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Novel Green Synthesis of Silver Nanorods Using Linear Polysaccharides

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Abstract *- In the current study,facile Synthesis of silver nanoparticles were initiated from precursor silver nitrate, chitosan as a capping agent and reducing agent citrate. Characterization and confirmation of fabricated Ag NPs were accomplished by Fourier transforms infrared (FT-IR), X-ray diffraction (XRD) and scanning electron microscope (SEM) analysis. In the FTIR spectrum of chitosan capped silver nanoparticle, band appeared at 1640 cm-1 which revealed the attachment of silver to nitrogen atom. XRD pattern has indicated that Ag NPs were nanorods and crystalline in nature (JCPDS card no: 4-0783). SEM image examined morphology of produced particles.*

Keywords — *silver nanorods, chitosan, sodium citrate, XRD, FE-SEM*

I. INTRODUCTION

Nanoscience is a rapidly developing field contributed to produce a wide range of various synthesized metal nanoparticles (MNPs). Nanoparticles include different types of inorganic nanoparticles like metals and metal oxides. Now a day researcher focused on synthesizing different metal nanoparticles have drawn significant amount of attention as they hold exceptional chemical, electronic, mechanical, magnetic and optical properties which are considerably different from those of corresponding bulk ones [1-7]. All With unique physicochemical properties of MNPs and their shapes, a promising scientific area of research appeared for biotechnical applications. These Biotechnical applications in biomedicine [8-12], environmental bioremediation, drug delivery [13] as well as usage in bioimaging [14] and enzyme mimetic [15]. Silver is the most noble metal in fabrication of nanoparticles, one dimensional silver nanostructures such as nanoparticles (Ag NPs), nanorods, nanowires and nanotubes. Formation of Ag NPs was attained physically and chemically by different methods [16-17]. Green synthesis of MNPs involve naturally biodegradable components such as linear and derived polysaccharides. Out of them chitosan source has been paid great attention due to their biocompatibility, biodegradability and hydrophilic properties giving them opportunities for various applications [18].

In present research work, synthesis of silver nanoparticles (Ag NPs) achieved by using silver nitrate as a novel metal precursor. Synthesis was accomplished by green way using chitosan as capping agent and sodium citrate as reducing agent. The produced Ag NPs was characterized by UV–visible spectroscopic analysis followed by Fourier transform infra-red (FTIR), X-ray diffraction (XRD) and scanning electron microscopy (SEM).The aim of this work is to develop knowledge in the green synthesis methods of silver nanoparticles.

II. MATERIALS AND METHOD

Silver nitrate ($AgNO_3$ Merck Inc.), Chitosan (Sd Fine Chem.), Acetic acid (Merck Inc.), Sodium citrate (Merck Inc.).

A. Preparation of silver nanoparticles

Chitosan (0.5 %) solution was prepared by dissolving chitosan (0.5 g) in acetic acid (100 ml, 2 %) solution. The chitosan solution was then filtered to obtain homogenous solution 10ml of 10mM citrate were introduce in 250 ml solution of 1Mm silver nitrate. Homogenous chitosan solution was added to silver solution. The mixture was stirred and refluxed at 70 ^{0}c. After 60min.reaction this reaction mixture became turbid yellow in colour indicating the formation of silver nanoparticles. This indicates the formation of Ag NPs. These silver nanorods were separated by centrifuging the samples at 3000rpm for 30 min. Resulting product was washed with distilled water and then by 50% ethanol. Resulting product dried at 80^{0}C and characterised by UV–visible spectroscopic analysis followed by Fourier transform infra-red (FTIR), X-ray diffraction (XRD), scanning electron microscopy (SEM).

III. RESULTS AND DISCUSSION

Fig.1 UV–Visible absorption spectra of reaction mixture shows A single strong peak with a maximum around 420 nm is characteristic λmax for AgNPs.

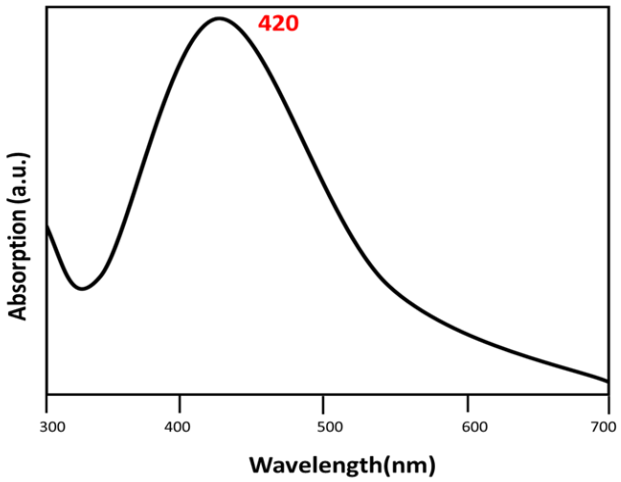

Fig.1: UV spectrum of Ag nanoparticles

Fig.2 depicts FT-IR spectrum of Ag nanoparticles was recorded in solid phase using KBr pellet technique in the range of 400-4000 cm-1. the FTIR spectrum of silver nanoparticle shows characteristic absorption band at 1,640 cm-1 which indicate the attachment of silver to nitrogen atom of chitosan. The absorption band at 3,665 cm-1 occurred because of contribution of chitosan toward the stabilization process. 1070 and 505 cm-1 absorption bands are due to C-O and C-C bond respectively.

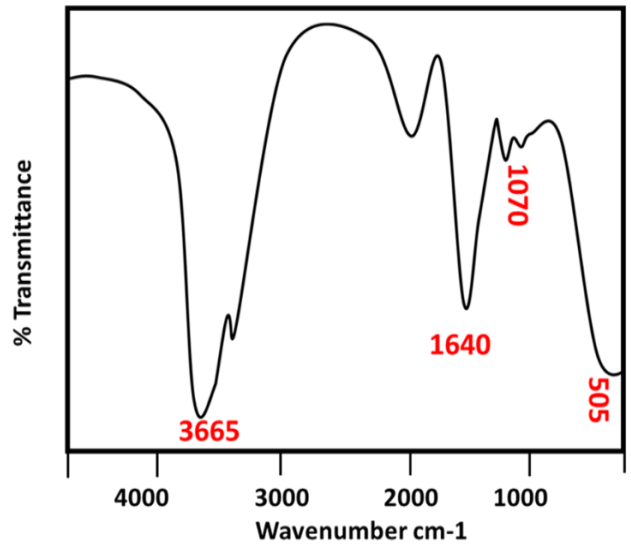

Fig.2: FT-IR spectrum of Ag nanoparticles

XRD pattern of as prepared silver nanoparticles is shown in Fig. 3. XRD pattern of silver nanoparticles matches with JCPDS 4 -0783 shows peaks at 38°, 44.1°, 69° and 77° with plane (111), (200), (220) and (311) indicating that crystal structure of the nanorods was face cantered cubic (fcc)

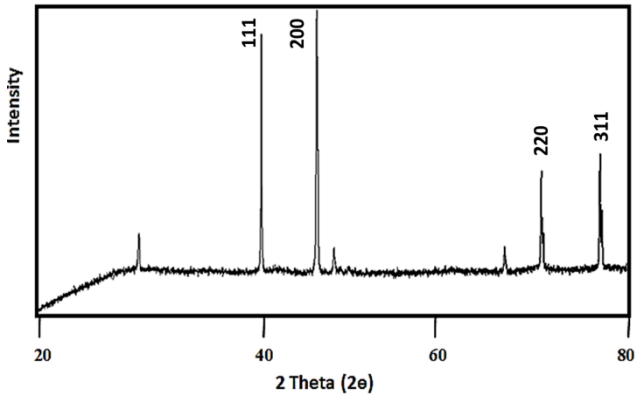

Fig.3: XRD pattern of Ag nanoparticles

FE-SEM image of synthesized Ag nanoparticles in Fig.4 shows pure and uniform cubic shaped nanoparticles. The scanning electron micrographs of chitosan capped Ag-NPs shows homogenous, dense, smooth, rod and porous surface structures.

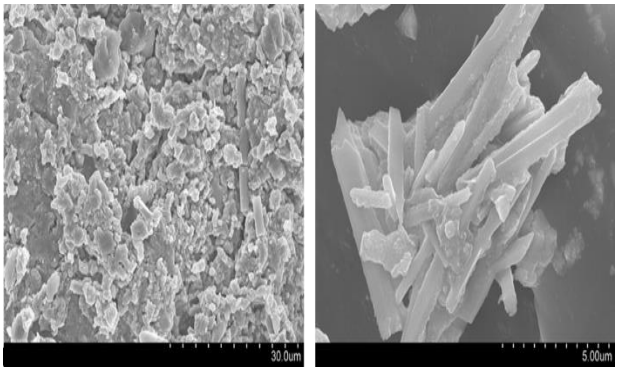

Fig.4: SEM of Ag nanoparticles

IV. CONCLUSION

In the current study, Ag-NPs were synthesized by green, eco-friendly, low valued process using silver nitrate as a metal precursor. Process includes biodegradable chitosan as a capping agent and reducing agent sodium citrate. Physical, structural and morphological properties such as size, shape of Ag-NPs was characterized by UV–Visible, FT-IR, XRD and SEM analysis. The characterization confirms the uniform and pure Ag nanorods. The proposed synthesis process of nanoparticles can be efficient for large scale industrial manufacture of Ag nanoparticles.

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