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Contents

Invited Lectures

Research papers

12. Synthesis of N-doped TiO_2 Photocatalyst by Sol-Gel method
Pradeepan Periyat

13. Mechanical and Melt Rheological Properties of Nano Zirconia Reinforced HMHDPE-LLDPE Blend
Shadiya. M A*, K. E. George, Rani Joseph

14. Synthesis and photoluminescence of CdS quantum dots in functional copolymer hydrogel template
Jolly V Antony*, Philip Kurian, Nampoori V P N, George K E

15. Silane functionalized/Ethylenediamine Reduced Graphene : Synthesis, Characterization and Reinforcing Effect on GY 250 Epoxy Resin
Bindu Sharmila. T K*, P. M. Sabura Begum, Eby Thomas Thachil

16. DFT Study of the Effect of Alkyl Substitution on the HOMO-LUMO Gaps of Aromatic Compounds
Maria Linsha P L*, M. George

17. Effect of solute-solvent interaction on the absorption maxima of N-(4-nitrophenyl)-benzylamine
Reshmi Karamel*, Sharon P. Mohan, Abinas V. A, Maria Linsha, M. George

18. Preparation and Properties of Chemically Modified Fly Ash/ Natural Rubber Composites
M T Ramesan*, Subburaj M

19. Novel copper-catalyzed Sonogashira type C-C bond forming reactions
Asha S*, Gopinathan Anilkumar

20. Novel Copper mediated Carbon-Heteroatom Coupling Reactions
Anns Maria Thomas*, Gopinathan Anilkumar

21. Fuel from Degradation of Polyolefin and its Purification using ZSM-5 Catalyst
Sanjay R*

22. Evaluation of Mechanical Properties of Polypropylene-Exfoliated Graphite Nanocomposites
Dennymol. P V*, Rani Joseph

23. Spectroscopic and Antimicrobial studies of a Bioactive Schiff base and its Ni(II) complexes
Rejimon. P K*, Muraleedharan Nair. M K

24. Structure and Properties of Regenerated Cellulose Film Prepared from coconut leaf midrib Cellulose in LiCl/DMAc solution
Sreejesh P Raghunathan*, Sona Narayanan, Rani Joseph

25. Large Third-Order Nonlinearity of π-conjugated EDOT-fluorene Donor-Acceptor copolymer
Sona Narayanan*, Sreejesh P. Raghunathan, Sebastian Mathew, Anshad Abbas, Cheranellore Sudha Kartha, Krishnapillai Sreekumar, Rani Joseph

26. Green Synthesis and Characterization of Nanosilver
Midhun Dominic C D, Malasree B*

27. Adsorption interaction and corrosion inhibition behaviour of amino acid Schiff base MOAB [(Z) – 3 – methyl – 2- (2- oxoindolin–3–ylideneamino) butanoic acid] on copper in sulphuric acid
Mathew Kuruvilla*, Shainy K M, Abraham Joseph

28. Synthesis and Morphological Studies of CuSe nanocrystal supported on graphene
Cyril Jose, Linu Mathew*, George V Thomas

29. A Computational Chemistry Investigation on the Solubility and Conformational fluctuations of Cholesterol in Water
Adithya M*, Cicily K A, Sindhu K S, Abi T G

30. The Dissociationof Protonated N-benzyl and N-(1-phenylethyl) tyrosine Amides viaIon/neutral Complexes: An ESI Mass Spectral and DFT Study
Justin Paulose*, Maria Linsha P. L., Revi P. Achuthan, George Mathai

31. Electrochemical Sensing of Metronidazole benzoate on a conducting polymer layer of p-TSA on GCE
Theresa C. J.*, K. Girish Kumar

32. Voltammetric Determination of Octyl Gallate using SAM Modified Glassy Carbon Electrode
Unni Sivasankaran*, K. Girish Kumar

33. Voltammetric Determination of Sunset Yellow using MWCNT/AuNP Nanocomposite Film Modified Glassy Carbon Electrode
Anuja E.V*, K. Girish Kumar

Green Synthesis and Characterization of Nanosilver

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Abstract

Green chemistry is one of the burning research topics to researchers. The aim of the present work is to synthesis silver nanoparticles using bio reduction method mediated by a commonly seen plant in Kerala, Bauhinia acuminata. The nanosilver particles were synthesized by adding plant extract to 1mM $AgNO_3$ solution. The phytochemicals present in the leaf extract reduced the Ag+ ions in to nanoAg. The formation of Ag nanoparticles was confirmed by UV- Vis spectroscopy, SEM, EDX etc. The UV-Vis spectra showed an absorbance peak at 420nm, which is characteristic for Ag nanoparticles. The surface morphology of Ag nanoparticles was identified using SEM. The majority of Ag nano particles were found to be square shaped and some of them were having rod type morphology and are highly agglomerated. The purity of Ag nanoparticles was confirmed by EDX spectra. There were peaks only for elemental Ag and no other peaks were observed.

Keywords: Green Chemistry, Phytochemicals, morphology.

Introduction

Nano particles are the particles having the size between 1nm and 100nm. They are having different properties than the bulk material of the same element due to variation in size, shape and distribution of the particles [1]. Among all the noble metals nano silver is most important that it posses good conductivity, chemical stability, catalytic and antibacterial activity [2, 3]. Due to these properties, silver nanoparticles can be used as catalysts in chemical reactions, optical elements, and in medical field [4-6].

There are various methods available for formation of Ag-NPs such as chemical reduction , heat evaporation, solvo thermal reduction, photochemical method, electrochemical technique, non-sputtering, reverse micelles, microwave assisted methods, sol gel process etc [7-14]. Green chemistry is the sustainable chemistry that encourages the design of products and processes that minimize the use and generation of hazardous substances. Green methods are cost effective and environmentally friendly. The green synthesis of nano silver using plant leaf extract is available in the literature [15-21].

In this study green synthesis of silver nano particle is carried out using the leaf extract of Bauhinia acuminata, which is a flowering shrub belonging to family Caesalpiniaceae. The bark, flower and root of the bauhinia plant are used for various skin diseases, worms, tumours and diabetes. Here the leaf extract is obtained using water as the solvent by heat treatment.

Materials and Methods

Synthesis of nanosilver

10g of Bauhinia acuminata leaves were washed with distilled water and chopped into small pieces. It is transferred into 75ml distilled water in a beaker and boiled for 3minutes.Filtered through a good quality filter paper.10mL of the leaf extract is mixed with 90mL 0.001M silver nitrate solution in a conical flask and heated at 40°C until the colour changes to reddish brown.

Characterization of silver nano particles

UV-Vis Analysis: The optical property of Ag nano particles was determined by UV-Vis spectrophotometer (schimadzu uv spectrophotometer). After the addition of AgNO3 to the plant extract, the spectra were taken after 24Hrs. between 350 nm to 500 nm.

SEM Analysis: The morphological features of synthesized silver nanoparticles from Bauhinia leaf plant extract were studied by Scanning Electron Microscope (JSM-6480 LV). The SEM slides were prepared by making a smear of the solutions on slides. A thin layer of platinum was coated to make the samples conductive. Then the samples were characterized in the SEM at an accelerating voltage of 20 KV.

Results and Discussion

Phytochemical screening

The result obtained for phytochemical screening is given below.

Table 1: Qualitative analysis of phytochemicals in the aqueous leaf extract of Bauhinia acuminata.

Phytochemicals	**Aqueous Leaf Extract**
Tannin	+
Phlobatannins	-
Saponin	+
Flavonoids	-
Steroids	-
Terpenoids	+
Cardiac glycosides	+
Alkaloids	-
Phenols	+
Anthraquinol	-
Carbohydrate	-

(+) – Indicates the presence of phytochemicals

(-) – Indicates the absence of phytochemicals

Change in colour of the reaction mixture

It was observed that, after the addition of leaf extract to the $AgNO_3$ solution the colour changes from pale yellow to reddish brown, confirms the formation of Ag nanoparticles. The reddish brown color is due to the surface Plasmon resonance (SPR) of metal nanoparticles.

Fig 2(a): $AgNO_3$ solution with leaf extract

Fig 2(b): Synthesized Ag nanoparticles

UV-Vis Spectrophotometer Analysis

Reduction of silver ions into silver nanoparticles during exposure to plant extracts was observed as a result of the color change. The reddish brown color is due to the Surface Plasmon Resonance phenomenon. The metal nanoparticles have free electrons, which give the SPR absorption band, due to the combined vibration of electrons of metal nanoparticles in resonance with light wave. The sharp bands of silver nanoparticles were observed around 421 nm, which is characteristic for Ag nanoparticles. The reduction of the metal ions occurs fairly rapidly; more than 90% of reduction of Ag^{+} ions is complete within 4 Hrs.

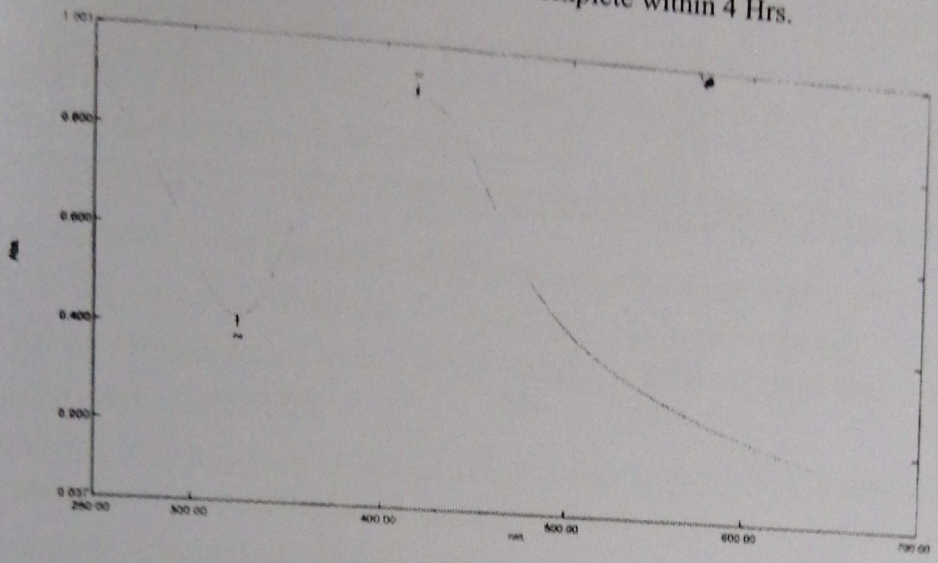

Fig 3: UV-Vis spectra of Ag nanoparticles

SEM Analysis

SEM provided further insight into the morphology and size details of the silver nanoparticles. From the SEM analysis it was found that majority of the synthesized Ag nano particles are square shaped and some are rod shaped. There are no other reports in the literature that shows these kind of morphology for Ag nanoparticles, synthesized via plant leaf extract mediated bio reduction as far as we know. The particle size of the Ag nanoparticles ranges from 140 to 470nm.

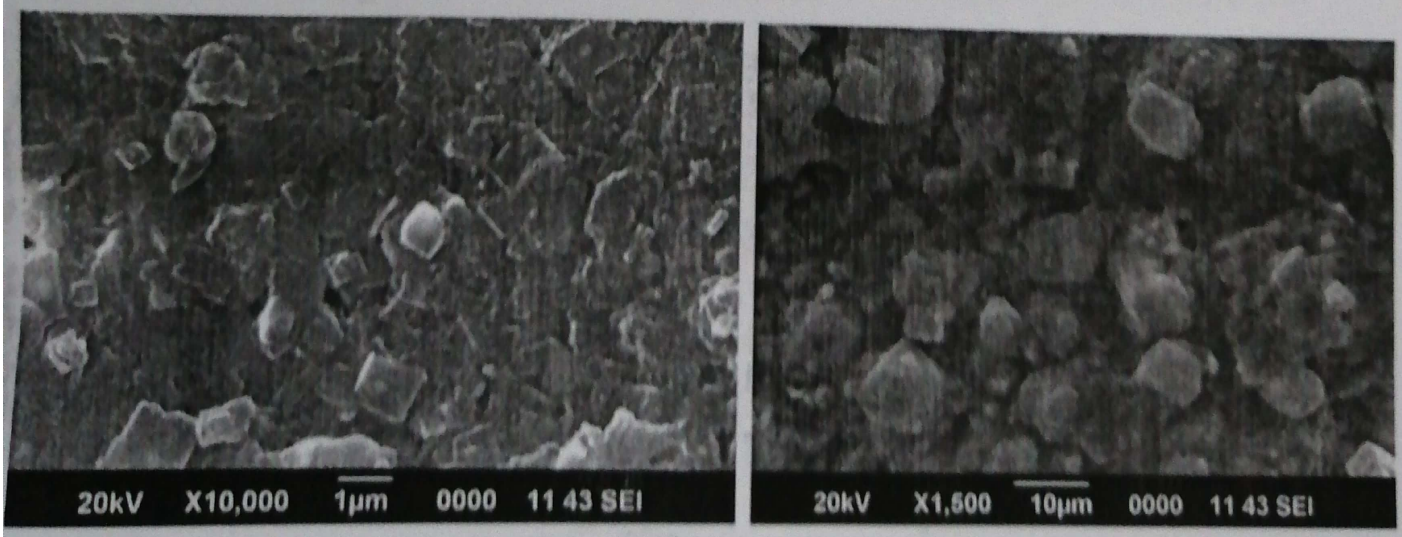

Fig 4: SEM of rod and square shaped Ag nanoparticles.

EDX Spectra

The EDX spectra also confirms the formation of Ag nanoparticles. The spectra shows peaks only for Ag, that shows the high purity of synthesized Ag nanoparticles.

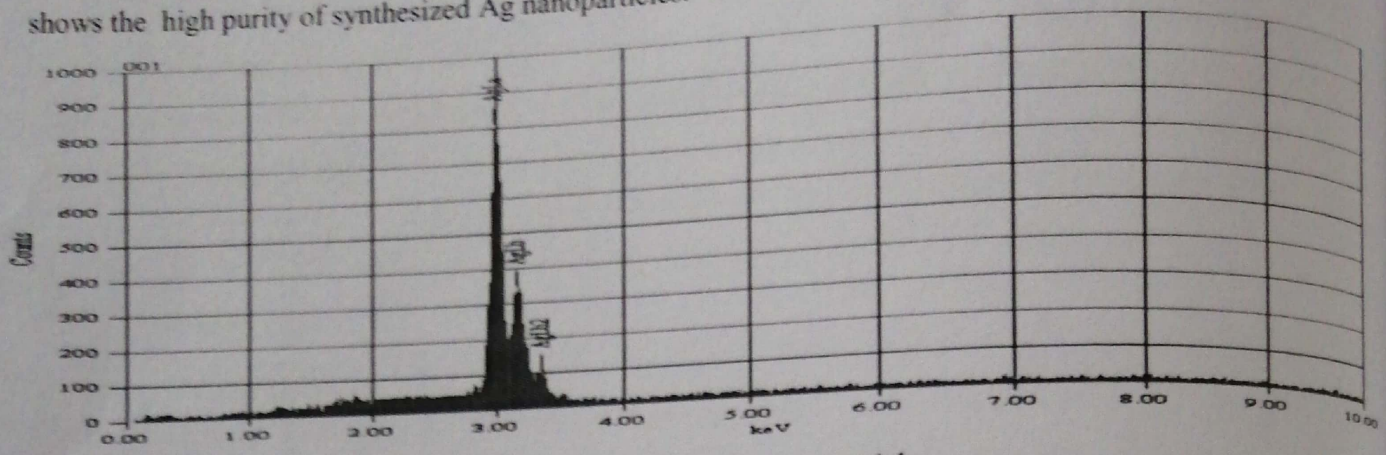

Fig 5: EDX spectra of synthesized Ag nanoparticles

Element	(keV)	Mass%	Atom%	K
Ag L	2.984	100	100	1
Total		100	100	

Summary and Conclusions

Nano silver particles can be synthesized by the green bioreduction method using the plant leaf extract Bauhinia acuminata.The reddish brown colour of the product confirms the formation of silver nanoparticles and it is due to the surface plasmon vibrations of silver particles.The plant leaf extract contains different phytochemicals such as tannin, saponin, phenol etc. may cause the reduction of Ag ions into nanoAg.The UV-Vis spectrum shows an absorbance peak at 420nm which is characteristic for nano silver. The SEM analysis shows Ag nanoparticles have square and rod type morphology. The particle size ranges from 140nm-470nm and the particles are found to be highly agglomerated.EDX spectra confirm the high purity of silver nano particles.

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