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BIOGENIC SYNTHESIS OF SILVER NANOPARTICLES AND ITS CHARACTERISATION

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Abstract

Silver nanoparticles possess unique physical, chemical and biological properties due to which they exhibit catalytic, antimicrobial, anticancer and wound healing activity. In the present study silver nanoparticles are synthesized by reduction of silver salt with apple extract. The obtained silver nanoparticles were characterized using Xray diffraction (XRD), FT-IR spectroscopy, Scanning Electron Microscopy (SEM) and UV-vis spectroscopy. Silver nanoparticles are in a state of tensile strain with an average particle size of 19.34 nm. The Surface Plasmon Resonance (SPR) peak in the absorption spectra showed an absorbance maximum at 423 nm. The constancy in peak position with increasing time period indicates the stability of obtained silver nanoparticles.

Keywords: Xray diffraction, , UV-Vis spectroscopy, FT-IR spectroscopy

I. INTRODUCTION

Recent advances in nanoscience and nanotechnology radically changed the way we diagnose, treat, and prevent various diseases in all aspects of human life. Silver nanoparticles (AgNPs) are one of the most vital and fascinating nanomaterials among several metallic nanoparticles that are involved in biomedical applications. AgNPs play an important role in nanoscience and nanotechnology, particularly in nanomedicine. Although several noble metals have been used for various purposes, AgNPs have been focused on potential applications in cancer diagnosis and therapy. Silver nanoparticles have unique optical, electrical, and thermal properties and are being incorporated into products that range from photovoltaics to biological and chemical sensors. Examples include conductive inks, pastes and fillers which utilize silver nanoparticles for their high electrical conductivity, stability, and low sintering temperatures. An increasingly common application is the use of silver nanoparticles for antimicrobial coatings, and many textiles, keyboards, wound dressings, and biomedical devices now contain silver nanoparticles that continuously release a low level of silver ions to provide protection against bacteria [1].

This work aims to prepare silver nanoparticles in a cost effective and simple route and hence its characterization using XRD, FT-IR spectroscopy, SEM and UV-Vis spectroscopy.

II. EXPERIMENTAL

Required quantity of red apple, purchased from local market is thoroughly rinsed with pure water and is cut into fine pieces. It is then added to deionized water and is heated at 80^{o}C for 1 hour till the apple pulp is obtained. The extract was filtered using a filter paper and this extract is used as reducing agent for preparing silver nanoparticles.

$AgNO_3$ solution is taken in a beaker and is stirred using a magnetic stirrer, at 70^{o}C for thirty minutes. 10ml apple extract is added to the solution drop wise while stirring. The colorless reaction mixture changes its color from pale yellow to dark-brownish suspension after a few minutes. This color change is due to the reduction of silver ions present in the aqueous solution to silver nanoparticles [2].

The silver nanoparticles thus obtained were characterized using X-ray diffraction (XRD), Fourier Transform Infrared (FT-IR) spectroscopy and UV-vis spectroscopy.

III. RESULTS AND DISCUSSIONS

3.1 XRD ANALYSIS

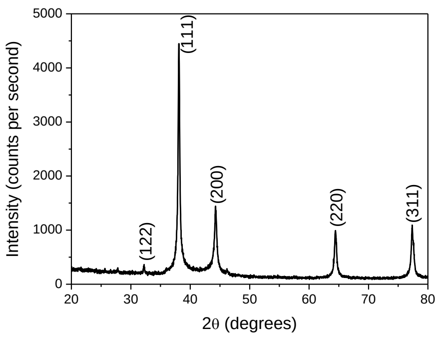

Figure 1: XRD pattern of silver nanoparticles

The XRD pattern of silver nanoparticles is shown in figure 1. XRD patterns confirm the presence of crystalline silver nanoparticles. Five diffraction peaks are indexed for face centered cubic structures of silver (JCPDS: File No. 4-783). Detailed analysis shows that silver nanoparticles are in a state of tensile strain and has an average particle size of 19.34 nm.

3.2 FT-IR ANALYSIS

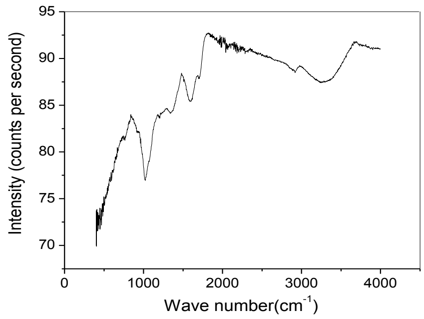

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Figure 2: ***FT -IR spectrum of silver nanoparticles***

FT-IR spectra of silver nanoparticles is shown in figure 2. The peaks at 3260.3cm^{-1}was assigned to O-H stretching of polyphenols, flavonoids, which are the main components of apple. The presence of band at 1594.64 cm^{-1} confirms that carboxylate group of proteins interacted with the silver nanoparticles [3]. All these prominent peaks indicate the fruit extract are responsible for the reduction/stabilization of Ag nanoparticles.

3.3 UV–VISIBLE ANALYSIS

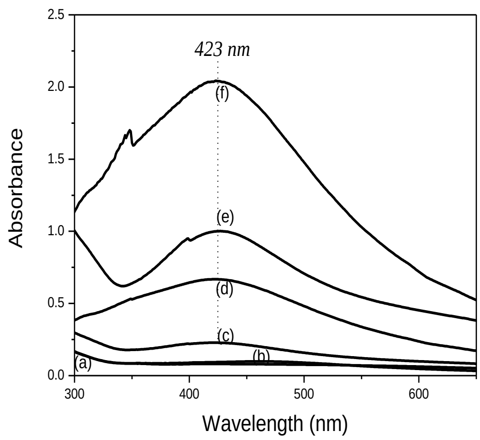

Figure 3: ***UV-Vis spectra of silver nanoparticle solution recorded at different time intervals***

UV-Visible absorption spectra of the silver nanoparticle solution, recorded at different time intervals are shown in figure 3.Silver nanoparticles show Surface Plasmon Resonance peak at ~423 nm. The intensity of this absorption peak increases with increasing time period.

VI. CONCLUSIONS

In the present work, a simple, low cost, biogenic synthesis method is used to prepare silver nanoparticles. XRD patterns of the samples matched with the face centered cubic structure of silver and particle size is found to be 19.34 nm. FTIR measurements shows that biomolecules present in fruit extract are responsible for the formation of silver nanoparticles. The UV-visible spectra of silver nanoparticles show characteristic SPR peak at ~423 nm.

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