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Synthesis of Silver Nanoparticles using *thuja* leaf extract

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Abstract

The Silver nanoparticles were obtained from Thuja (Morpunkhi) leaf extract using biosynthesis method. The obtained silver nanoparticles were studied by X-Ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR). Using Scherrer's formula, the grain size of silver nanoparticles was obtained. The average size of obtained silver nanoparticles found to be 41.48 nm. The benefits of this biological method is an ecofriendly and easy to obtain silver nanoparticles. This method is affordable and pollution free.

Keywords: Silver nanoparticles, *Thuja* leaf extract, Biosynthesis, XRD, FTIR.

Introduction

The silver nanoparticles (AgNPs) have the wide range of applications in various fields. The silver nanoparticles have the improved properties depending upon the size and morphology of nanoparticles. The metal nanoparticles obtained from the plant leaf extract using the biosynthesis method have many approaches. The biosynthesis method has many benefits over chemical, Physical and microbial synthesis[1].

Indian greeneries are easily available and most of the plants are used for medicinal purpose. Such types of plants are largely used in Ayurveda; now a day such medicinal plants have the great importance in the nanotechnology research due to their unique constituents and their wide applications. The silver nanoparticles are effectively used in agricultural field to obtain the good health crop[2].

In metal nanoparticles, copper nanoparticles also play an important role due to the good optical, electrical and thermal properties. Copper nanoparticles are more popular amongst the researchers due to low cost as compared to the silver, gold nanoparticles etc[3]. The metallic nanoparticles using the plants have the wide applications in different fields such as opto-electronics, Biology, medicine field etc[4]. The silver nanoparticles (AgNPs) are also obtained from fruit extract.

The researchers from biology and physics are also attracted towards nano biotechnology. The fruit juice is used for curing the various diseases, so that the silver nanoparticles has wide the applications in medical field. Such nanomaterials are used in nanotechnology based industries[5-6].

The silver nanoparticles, gold nanoparticles, platinum nanoparticles, Zinc nanoparticles have the wide applications in all fields[7]. The silver nanoparticles are also got from stem. The silver nanoparticles show the antibacterial activity. The silver nanoparticles showed the good activity against the biofilm bacteria[8].

Therefore, the silver nanoparticles were prepared using the *Thuja* leaf extract. These nanoparticles were characterized by XRD and FTIR.

Materials and Methods

Materials: The chemicals used for obtaining the nanoparticles were the AR grade. The *Thuja* leaves were collected from around the Rajgurunagar, Pune, Maharashtra, India.

Methods: The collected 10 gm *Thuja* leaves washed with distilled water. These *Thuja* leaves were cut and added into 100 ml distilled water. This solution boiled at 80°C for 10 minutes. After cooling this solution, this solution was filtered out through Whatman paper No. 1. The 10 ml of *Thuja* leaf extract is mixed with 100 ml of 0.1 M silver nitrate solution and color of solution changes. This solution was stirred for 3-4 hours on a magnetic stirrer. The solution was kept overnight and later centrifuged at 12000 rpm for 20 minutes. The sediment obtained was dried by keeping in Hot air oven for 4-5 hours. The dried powder was used for characterization.

Results and Discussion

The color of *Thuja* leaf extract changes after adding the silver nitrate solution; this confirms that silver nanoparticles were formed. The synthesized silver nanoparticles are characterized by XRD and FTIR spectrum. We calculated the grain size of obtained silver nanoparticles from X ray diffraction characteristics.

X-Ray Diffraction: The average grain size of silver nanoparticles reported as 41.48 nm and lattice constant is 2.232 AU. The high crystallinity level obtained at diffraction angles of 21.98°, 29.98°, 35.75°, 38.40° and 43.70°.

Figure-1
***Thuja* Leaf Extract**

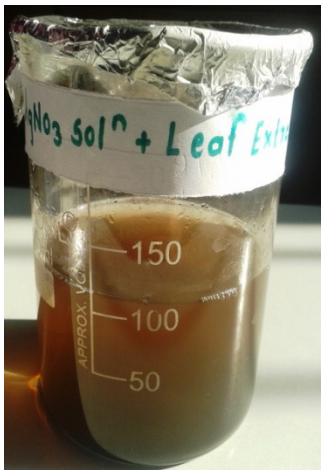

Figure-2
***Thuja* Leaf Extract + AgNo3 Solution**

The Scherer's formula is given below, used for the calculation of the nanoparticles size

$$D = K \lambda / \beta \cos(\theta)$$

Where: K = Scherer's constant which varies from 0.9 to 1.0, β = the width of the XRD peak at half height, λ = the wavelength of the X-Ray = 1.5418 AU, θ = the Bragg angle.

The FT-IR spectrum of Ag nanoparticles shows the bands at 3450, 2910, 1620, 1450, 1371 cm^{-1} which originated from the biomolecules present in the extract. The broad absorbance at 3450 cm^{-1} can be attributed to stretching modes of hydroxyl (-O-H) and (-N-H) functional groups.

Also, the band at 2910 cm^{-1} is characteristic of the stretching vibration of C-N functional group which may indicate the presence of amines on the surface of nanoparticles. The IR frequency at 1620 cm^{-1} is indicated presence of C=C in the molecules. The band at 1450 cm^{-1} indicate of C-C stretching in cyclic compounds and the band at 1371 cm^{-1} is assigned to C-O stretching in organic molecules.

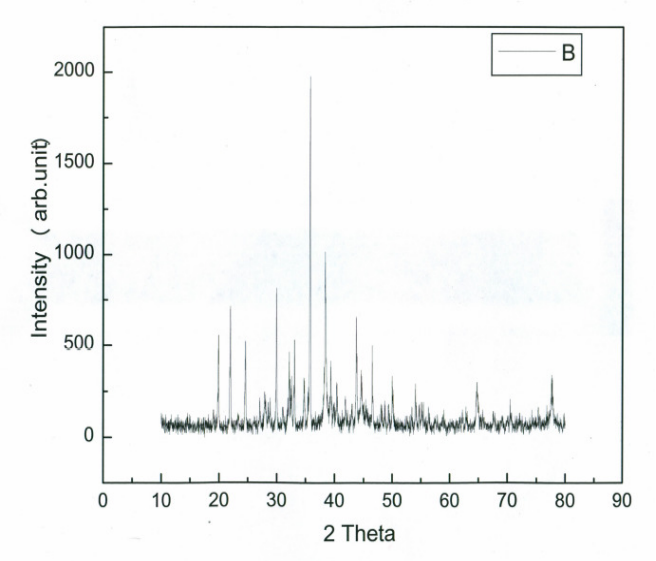

Figure-3
XRD of Ag Nanoparticles

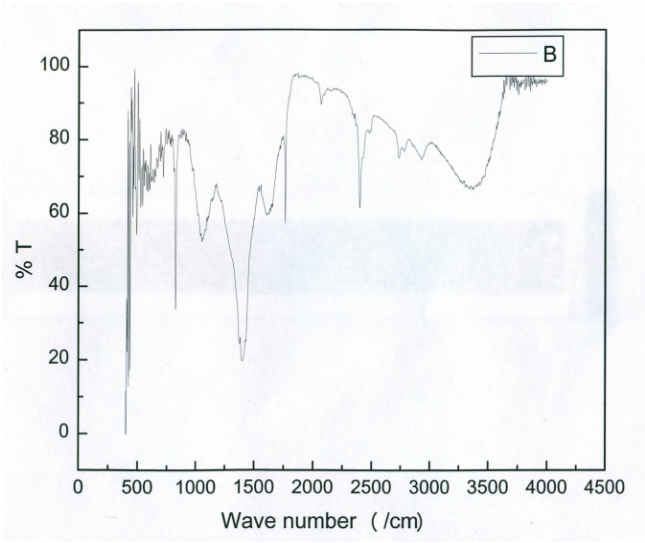

Figure-4
FTIR of Ag Nanoparticles

Conclusion

The silver nanoparticles using the *Thuja* leaf extract were obtained by biological method. This method is very easy to perform in college level laboratory. This method is pollution free and inexpensive. The green nanotechnology creates the more interest new researchers.

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