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Synthesis and characterization of Silver Nano rod like Structures by Green Synthesis method using Curcumin Longa

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Abstract: In this study, silver nano-rod like structures were biosynthesized from aqueous silver nitrate ($AgNO_3$) through a simple and eco-friendly route using Turmeric powder extracts, which acted as a reducing agent. Characterizations of nano-Structures were done using different techniques, which included Rutherford Backscattering (RBS), Particle Induced X-Ray Emission (PIXE), Scanning electron microscope (SEM), Energy dispersive Analysis X-ray (EDAX) and Fourier-transform infrared spectroscopy (FTIR).RBS and PIXE were used for elemental and compositional analysis. RBS and PIXE showed the presence of Ag in the sample. SEM confirmed their rod like morphology. Presence of silver ions (Ag+) was revealed with the help of EDAX. The FT-IR spectra were recorded to identify the possible bio molecules responsible for the reduction of the Ag+ ions from aqueous $AgNO_3$Solution.
Key Words: $AgNo_3$, RBS,PIXE, SEM, FT-IR and bio molecules.

Introduction

Metallic Nano materials have gained tremendous interest over past few decades. Amongst these, silver nanostructures have attracted much attention especially due to its antibacterial application[1]. Its broad spectrum of antibacterial and anti-fungicidal activity has made it extremely popular in a diverse range of consumer products, including plastics, soaps, pastes, food and textiles, increasing their market value[1]. Nano silver can be used in liquid form such as colloids in paints and spray or contained in a shampoo and be used in polymer[2-4]. The properties of Nano Silver are directly dependent on its aspect ratio. Many modern methods are being used in developing controlled shape of one dimensional nanostructure such as silver wire[5], silver rod[5], silver Nano disks[6] and silver triangular Nano rings[7]. The hydrothermal process[8], sol gel method[9] are used conventionally. The main disadvantage of these synthetic methods is that they involve hectic procedure, involvement of hazardous chemicals and their yield is relatively very low. Hence there is requirement of ecofriendly bioprocessing protocols for the synthesis of Ag nanostructures. More potential research is carried out to increase yield and to use relatively less toxic or no toxic solvents and also obtain a controlled growth of crystals

as required. The wet chemical process is also revolutionary[10]. The alternative way for this process is green synthesis where we use microorganism[11] to obtain a controlled shaped and size of the crystal. Marine fungus[12,13] are also involved in making alternative protocols and many other biological maters are used in the process of synthesis of Ag particle process. In this study we discuss one such green synthesis protocol for the synthesis of silver nanostructures with the help of curcuma longa and its characterizing with the RBS, SEM, PIXE and FTIR.

Experimental

Extract Preparation

The extract was prepared by the freshly obtained Curcuma longa tubers (Turmeric)obtained from local market .The Tubers were then washed and the cut into small pieces and ground till the fine powder was obtained.The obtained powder was left to dry to remove the moisture from the powder under direct sunlight.Then 4 grams of this powder was added to 20ml of distil water and stirred for 2hours.After 2 Hours 20 ml of distil water was again added and stirred for another 2 hours.

Procedure

40ml solution of 1M $AgNo_3$ was prepared and stirred for 30minutes.The freshly prepared extract was added to the solution and heated to 25 Celsius with continuous stirring for 4 hours. It was noted that the colour of the solution changed to nearly brown indicating the formation of Ag nanostructure. The solution was centrifuged for 30 minutes at 5000rpm to separate the obtained powder from the solution. The obtained powder was incubated at 50 degree Celsius overnight to remove the moisture from the samples. The samples were then characterized by RBS, PIXE, SEM and FTIR.

The possible chemical equations for preparing the Ag-NRs are:

$Ag^+ (aq) + C.\ longa \longrightarrow [Ag\ (C.\ longa)]^+$

$[Ag\ (C.\ longa)]^+ + R–CHO\ [Ag\text{-}(C\text{-}longa)] + R–COOH$ (2)

Characterization and Results

RBS analysis was carried out for the elemental analysis of the sample. RBS analysis was carried out with the 4He++ beam with the beam energy of 2MeV. Throughout the analysis the current of 10μC was maintained. Fig 1 shows the obtained RBS spectra of Ag nanorods. From the RBS Spectra the presence of peak near 700 was seen which corresponds to Ag. The peak for Ag was confirmed by the XRUMP simulation carried out at the similar parameter used for actual RBS analysis. It was concluded that the sample being analyzed contains Ag as it main component. PIXE analysis was carried out to support the results obtained from the RBS analysis (Fig.2.). From the PIXE spectra peaks at 3.150eV Corresponding to the Lβ X-ray emission. The results were confirmed with comparison with the X-ray emission table. The peak at 6.390 corresponds to Fe which is due to the impurity present in the sample as a result of Dye used for formation Ag Pellets for analysis. From the RBS and PIXE analysis it was confirmed that the sample contains Ag.

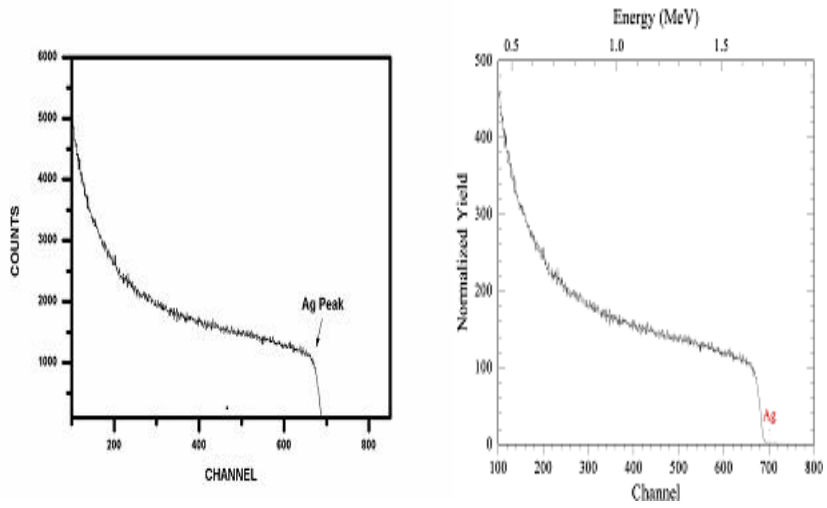

Fig.1. A) RBS spectra of Ag Nanorods. B) Simulated spectra of RBS for Ag Nanorods for peak analysis

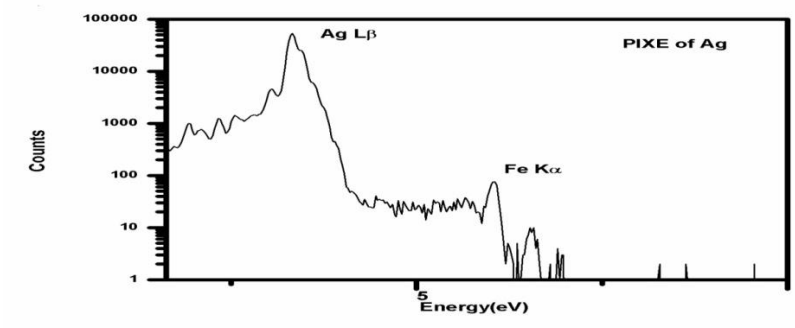

Fig.2. PIXE spectra of as obtained Ag Nanorods

The FT-IR spectra was recorded to identify the possible bio-molecules responsible for the reduction of the Ag+ ions and capping of the bio reduced Ag-NRs synthesized by the C. longa extract. The complete reduction of Ag Ions by the curcumin longa extract is followed by the centrifugation at 5000rpmfor the isolation of reduced Ag Ions for 30 minutes. Following drying overnight at 50°C the obtained sample was mixed with KBr in the proportion of 1:10 for the pellet formation. The pellets were analyzed with ALPHA FTIR Spectrometer. The spectrum in Fig.3 shows transmission peaks at 3415, 2924, 2733, 2394, 2355, 1761, 1580, 1380, 826 , 796 , 726 , 470 , 459 , 440 , 425 cm−1.

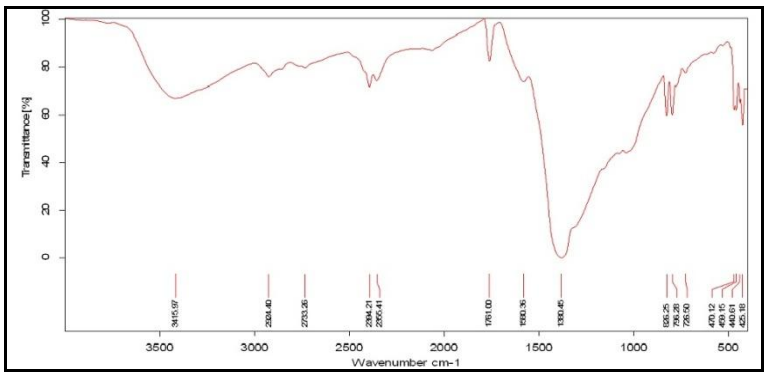

Fig.3. FT-IR spectra of the as obtained Ag Nanorods

The transmission peaks at3450–3250 belong to N–H stretch 1˚, 2˚ amines, amides and 1680–1640 belong to –C=C– derived from heterocyclic compounds, e.g., alkaloid or flavones. These bonds are derived from the proteins that are present in the tuber-powder extractand are the capping ligands of the nano structure obtained. The broad and strong bands at 3415–2920 cm−1 were due to bonded hydroxyl (–OH) or amine groups (–NH) and aliphatic C–H of the C. longa tuber-powder extract, respectively. The peak at 1761 cm−1 is attributed to the carboxyl group (–C=O) stretching vibration. The adsorption at around 1375–1420 cm−1 notably showed that –NO3 existed in residual amounts. The broad peaks at 510 and 299 cm−1 are related to Ag-NP banding with oxygen from hydroxyl groups of C. longa compounds.

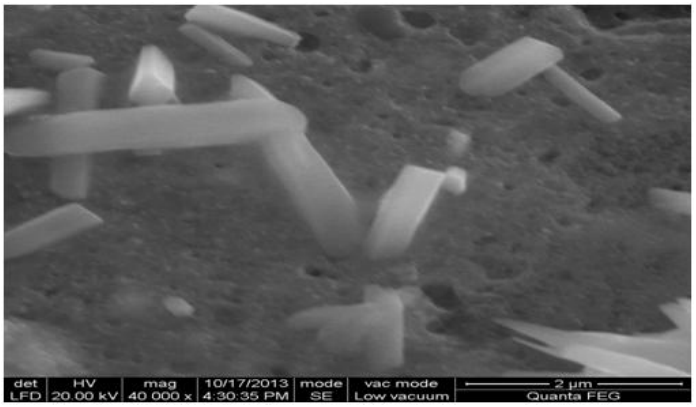

Fig.4. Micrograph of Ag Nanorods

The Micrograph images of the prepared samples are shown in fig 4 and the samples were green synthesized under the conditions of 25^0C for 8hrs followed by drying at 50^0C for overnight to remove moisture. The surface morphology of the samples shows the formation of nanorods without any considerable variations from each other. From the images, it has been observed that the nanorods were formed identically, irrespective of extract with Ag or Extract concentration. The mean length of the rods was found to be around 70nm by using Image J software.

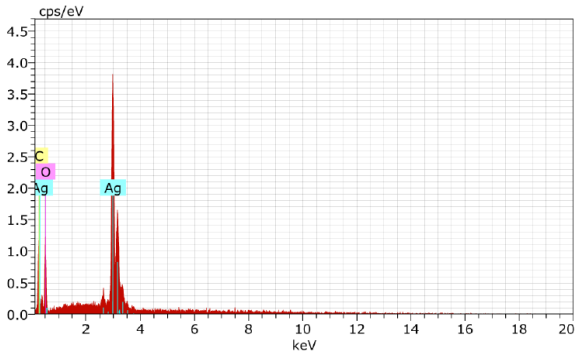

Fig. 5. EDAX spectrum of the Ag samples.

Energy Dispersive analysis of the samples has been shown in fig.5. EDS spectrum of Ag was found to contain Ag with a negligible amount of O element. Whereas, the elements present in each sample and their corresponding wt% are listed out in the table 1.

El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (1 Sigma) [wt.%]
Ag	47	L-series	51.54	59.70	16.86	1.73
O	8	K-series	26.00	30.12	57.33	5.48
C	6	K-series	8.79	10.18	25.81	1.98
		Total:	86.33	100.00	100.00	

Table.1

The presence of C and O can be attributed due to their presence in the extract used for the preparation of the Ag Nanorods.

Conclusion

Silver nanorods were successfully obtained from the green synthesis method thus paving the way for further investigation and synthesis of Ag Nano structures using the green synthesis. The obtained Ag Nanorods were characterized with RBS. RBs showed the presence of Ag in the sample. PIXE spectra supported the RBS analysis for the elemental composition of the sample. FTIR analysis showed the various types of bindings in the sample. SEM showed the morphology of the Nanorods.

References:

1. QuangHuy Tran, Van Quy Nguyen and Anh-Tuan Le,Silver nanoparticles: synthesis, properties, toxicology, applications and perspectives, Adv. Nat.Sci.: Nanosci. Nanotechnol. 4 (2013) 033001 (20pp) doi:10.1088/2043-6262/4/3/033001.
2. Garc´ıa-Barrasa J, L´opez-de-luzuriaga J M and Monge M,2011 Cent. Eur. J. Chem. 9 17.
3. Fabrega J, Luoma S N, Tyler C R, Galloway T S and Lead JR 2011 Environ. Internat.37 517.
4. Dallas P, Sharma V K and Zboril R 2011 Adv. Colloid Interface Sci. 166 119.
5. Youyi Sun, Binghua Yang, Wei Cai, Yaqing Liu, Zhao Guizhe, QijinZhang,pH controlled synthesis of silver nanorods and nanodisks,Published in Micro & Nano Letters; Received on 19th March 2010; Revised on 21st April 2010.
6. Maillard M., Giorgio S., Pileni M.-P.: 'Silver nanodisks', Adv.Mater., 2002, 14, pp. 1084–1086.

7. Sun Y.G., Xia Y.N.: 'Triangular nanoplates of silver:Synthesis, characterization, and use as sacrificial templates for generating triangular nanorings of gold', Adv. Mater.,2003, 15, pp. 695–699.
8. Shan G[1], Zheng S, Chen S, Chen Y, LiuY,MultifunctionalZnO/Ag nanorod array as highly sensitive substrate for surface enhanced Raman detection.Colloids Surf B Biointerfaces. 2012 Jun 1;94:157-62. doi: 10.1016/j.colsurfb.2012.01.037. Epub 2012 Feb 1.
9. A. H. Shah, E. Manikandan*, M. Basheer Ahmed and V. Ganesan ,Enhanced Bioactivity of Ag/ZnONanorods-A Comparative Antibacterial Study,Shah et al., J NanomedNanotechol 2013, 4:3 http://dx.doi.org/10.4172/2157-7439.1000168.
10. Nikhil R. Jana,*[a] LathaGearheart[a] and Catherine J. Murphy*, Wet chemical synthesis of silver nanorods and nanowiresof controllable aspect ratio,Chem. Commun., 2001, 617-618, DOI: 10.1039/B100521I,Received 15 Jan 2001, Accepted 15 Feb 2001
11. Swetha Sunkar, C.ValliNachiyar,Green synthesis of silver nanoparticles using Bacilluscereus, an Endophytic Bacterium isolated from Garciniaxanthochymus
12. A.K. Vala1, B. Chudasama2, R.J. Patel1Green synthesis of silver nanoparticles using marine-derived fungus Aspergillusniger,Published in Micro & Nano Letters; Received on 12th June 2012.
13. S.Pirathiba, TasneemAbbasi, Gainful Utilization Of A Highly Pernicious And Worthless Weed Mimosa Pudica For The Green Synthesis Of Silver Nanoparticles.

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