



SYNTHESIS AND CHARACTERIZATION OF SILVER-CHITOSAN NANOPARTICLES ON TEXTILE

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ABSTRACT

Metal nanoparticles these times have gathered huge popularity in the fields of health industry. This study focuses on synthesis of silver and chitosan nanoparticles and study their antibacterial effects and cytotoxicity when they are coated on a fabric. The prepared fabric was subjected to characterization techniques such as XPS, XRD, EDX and SEM. These tests confirmed the presence of silver nanoparticles on the surface of the fabric. Antibacterial and cytotoxicity tests were conducted, and the results exhibited that silver nanoparticles have showed good antibacterial effect on both gram positive and gram-negative bacteria and showed no cytotoxicity. The antibacterial effect was effective after 10 cycles of washing.

INTRODUCTION

Silver nanoparticles (AgNPs) are known to exhibit inhibitory and bactericidal effects. Physical and chemical methods are employed for the preparation of metal nanoparticles. However, chemical methods such as reduction are most often used. AgNPs were previously applied onto polyester fabric by exhaustion method (Chattopadhyay, 2010). However, very few researchers (Chattopadhyay, 2010), (Thomas, 2011) have studied and demonstrated the effects of silver-chitosan nanoparticles on polyester fabric. In literature, XRD, EDS and SEM analysis have been mostly used for characterizing and proving the presence of silver nanoparticles on the fabric. This coating has shown positive results when tested the fabric sample against Gram-negative bacteria *Escherichia coli* and Gram-positive *Staphylococcus aureus* (Ali, 2011), (Ilić, 2009). This work studied the application of silver-chitosan nanoparticles on polyester fabrics for application in biomedical industry.

RESULTS AND CONCLUSIONS

Synthesis of silver-chitosan nanoparticles in acidic media was performed successfully by using exhaustion method. From XRD analysis, the value of 2θ was found to be 38.1° and the size of the crystallite was determined as 12 nm using Scherrer Debye relation confirming the presence of silver in metal state. From UV-Vis analysis, the adsorption rate of silver nanoparticles at concentration of 0.02 % was reported as 423 nm. The XPS elemental analysis was used to confirm the presence of silver nanoparticles and its distribution was confirmed in the EDX mapping analysis (Figure 1). The SEM analysis (Figure 2) of the silver-chitosan sample confirm that silver nanoparticles are uniformly distributed on the fibre surface. The antimicrobial effect of the AgNPs was determined by testing them against Gram-negative bacteria *Escherichia coli* and Gram-positive *Staphylococcus aureus*. From the results (Table 2) it can be concluded that all the configurations show positive effect against both bacteria. After 10 washing cycles the samples with only silver or chitosan showed a slight decrease in antimicrobial efficacy while the sample with the chitosan-silver nanoparticles did not show any loss in the antimicrobial efficiency. The samples show no cytotoxicity (Table 2).

Table 1 Synthesis Conditions of Silver Nanoparticles with Different Weight Percentages

| Sample | Silver Nitrate w/v % | Chitosan w/v % | Citric Acid w/v % | Sodium Hypophosphite w/v % |
|---------------|-------------------------|-------------------|----------------------|-------------------------------|
| 1 – Ag + Chit | 0.002 | 0.1 | 0.5 | 0.3 |
| 2 – Chit | - | 0.1 | 0.5 | - |
| 3 – Ag | 0.002 | - | 0.5 | 0.3 |

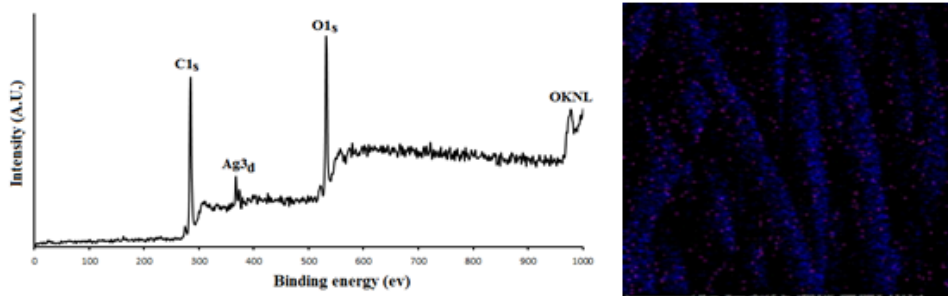


Fig.1 XPS and EDX Mapping Analysis

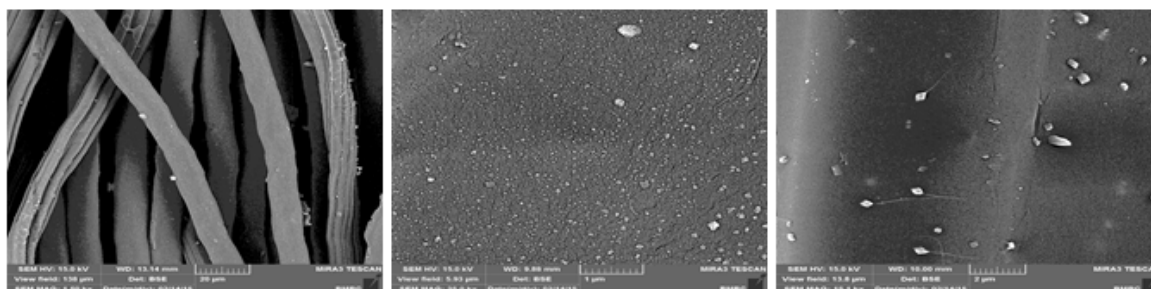


Fig.2 SEM Images of Polyester and Silver Chitosan Sample with Two Magnifications

Table 2 Antimicrobial Activity Before and After Washing and Cytotoxicity Results

| Sample | <i>S. Aureus</i> | <i>E. Coli</i> | <i>S. Aureus after wash</i> | <i>E. Coli after wash</i> | cytotoxicity |
|---------------|------------------|----------------|-----------------------------|---------------------------|--------------|
| 1 – Ag + Chit | 99.9 | 99.9 | 99.9 | 99.9 | 0 |
| 2 – Chit | 99.9 | 98.1 | 99.9 | 67.3 | 0 |
| 3 – Ag | 99.9 | 99.9 | 99.9 | 98.3 | 0 |

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