GREEN SYNTHESIS AND CHARACTERIZATION OF CADMIUM OXIDE NANOPARTICLES

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Abstract :

In this study Cadmium oxide nanoparticles were synthesized using Cassia auriculata flower extract. The flower extract acts as both reducing and stabilizing agent for the synthesized nanoparticles. The formation of Cadmium oxide nanoparticles were confirmed by visualizing the colour change after addition of flower extract into the Cadmium nitrate solution. The biosynthesized CdONPs were characterized by using UV-Vis analysis, Fourier Transform Infrared analysis (FTIR), Scanning Electron Microscopy (SEM). FTIR analysis confirmed the presence of metal oxygen stretching.

Keywords: Green synthesis, Nanoparticles, Cassia auriculata, Characterization.

Introduction:

Nanotechnology is manipulation of matter on an atomic, molecular, and supramolecular scale. The earliest, description of nanotechnology [1][2] referred to the particular technological goal of manipulating atoms and molecules for fabrication of macroscale products, also now referred to as molecular nanotechnology. The systems with at least one novel/superior property[3]. Nanotechnology is naturally very broad fields of science as diverse as surface science, organic chemistry ,molecular biology, semiconductor physics, energy storage,[4][5] micro fabrication,[6] molecular engineering,.[7], Opto electronic [8] etc.

Metal oxides play a important role in many areas of chemistry, physics and materials science [9]. The metal elements are able to form a large diversity of oxide compounds [10]. The metal oxide nanopowders play a significant role in several areas of chemistry, physics and materials science [11]. CdO nanoparticles possess excellent photocatalytic and antimicrobial activities due to their surface characteristics, size and shape [12]. Many researchers used bio synthesis methods for different metal nanoparticles due to their eco-friendly properties [13].Green synthesis method was found to be the best method when compared to the other method such as sool gel method, chemical reduction, photochemical reduction, electrochemical reduction, heat evaporation etc., [14]. In the present work we choose flower part of plant namely Cassia auriculata have been used for synthesis of Cadmium oxide nanoparticle.

2. Materials and Methods

2.1. Materials

In the present work all the chemicals used are analytical grade were obtained from E-Merck chemicals. Whatman no.1 filter papers are used for filtration purpose. Double distilled water was

used for dilution purpose. All Glasswares were washed well, rinsed with double distilled water and dried in hot air oven before starting the experiment.

2.2 Methods

2.2.1. Collection of Cassia auriculata Flower:

Cassia auriculata was collected from in and around Ottabidaram at Thoothukudi District.

2.2.2. Preparation of the Cassia auriculata Flower extract

The collected Cassia auriculata was incised into small pieces, washed well with double distilled water to dirt and other forein materials. About 10 grams of thus dried Cassia auriculata were weighed and transferred into 250mL beaker containing 100mL of Ethanol and boiled well for 30 minutes. The extract obtained was filtered through Whatman No-40 filterpaper and the filtrate was collected in a 250mL beaker and stored in refrigerator for further use.All the experiment was carried out using this extract.

2.2.3. Green synthesis of Cadmium Oxide nanoparticles:

In this method Cadmium nitrate was used as a precursor and Cassia auriculata Flower extract as a reducing and stabilizing agent for the synthesis of Camium Oxide nanoparticle.For the green synthesis of Cadmium Oxide nanoparticles, 50mL of previously prepared Cassia auriculata flower extract was taken in a 100mL beaker. To this 5g of $CdNO_3$ solution was added and the solution in the beaker was stirred in a heating magnetic stirrer at70^oC until the brown paste was obtained. Then the paste was collected in a ceramic crucible and calcinated in Muffel Furnace at 350 ^oC. A brown coloured powder of CdO nanoparticles was obtained and this was carefully collected and preserved in the air-tight sample tubes for further studies

2.3. Characterization

UV–Vis spectral studies of CdO nanoparticle was monitored on a JASCO,V-600 spectrophotometer. Shimadzu (IR Tracer-100) instrument was used for record FT-IR spectra. SEM was recorded in Ziess instrument.

3. Result and Discussions

3.1. UV Visible spectrum of Cadmium Oxide nanoparticle synthesis by using Cassia auriculata flower extract:

The Cadmium Oxide nanoparticles was synthesized from Cassia auriculata flower extract by sunlight induced method. The formationof cadmium oxide nanparticles from cadmium nitrate was monitered by UV-Visible spectroscopy . UV-Vis spectra of synthesized CdONPs from Cassia auriculata flower extract are shown in fig3.1.

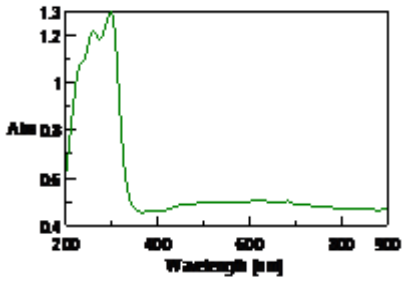

Fig.3.1. UV- Vis spectra of CdONPs synthesized from the extract of Cassia auriculata flower

The peak observed at 300 nm indicated that the formation of Cadmium Oxide nanoparticles **[**15**]**

Band Gap Energy:

The band gap energy is the energy gap between valence band and conduction band .The band gap energy of cadmium oxide nanoparticle can be obtained by using absorption wavelenghth of nanoparticle. The band gap energy can be calculated by using formula

E = h c / λ

Where h= planck's constant, c= velocity of light, λ= wavelength.

Band gap energy of CdO nanoparticle is 5.2eV. Due to this Due to this high band gap energy,absorption peak of CdONPs is highly blue shifted (300nm).

3.2. FTIR analysis:

Fourier transform infrared spectroscopy gives data of functional group in leaves extract that interact with metal oxide and also gives the information about M-O bond. The identification of functional groups leads to determine the reducing agent and the capping agent responsible for synthesis and stability of metal oxide nanoparticles.

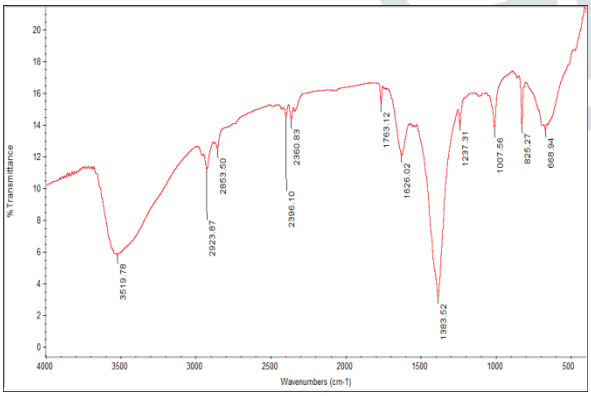

Fig.3.2. FTIR spectrum of CdONPs synthesized using extract of Cassia auriculata flower

The FTIR spectrum of CdO nanoparticles using Cassia auriculata flower extract are shown in Fig 3.2. The peak at 3519 cm^{-1} indicates the presence of O-H Stetching of phenolic compound. [16].The peak at 1763cm^{-1} is due to presence of C=O stretching [17]. The peak at 2923 and2853 cm^{-1} shows C-H stretching of alkane. The peak at 2396 and2360cm^{-1} is due to C-H stretching of alkene.[18] The peak at 1626cm^{-1} indicates the presence of N-H Stetching of amide. [19]The peak at 1383cm^{-1} is due to C-O stretch. [20]The peak at 1237cm^{-1} is dueto C-N stretching. [21] The peak at 825cm^{-1} is due to aromatic C-H out of plane.. [22] The peak at The peak at 668cm^{-1} is due to Cd-O bond.[23].

3.3. Scanning Electron Microscopy:

The surface morphology of the cadmium oxide nanoparticles was studied by Scanning Electron Microscopy (SEM) analysis.

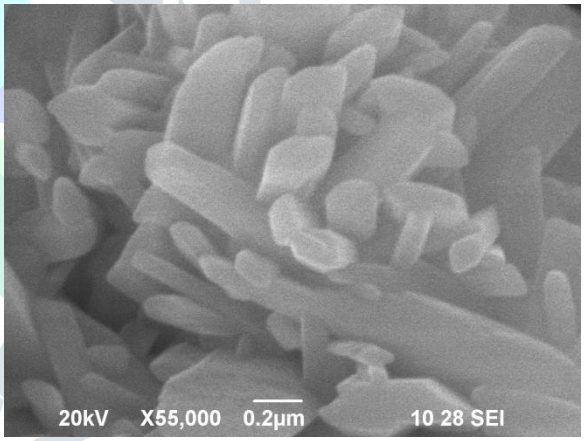

Fig.3.3. SEM image of CdONPs synthesized using Cassia auriculata flower extract

The Fig.3.3 shows the SEM image CdONPs synthesized by Cassia auriculata flower extract. It shows a rod like shape . This shape of the cadmium oxide nanoparticles may be due to the phenolic compounds present in extract which may act as structure directing agent.

CONCLUTION:

The cadmium oxide nanoparticles was successfully synthesized by using *the extract of*

cassia auriculata which provides cost effective, easy and proficient method for synthesis of CdONPs.. The synthesized cadmium oxide nanoparticles was charecterized using UV-spectrophotometer, FITR, SEM. The blue shift in wavelength indicate the smaller size of nanoparticlewas confirmed by UV-VIS spectrophotometer. The metal-oxide bond was confirmed by

FTIR analysis. SEM analysis shows the morphology of CdO nanoparticles

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