Digest Journal of Nanomaterials and Biostructures Vol. 6, No 1, January-March 2011, p. 325-330

ENVIRONMENTAL BENIGN SYNTHESIS AND CHARACTERIZATION OF SILVER NANOPARTICLES USING PHYLLOSTACHYS SP LEAVES EXTRACT

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In this paper we present an effective and environmental benign synthesis of silver nanoparticles using natural extracts of phyllostachys sp. These nanoparticles were characterized by UV-vis spectroscopy, X-ray diffraction (XRD) and Transmission electron microscopy (TEM) techniques. The surface plasmon resonance of silver nanoparticles was studied by UV- vis spectroscopy. The UV spectra of the silver nanoparticles showed an adsorption peak at 425 nm. XRD results reveal that the nanostructures possess a face-centered cubic crystal structure. The structure and morphology of silver nanoparticles were also confirmed by Transmission electron microscopy. The TEM images reveal that the silver nanoparticles are spherical in shape and its size varied from 25 – 35 nm.

(Received January 24, 2011; January 30, 2011)

Keywords: Silver nanoparticles, phyllostachys sp, silver, leaves extract, TEM, XRD, UV

1. Introduction

In recent years novel nanomaterials synthesis has caught the attention of many researchers. Synthesis of nanomaterials in an environmental benign way is a challenge. Silver nanoparticles have unique catalytic, optical, electrical and antimicrobial properties [1]. Silver is a nontoxic inorganic antimicrobial agent, which is inhibiting 650 types of microbe's growth [2]. Various methods are available for synthesis of silver nanoparticles such as chemical reduction [3], sol gel [4], hydrothermal [5], sonochemical [6], thermal decomposition [7] and microwave irradiation method [8]. All the above methods involve the usage of hazardous reagents for synthesis of silver nanoparticles. In view of an environmental sustenance, there is an urgent need to develop an ecofriendly method of synthesis of nanomaterials. Many of the reports published involve the biological synthesis of nanomaterials using bacteria, fungi and plant extracts. Silver nanoparticles have been synthesized using various plant extracts such as Cinnamon camphora [9], Cinnamon zeylanicum [10], Geranium [11], Neem leaf broth [12], Aloe vera plant extracts [13], lemongrass extract [14], Tamarind leaf extract [15] and Acalypha indica [16]. In this paper we are reporting a simple, effective, low cost and environmental safe synthesis of silver nanoparticles using phyllostachys sp leaves extract. The synthesized silver nanoparticles were characterized by UV-vis spectroscopy, XRD and TEM.

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2. Materials and methods

2.1. Materials

Phyllostachys sp. leaves were collected from Sona College of technology college campus, Salem, India. Silver nitrate was purchased from Qualigens, India. All the aqueous solutions were prepared using double distilled water.

2.2. Synthesis of silver nanoparticles:

The fresh phyllostachys sp leaves were collected and washed with distilled water. To 10 g of the fresh leaves, 200 ml of distilled water was added. The leaves with the water was heated at 100 ˚C for 10 minutes and filtered through a Whatman No.1 filter paper. 5 ml of the plant leaves extract was added to 100 ml of 0.001 M Silver nitrate solution at room temperature. The colorless silver nitrate solution is changed to yellowish brown color which indicates the formation of silver nanoparticles [17].

Fig. 1.The digital photograph of Phyllostachys sp leaves

2.3. Characterization of silver nanoparticles:

2.3.1. UV –vis Spectroscopy:

The surface plasmon resonance of silver nanoparticles was studied by UV- vis spectroscopy. After addition of phyllostachys sp leaves extract to the silver nitrate solution, the UV–vis spectra of the solution was measured every 30 minutes in the range of 200 nm to 800 nm by using a UV spectrophotometer (Shimadzu UV-1800).

2.3.2. X- ray diffraction:

The synthesized silver nanoparticles solution was cast onto glass slides. The slides were subjected to XRD measurements in a Shimadzu X 600 instrument using Cu-Kα radiation (0.15406 nm).

2.3.3. Transmission electron microscope:

The structural characterization of the silver nanoparticles was carried out by transmission electron microscopy (Philips CM10). The sample was prepared by air-drying drops of diluted solutions of the preparations on carbon films supported by copper grids.

3. Results and discussion

Fig. 2 shows the colorless silver nitrate and the changeover to yellowish brown color after the addition of phyllostachys sp leaves extract. This indicates that the silver ion has been reduced to silver nanoparticles by the phyllostachys sp leaves extract. Fig. 3 shows the surface plasmon resonance of silver nanoparticles. As the time increases, the adsorption intensity also increases due to the surface plasmon resonance of silver nanoparticles. The silver nanoparticles show an adsorption peak at 425 nm. The XRD result of the silver nanoparticles is shown in Fig.4. The XRD results reveal the formation of silver nanoparticles having a face-centered cubic crystal structure. The XRD results closely match with previous reports [14]. The structure and morphology of synthesized nanoparticles were characterized by Transmission electron microscope. Fig.5 a – c show the TEM images of silver nanoparticles .The TEM images show that the particles are spherical in shape and that their size varies from 25 – 35 nm.TEM images also reveal that the nanoparticles are coated by plant organic materials which stabilizes the nanoparticles.

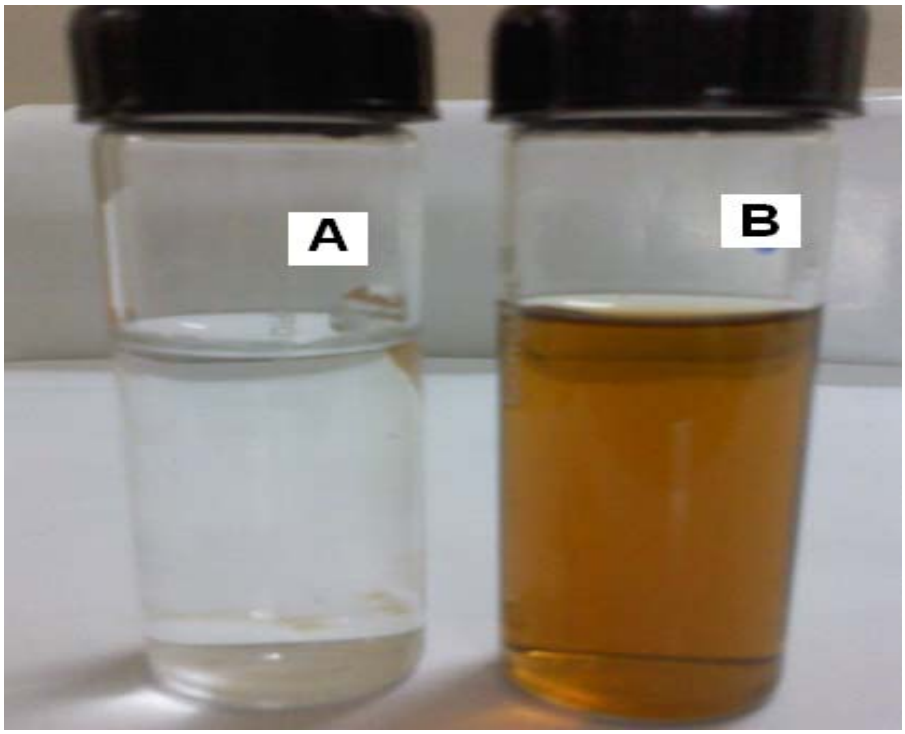

Fig. 2. Aqueous solution of 0.001M $AgNO_3$ with phyllostachys sp. leaves extracts (A) before adding the leaf extract and (B) after addition of leaf extract after 30 min.

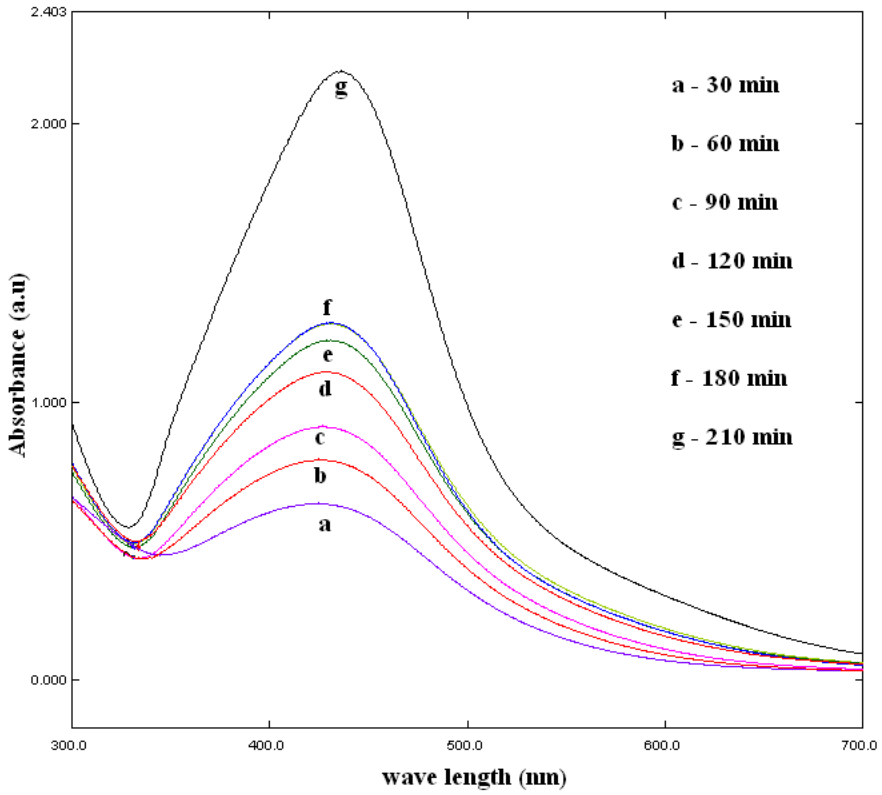

Fig. 3. UV–vis spectra of aqueous silver nitrate with phyllostachys sp. leaves extract at different time intervals

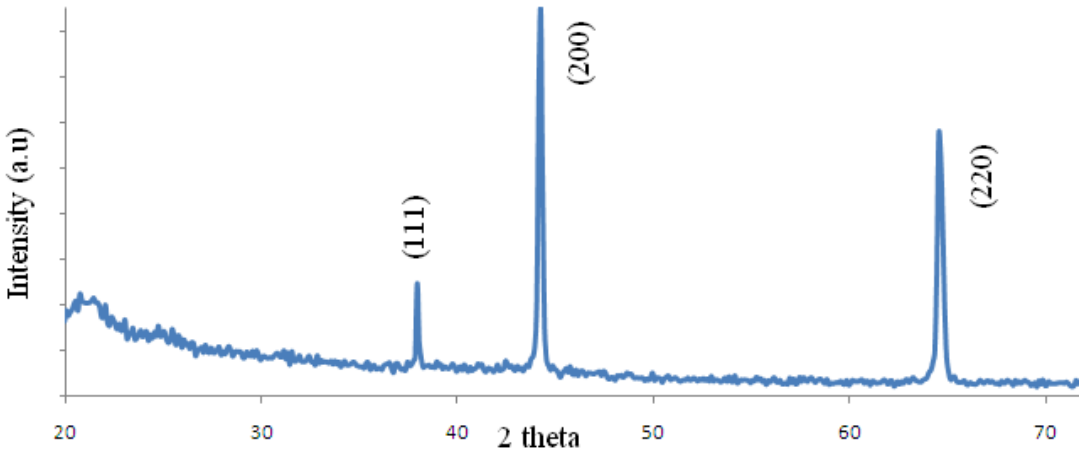

Fig. 4 XRD pattern of the silver nanoparticles synthesized from aqueous leaves extract of phyllostachys sp.

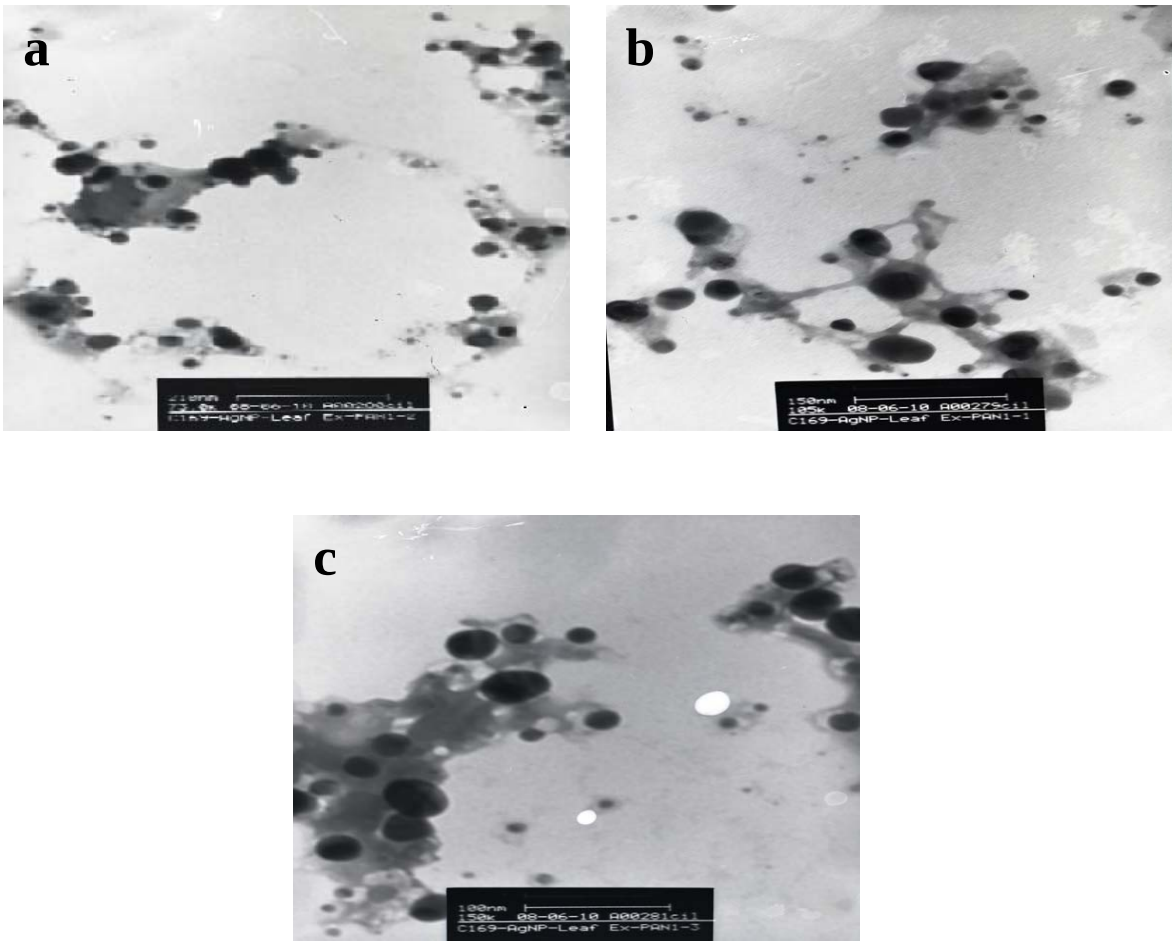

Fig. 5. TEM images of silver nanoparticles synthesized by phyllostachys sp. at various magnifications.

4. Conclusions

In this paper we have successfully synthesized silver nanoparticles using phyllostachys sp leaves extract. The morphology of silver nanoparticles was characterized by Transmission electron microscope. The TEM images reveal that the particles are spherical in shape and their size varies from 25 – 35 nm. The XRD result confirms that the particles have a face centered cubic crystalline structure.

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