

**BIOGENESIS AND CHARACTERIZATION OF TRI- METALLIC ALLOY
(AU-CU-SR) NANOPARTICLES**Sharanabasava V. Ganachari^{1*}

¹ Centre for Material Science, Advanced research in Nanoscience & Nanotechnology, School of Mechanical Engineering, KLE Technological University (formerly known as B. V. Bhoomaraddi College of Engineering & Technology), Vidyanagar, Hubballi-580-031, INDIA

ABSTRACT- Crystallized Gold (Au), copper (Cu), Strontium (Sr) tri-metallic nanometal alloy have been prepared and stabilized using plant extracts of *Coriandrum sativum* in an aqueous system. Analysis of the feasibility of the biologically synthesized bio-functional core-shell nanometal alloy from plant root extract is particularly noteworthy. The colloidal suspensions obtained were in highly stable condition for 18-20 weeks. The composition, morphology, size and structure of the nanoparticles were determined by Fourier transform infrared spectroscopy (FTIR) and Scanning electron microscopy (SEM).

Keywords- *Coriandrum sativum* root extracts, green nanotechnology, tri-metallic alloy nanoparticles, Fourier transform infrared spectroscopy, x-ray diffraction, scanning electron microscopy.

1. Introduction

Nanometals are used in variety of applications because of their small size and properties depending on their shape. The synthesis of these metal nano particles are either by physical or by chemical processes which are pretty expensive techniques also it might be potentially hazardous to the environment and living organisms in the environment. Thus, in order to make a cost effective and safe synthesis technique, biological method was brought into use [1].

The biological synthesis method is basically of two types bottom up approach and top down approach. In bottom up approach the bulk nano particles are built or made from the smaller entities bringing them together whereas in top down approach it is reversing the smaller nano particles are made by breakdown of bulky nano material [2]. When it comes to nano scale the bottom up approach of synthesis is preferred over top down as they also induce internal stresses in addition to defects and contaminations [3]. The biological method of synthesis is a simple and environmentally safer approach where the salts of the metals are mixed with plant extracts or microbial extracts, whole plant or microbes like fungi, yeast and more useful microbes to get metallic ions in nanometer size of 1 to 100nm [4]. For visualizing the physical properties or the chemical composition of the nano particles synthesized various characterization techniques are used like UV vis. spectroscopy, SEM, TEM, FTIR, powder XRD and EDS [5].

The antimicrobial study was done against gram positive (*Staphylococcus aureus*) as well as gram negative bacteria (*Pseudomonas aeruginosa*) by disk diffusion method [6].

A paper wherein Rapid biological synthesis of platinum nanoparticles using *Ocimum sanctum* for water electrolysis applications [7]. This article suggests green synthesizing platinum nanoparticles from leaf extracts of *Ocimum sanctum* and an aqueous solution of chloroplatinic acid ($\text{H}_2\text{PtCl}_6 \cdot 6\text{H}_2\text{O}$). More conversion of platinum ions to platinum nanoparticles takes place when a tulsi leaf extract is used at a reaction temperature of 100°C. Platinum nanoparticles were then dried and their structure and composition were analyzed by XRD with EDAX, SEM, FTIR, and LSV. The EDAX showed platinum of about 71.56%. Also, sodium, calcium, carbon elements were also seen. Scanning electron microscopy showed images of the platinum nanoparticles are irregularly shaped ones some were rectangular and some were triangular. Size was seen as 50 nm. The XRD analysis showed the average particle size as 23 nm. FTIR showed peaks assigned as OH stretching in alcohols, alkali, amine, carboxylic acid functional groups present Application of this reduced platinum is for the electrolysis of water [8].

A paper suggesting Bio synthesis of nickel oxide and nickel nanoparticles and their characterization [4]. Here article, the nickel oxide and nickel nanoparticles were synthesized by boiling method using leaves of *Azadirachta indica* and *Psidium guajava*. The size and morphology of the particles was to be 17-77 nm by transmission and scanning electron microscopy. XRD showed formation of pure Ni and NiO cubic phases with a crystalline size of 44 nm. There is a chance that Ni and NiO nanoparticles can be used for cancer therapy.

A review article showing Gold nano particles synthesis, its properties and applications. [6]. There are many methods to synthesize gold nanoparticles. By chemical method gold nanoparticles are synthesized by reducing hydrochloroauric acid using some stabilizing agent. Turkevich method synthesizes gold nanoparticles of size 10 to 20 nm, spherical in shape.

B Brust method involves reduction of hydrochloroauric acid with tetra octylammonium Bromide it would act as anti-coagulating agent and also a reducing agent the size of nanoparticles would be 6 nm[9]. Seeded growth method synthesizes nanoparticles in variety of shapes such as rods, cubes, tubes. Also, the gold nanoparticles can be generated using plant extracts as it would be mostly uniform shape and size of nanoparticles. Some microbes used for the synthesis includes *Bacillus subtilis*, *Fusarium oxysporium* and *Candida albicans*[10]. detecting hydrogen sulfide (H_2S) using bio-functionalized gold nanoparticles [11]

This research article is represents the biosynthesis of tri-metallic alloy Au-Cu-Sr formed out of its salt solutions by mixing it with plant root extract of *Coriander sativum*. The metals were generated from their salt solutions of $AuCl_3$ for Au, $CuSO_4$ for Cu, and $SrCl_2$ for Sr. The root extract preparation was done and few ml of extract was added to a 1:1:1 mixture of its 1N salt solution. Then the sample was sent for characterizations which was SEM and FTIR.

2. Materials and methods

2.1 Materials

The metal salt solutions used were 1N Gold chloride ($AuCl_3$), 1N Copper Sulphate nitrate ($CuSO_4$) 1N Strontium chloride ($SrCl_2$). The root extract prepared from *Coriandrum sativum* – coriander.

2.2 Method

The bottom up bio synthesis method is used. The roots were cleaned and then mashed by using mortar and pestle then the squashed roots were boiled in distilled water. Then the root remains were filtered out and the extract solution was stored in refrigerator. The tri metal alloy of Au-Cu-Sr was prepared by mixing 1:1:1 ratio of their 1 Normality salt solutions which is of gold chloride, copper sulphate, and strontium chloride. 16.5ml of each of these salts were mixed together. Then 2ml of extract was added and a colour change was observed from colourless to light blue and then turned darker when heated and kept at room temperature. Then the sample was sent for characterization tests which are UV visible spectroscopy, SEM, FTIR, XRD.

3. Characterization

3.1 Field emission scanning electron microscopy

JEOL JSM scanning electron microscope to get to know the morphology of the synthesized nano metal alloy.

3.2 Fourier transform infrared spectroscopy

This test was done on Nicolet 6700 FTIR spectrometer to know the functional groups present in the synthesized nanometal alloy and also the chemical composition of the sample.

4. Results and Discussions

The first observation from the work was change of color of solution when the coriander root extract was added from colorless to blue when later when heated for 10 seconds turned dark This allowed us to know the presence of tri- metallic alloy (Au Cu, Sr) nanoparticles (Fig 1).

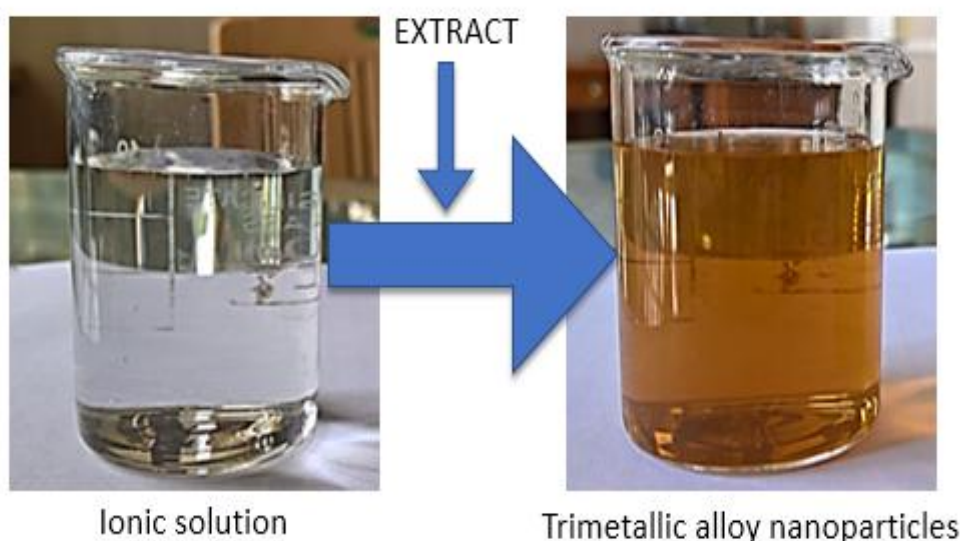


Figure 1 formation of tri- metallic alloy (Au-Cu-Sr) nanoparticles

4.1 Field emission scanning electron microscopy

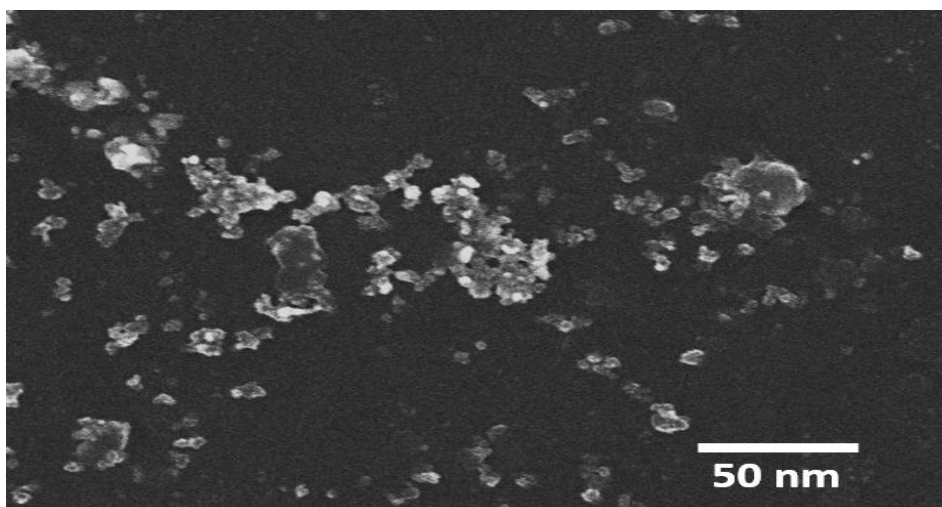


Figure 2 SEM Images of tri- metallic alloy (Au Ag, Sr) nanoparticles

From this picture, we get to know that the shape of the nano particle generated as well as the size of the particle. The shape as we can see is almost spherical and the size was found to be below 15 to 10 nm. Also, the particles are agglomerated.

4.2 Fourier transform infrared spectroscopy

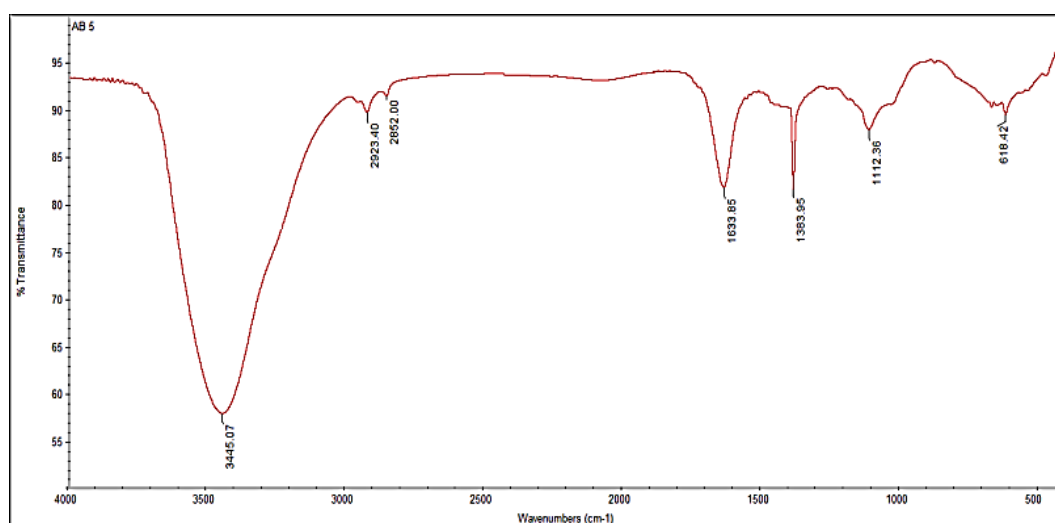


Figure 3 FTIR spectra of tri- metallic alloy (Au Ag, Sr) nanoparticles

The first absorbance peak of 3345.07 shows stretching of second degree amines (NH). Whereas the next peak of 1633.85 showed 1° R- NH₂ with δ NH in plane with stronger bond than in 2° amines. The peak valued 1112.36 indicates the presence of aliphatic -C-O-C-.

Conclusion

The nano metal alloy of gold-copper-strontium was successfully synthesized by biological method using root extract of *Coriandrum sativum* – coriander. Size of the biofunctionalised trimetallic alloy are around 10 nm.

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