Chapter 8
Biosynthesis of Silver Nanoparticles for Study of Their Antimicrobial Effect on Plasma-Treated Textiles:
Silver Coating of Plasma-Treated Cotton Fabric

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ABSTRACT

Dielectric barrier discharges (DBD) are the configurations for the production of electrical discharges using a dielectric medium between the metallic electrodes. Plasma treatment produces negative radicals, which increase the adhesion of fabric for nanoparticles. The plasma treatment made the fabric surface rougher because of the etching effect. UV-vis spectra of the Plasmon resonance band observed at 253-400 nm. X-ray diffraction results showed that AgNPs has a cubical structure and the average

DOI: 10.4018/978-1-7998-8398-2.ch008

crystalline size is 25 nm. SEM results determined that the morphology of the silver nanoparticles are flower shaped. The energy bandgap of AgNPs was observed at 2.59 eV. The silver nanoparticles were found to have enhanced antimicrobial properties and showed better zone of inhibition against isolated bacteria (Escherichia coli). DBD plasma treatment changed the chemical as well as physical properties of the cotton fabric. FTIR spectrum revealed that oxygen-containing groups, such as C-O, C=O, O-C-O, as well as O-C=O, increased on DBD treatment of cotton samples.

INTRODUCTION

The widely accepted finishing technique for textile is nanotechnology-based coatings. Nanostructured materials and nanoparticles are introduced on the surface of textiles for smart functionalization and surface modification. The benefits of nanoparticles depend on their surface area to volume ratio and size-dependent properties, which lead to their better characteristics as compared to bulk size particles. The natural fabric has well-known physical properties like softness, comfort, and better wettability (Hebeish et al., 2011). Promoting such inherent properties of natural fabrics with nanoparticles has fascinated the significant attention of manufacturers and scientists, which lead to the origination of garments and apparel in the past few years.

The coatings of nanoparticles have become important in recent times due to their ability to develop smart surfaces, acceptable cost and feasibility. In traditional coating formulations, it is necessary to combine various forms of nanoparticles to produce new materials with novel functionalities without serious changes to the existing machinery. Different types of nanoparticles are being used to impart unique properties to different products (Hebeish et al., 2011). Considering their enormous potential for practical applications, the production of multifunctional textile coatings is well-known as one of the most desirable areas for researchers. Researchers also tried to develop the features like electrical conductivity, antistatic strength, antimicrobial action, self-cleaning, flame retardant, UV safety, thermoregulation for numerous applications (Leroux et al., 2009; Aalipourmohammadi et al., 2019; Dong et al., 2019). Self-cleaning and conductive textiles are more important among different types of novel features due to their applicability in hospitals, underwear and army. Such functionalities can be accomplished by various care strategies and processes.

Properties of Coated Fabrics

Imparting novel and unique properties such as electrical conductivity, electromagnetic shielding, fire retardant, superhydrophobic, super hydrophilic, bactericidal activities,