CHARACTERISATION AND SYNTHESIS OF SILVER NANO PARTICLE USING LEAF EXTRACT OF EPIPREMNUM AUREUM

SONALI SAHA*, M.M.MALIKb, M.S. Qureshi c

*Department of Physics, M.A.N.I.T., Bhopal, India
a,b,c

Email: pronit01@gmail.com

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Abstract

A single-step environmental friendly approach is employed to synthesize silver nanoparticles. In the present study the green synthesis of silver nanoparticles (AgNPs) using leaf extract of EPIPREMNUM AUREUM as reducing and capping agent along with D-sorbitol, to increase the stability of the synthesized nanoparticles is reported. On mixing leaf broth of EPIPREMNUM AUREUM and aqueous AgNO3 solution changed from yellowish to reddish brown. The synthesized nanoparticles were characterized using X-ray diffractometer (XRD), TEM and UV-visible spectrophotometer. Transmission electron microscopy (TEM) results were utilized for the determination the size and morphology of nanoparticles. Also visible photoluminescence (PL) emissions from the synthesized silver nanoparticles have been recorded.

Key words: Green synthesis, Silver nanoparticle, EPIPREMNUM AUREUM.

1. Introduction

Nanoparticles with controlled size and composition are of fundamental and technological interest as they provide solutions to technological and environmental challenges in the areas of solar energy conversion, catalysis, medicine, and water treatment. Thus, production and application of nanomaterials from 1 to 100 nanometers (nm) is an emerging field of research [1, 2]. Global warming and climate change have induced a worldwide awareness and effort to reduce generated hazardous wastes. Thus, “Green” chemistry and chemical processes are progressively being integrated in science and industry for sustainable development [3]. Nanobiotechnology is a thrust area and currently, there is a growing need to use environmental friendly nanoparticles that do not produce toxic wastes in their process synthesis protocol. To achieve this, it is essential to begin synthesis processes, which happen to be mostly of biological nature [4]. This has many advantages such as ease with which the process can be scaled up, economic viability, possibility of easily covering large surface areas by suitable growth of the mycelia, etc. Another advantage of nanobiotechnology is the development of reliable processes for the synthesis of nanomaterials over a range of sizes (with good monodispersity) and chemical composition.

Silver nanoparticles have been known for the variety of applications in various fields such as catalysis, electronics, optics, medicine, and environment. Particularly, Ag nanoparticles find applications in diagnostic biomedical optical imaging [5] molecular labeling [6], spectrally selective coating for the solar energy absorption [7], cancer therapy [8], and sensors for refractive index [9], and ammonia [10]. Moreover, Ag nanoparticles are known for the antimicrobial [11], surface-enhanced Raman scattering (SERS) [12] and metal-enhanced fluorescence properties [13]. Silver nanoparticles are also known for cytoprotective and anti-HIV-1 activities [14].

Generally, metal nanoparticles are synthesized and stabilized by using chemical methods such as chemical reduction [15-16], electrochemical techniques [17], photochemical reactions in reverse micelles [18], recently it is synthesised via green chemistry route [19]. Use of plants in synthesis of nanoparticles is quite novel leading to truly green chemistry which provide advancement over chemical and physical method as it is cost effective and environment
friendly easily scaled up for large scale synthesis and in this method there is no need to use high pressure, energy, temperature and toxic chemicals. Researchers are using bacteria, fungi and leaf extract for the synthesis of nanoparticles [20-26], however the use of leaf extract [27-28] reduce the cost. Moreover, any special culture preparation and isolation techniques are also not required.

In the present work the authors have synthesised silver nanoparticles by reducing aqueous solution of silver nitrate using money plant (EPIPREMNUM AUREUM) extract. Through elaborate screening process involving number of plants, it is observed that money plant (EPIPREMNUM AUREUM) is a potential candidate for synthesis of silver nanoparticles.

2. Materials and Method

Chemicals

All the experiments were conducted at room temperature. Materials used for the synthesis of silver nanoparticles are AR grade silver nitrate (AgNO3), purchased from Merck, India, fresh leaves of EPIPREMNUM AUREUM, D-sorbitol, purchased from Himedia, India.

2.1 Preparation of EPIPREMNUM AUREUM leaf extract

Fresh leaves of EPIPREMNUM AUREUM were collected from campus of MANIT BHOPAL, India. The leaf extract used was prepared by taking 4gm of finely cut leaf into a 250 ml beaker containing 40 ml of distilled water. The contents were mixed well and then the mixture was boiled for 2 minutes, before decanting. Further, the extract was filtered with whatman No. 1 filter paper and stored at 4°C and used for further experiments.

2.2 Synthesis of Silver nanoparticles

In a typical experiment aqueous solution of 10^{-3} M silver nitrate (AgNO3) and 10^{-2} M of D-sorbitol were prepared and used for the synthesis of silver nanoparticles. 40ml aqueous solution of silver nitrate is taken in a 250 ml beaker and the solution is added to 3ml leaf extract and 1ml of D-sorbitol solution at room temperature. The color change in the colloidal solutions occurred (shown in fig.1) indicating the formation of silver nanoparticles.

3. Results and discussion

Structural characterization has been performed using XRD analysis and the typical XRD pattern for, sample; viz. is shown in Fig. 2. From the Fig. 2 it is seen that three XRD peaks 1, 2, and 3 appear at 38.1°, 44.6°, and 64.8° due to reflections from (111), (200), and (220) planes of silver (JCPDF:03-0931).

Silver nanostructure exhibits interesting optical properties directly related to surface plasmon resonance (SPR), which is highly dependent on the morphology of the samples. UV-visible absorption spectrophotometer is the commonly used method to investigate the SPR. Reduction of aqueous Ag+ ions can easily be observed by UV-vis spectrophotometer (see fig 3). One of the most important features in optical absorbance spectra of metal nanoparticles is surface plasmon band, which is due to collective electron oscillation around the surface mode of the particles. Previous studies have shown that silver exhibits yellowish-brown colour due to the excitations of their surface Plasmon response (SPR) [29], when dissolved in water. The color of the solution changes from colorless to brownish yellow. And the reaction takes 2hrs for completion at room temperature.
Metal nanoparticles such as silver and gold have free electrons, which give rise to SPR absorption band [30]. The characteristic SPR resonance band of synthesised AgNPs occurred at 420 nm which is the characteristic of colloidal silver for reaction carried out at room temperature.

The TEM picture recorded from the silver nanoparticle is shown in Fig.4 (a, b, c). Fig.4 (a) picture shows separated silver nanoparticles and fig4 (b, c) number of aggregates. The morphology of the nanoparticles is highly variable. Under observation of such images, these assemblies were found to be aggregates of silver nanoparticles in the size range 40 nm.

The synthesized colloidal silver nanoparticles are found to be photo luminescent. Photoluminescence (PL) spectra obtained from the synthesized silver nanoparticles at room temperature are shown in Fig.5. From fig.5 it is seen that PL peaks appeared in 473.21.

![Fig.4(a,b,c): TEM images of synthesised Ag nanoparticles](image)

Conclusions
In the present study Ag nanoparticle through green route were synthesised which is very simple process. The size of the synthesised nanoparticle is less than 40nm. These reduced silver nanoparticles were surrounded by a faint thin layer of proteins and metabolites such as terpenoids having functional groups of amines, alcohols, ketones, aldehydes and carboxylic acids [31]. These obtained silver nanoparticles are advantageous in medical and pharmaceutical purposes. It also has potential applications in the biomedical field and can be produced commercially at large scale. Visible photoluminescence emissions are also observed from the synthesized silver nanoparticles.

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References


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