect newly-formed cells, facilitates angiogenesis and re-epithelisation, alleviate pain, and protect the wound against bacteria and contamination. Bacterial cellulose is a natural hydrogel whose properties better the hydrogel produced from synthetic polymers; for example, it displays high water content (98-99 %), good sorption of liquids, high wet strength, and high chemical purity and can be safety sterilized without any change to its structure and properties (Dieter *et al.,* 2001). Bacterial cellulose is synthesized by the acetic bacterium *Acetobacter xylinum*. The fibrous structure of bacterial cellulose consists of a three-dimensional non-woven network of microfibrils, containing same chemical structure as plant cellulose (Wojciech Czaja, Dwight Romanovic & R. Malcolm Brown, 2004), bound together by inter- and intra- fibrilar hydrogen bonding resulting in the never dried-state or hydrogel and high strength of bacterial cellulose.

Bacterial cellulose is an interesting material for using as a wound dressing since it can control wound exudates and can provide moist environment to a wound resulting in better wound healing. However, bacterial cellulose itself has no antimicrobial activity to prevent wound infection. To achieve antimicrobial activity, in this work silver nanoparticles were impregnated into the bacterial cellulose through the chemical reduction by immersing the bacterial cellulose in silver nitrate solution. Sodium borohydride was then used to reduce the absorbed silver ion (Ag^{+}) inside of bacterial cellulose to metallic silver nanoparticles (Ag^{0}).