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RESEARCH ARTICLE …………!!!

GREEN SYNTHESIS OF SILVER NANOPARTICLES

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ABSTRACT

Nanomaterials are defined as those structures that do not even have all dimensions in the nanoscale. Materials that have well defined physical properties, at the nanometer scale, can express quite different properties; an example is silver malleable and ductile, which if produced spheres or size below 50nm, completely loses its malleability and ductility and become a very hard materials. As already mentioned, the two main factors that give different properties of nanoscale materials are the increase of ratio between surface and volume and quantum effects. The effect is more significant when the size of the object is decreasing in some cases a very small size can also modify the mechanical properties; this happens in metals made of small crystalline grains. In this work, we have explored an inventive contribution for synthesis of silver nanoparticles using moringa olifera and Red oleander leaf extract. The procedure for the development of stable silver nanoparticles is rapid, simple and viable. Synthesized nanoparticles were characterized by various methods, such as UV-Vis spectroscopy, SEM, XRD and antimicrobial activity.

INTRODUCTION:

Nanoscience is the study of phenomena and manipulation of materials at atomic, molecular and macromolecular where proscales properties differ significantly between these scales and major scales. Conversely, nanotechnology refers to the design, characterization, production and the application of structures, devices and systems for the Greek word vavoc and a nanometer to one(nm) is equal to one billionth of a meter,10-9nm. A human hair is approximately 80 thousand nm wide, while a red blood cell approximately 7 thousand nanometers. Atoms are smaller than nanometer, while some molecules, such as proteins or antibodies are compatible with this size. The main effects that characterize the properties of nanoparticles compared to the same material at the macroscopic scale are two: size-dependent and quantum effects [1]. Nanomaterials can be constructed with top down or bottom up approaches. With top down very small structures are produced starting with a large part of material through processes of mass removal. On the contrary, with bottom up technique nanoscales materials are produced building up atom by atom, molecules by molecules. The evolution of this technique is self-assembling, in which the atoms or molecules are able to create structures according to their natural properties. Another aspect of the bottom up technique is the use of tools that can move individual atoms or molecules.

The main challenge of top-down method is the creation of small structure with sufficient precision, while for bottom-up is the creation of large structure with good quality and resistance that can be used as the a material. These two methods have evolved separately but the objective was always the same: the production of nanoscale structures. In recent years scientific community is trying to develop a hybrid technique able to take the positive aspects of both methods. Nanoscience and nanotechnologies encompass a large number of fields: chemical, physical, biological, medical, electronics and engineering. The four main subdivisions nanosciences are: nanomaterials, Nanomerology, bionanotechnology and optoelectronics for information and communication [2].

Nanomaterials:

Nanotubes or nanowrires are examples of 2- dimensional nanostructures with nanometer scale. Compounds that have 3-dimentional nano sized are colloids, precipitates and quantum dots. In this definition it is possible to find also materials with microscopic scalehey are nanocrystalline materials made of nanomaterials-sized grains. Fundamental properties for a materials, such as surface reactivity, resistance and electrical characteristics are size-depend and that depends on the number of atoms on the surface respect total amount of atoms while for a micro structure this ratio between surface atoms and total atoms tends to zero. For instance a particle with size of 30nm has 5% of atoms on its surface, while at 10nm are 20% and for nanoparticles with size of 3 nm on the incredibly thin cables, or even by linear series of points, self-assembled. Nanowires can be produced by wide range of materials, such as silicon gallium nitrate, and the indium phosphide. These structures have been shown to have magnetic, electronic and optical properties, for example silicon nanowires can bend the light also around a narrow angle. For this reason, the application of nanowires are different as the storage of data at high density for magnectic heads for writing on electronic media,for electronic devices and optoelectronic and metal interconnections between quantum devices and nanodevices [5].

Three nanometric dimension:

All three dimensions of this kind of materials are nanometric and as a consequence the volume of these structures is contained in a sphere-form structures with a size less than 100nm. The main structures of these type are fullerenes, dendrimers, quantum dots and nano particles.

Nanoparticles:

Nanoparticles are aggregates of molecule with size less than100nm. The term nano particles extended to include sub-categories such as nanopowders, nanoclusters and nanocrystals. Nanocrystals are compound with a crystalline form and a size less than 100nm. Nanopowders and Nanoclusters are compounds that do not have a crystalline form and which have,size less than 100nm and between 2 and 10 nm with a very narrow size distribution. There are many type of structures, the most important are four [6].

These compounds exhibit new and interesting properties that depend on the size, which is less than 100 nm. Nanoparticles are widely present in the natural world as photochemical reactions, as result of volcanic activity or produced by plants or algae. They have also been created, unintentionally, by humans in the form of products of combustion residues and cooked food or, more recently, as the remains of the exhausted fuel of vehicles. In comparison to the quantity of nanoparticles produced naturally or accidentally, nanoparticles synthesized for research or industrial purposes are a small minority. This minority increased in recent years and will grow even more in the next, thanks to developments that these special size-dependent properties carried out in the various fields in which they are exploited. For example, titanium dioxide or zinc oxide becomes transparent if form nanometer-sized structures and absorb and reject UV rays [7]

MATERIALS AND METHODS

Materials:

- Moringa olifera
- Red oleander
- Silver nitrate
- Distilled water

surface atoms is the half of the total. So a material will be more reactive in its nanometric form comp ared to the coarse one. Quantum effects modify optical, electrical and magnetic properties. The neighboring regions of these grains reduce are completely stop propagation of detects when the material is stressed. If the grains are nanometric, the number of interaction between them increases the effectiveness of the material under stress. For example, in experimental tests nano crystals of silver resulted to be much more resistant then the steel, the harder one[3].

One nanometric dimension:

Materials with one nanometric dimensions, such as films and active and used for decades in electronics, chemistry and engineering; probably greatest development occurred in the industry of silicon integrated circuits. The monolayers thickness of an atom or molecule, are frequently used in chemistry. The formation and properties of these layers can reasonably be understood from an atomic point of view, even in the case of complex layers, such as lubricants. Progress has been made in controlling the composition of the surface polishing and the film growth. The engineering of surfaces, such as the choice of the size or modulation of activity, finds many applications as cells with fuels or catalyst. The large surface area, full of nanoparticles, can be used in many applications, especially in the chemical and energy sector where the great reactivity and selectivity is exploited to save money reducing the main resources for the production of energy [4].

Two nanometric dimension

Research and investigation of nanostructures with the nanoscale dimensions is quite recent, about the last 15 years. The interest increased when the first results emphasized the great electrical and mechanical properties of these structures. Carbon nanotubes (CNTs) are graphene sheets and are of 2 types: single wall, a single tube or multi-wall, a series of concentric tubes. In both cases, the diameter is a few nanometers and the length ranges from several micrometers to few centimeters. Nanotubes are mechanically very strong: indeed, the value of the young's modulus is greater than 1terapascal, very similar to diamond.

In addition mechanical strength, they are very flexible and are good electrical conductors; actually they behave like semiconductors or metals. Applications of carbon nanotubes are several: the reinforcement of composite materials, nanoelectronics, sensors and displays. In addition to the carbon nanotubes they are nanotubes of inorganic compounds of molybdenum disulfide; they have excellent properties as lubricants, high impact resistance and high reactivity in catalytic capability to store oxygen and lithium. Nanotubes based on oxides, such as titanium dioxide may instead find good applications in the field of catalysis, photocatalysis and energy storage. Another example of materials with two nanometric dimensions and nanowires. These structures are composed of

Preparation of the plant extract:

Fresh leaves of *Moringa olifera* and red Oleander are collected from periyakulam. 25gm of collected green leaves and flowers were thoroughly washed with tap water and then with distilled water, cut into fine pieces, and boiled in 100ml of distilled water, for half an hour. The aqueous extract thus obtained was filtered through whatmann No.1 filter paper to obtain a clear extract s. the extract was collected in cleaned and dried 100ml beaker. Then, the filtrates were collected and refrigerated for further experiments. Synthesis of silver Nanoparticles using Plant extracts aqueous solution ($AgNO_3$) at concentration of 0.02mmol/ml was prepared and used for the synthesis of silver nanoparticles. The 10ml of the above prepared plant extract under normal condition was taken in test tube and 2ml of silver nitrate solution is added the change of color takes place within few minutes and the precipitate is formed. The precipitate separated with the help of whattman No.1 filter paper.

Characterization

In nanotechnology, nanoparticles synthesized either biologically or chemically must be characterized in order to understand their intrinsic properties such as size, mono dispersity, aqueous stability, the net charge, adsorption to biomolecules, aggregation and flocculation in various media. This provides vital information in terms of applications of these nanoparticles. For instance, it provides answers to know whether a particular nanoparticle can be used in biological application, or else to improve their synthetic processes, and/or chemical functionalization [8].

A variety of characterization the techniques are currently available some which precede the advent of nanoscience and technology and mostly drawn from material science. The development of new and integrated methods suited to probe nanomaterials is however a continuous process. The common techniques used in the characterization of nanoparticles are ultraviolet-visible (UV) spectroscopy, Fourier transform infrared spectroscopy (FTIR),X-ray diffraction studies(XRD),inductively coupled atomic/optical emission spectroscopy (IC AES/OES), florescence spectroscopy(FS), X-ray photoelectron spectroscopy (XPS),scanning /transmission electron microscopy (SEM/TEM),dynamic light scattering (DLS),atomic force microscopy (AFM) and energy dispersion and analysis of X-rays (EDAX) [9].

UV-visible spectroscopy

UV-Visible spectroscopy is based on the absorbance of photons in the visible, near-UV and near-infrared regions of the electromagnetic spectrum. UV-Vis spectroscopy, as a technique of characterization, also involves the transition of electrons, and it complements fluorescence spectroscopy which deals with transitions of electrons from excited state to ground state [10].

Generally, spectroscopy is used to identify elements and compounds for structural elucidation of matter at the atomic and molecular levels, the most common form being ultraviolet-visible (UV/Vis) spectroscopy [11]. Nanoparticles of silver have been extensively characterized by this technique due to their plasmodia nature and optical properties which are sensitive to size, shape, concentration and aggregation state. Although the wavelength for UV/Vis spectroscopy is within the nanoscale (i.e.<1μm), some nanomaterials have smaller dimensions and may require other spectroscopic techniques for characterization [12].

X-Ray Diffraction studies

For determination of crystalline size, Scherer analysis of XRD is commonly used. This technique relies on the broadening of diffraction peaks due to the finite number of diffracting planes. Because other factors, such as strain, can broaden XRD peaks, Scherer analysis generally provides a lower limit on mean crystalline size [13].

Scanning electron microscopy

In SEM, high resolution images are generated by focusing a high-energy beam of electrons on the surface of the specimen in a raster scanning fashion. These electrons interact with the specimen to produce signals that provides information about the sample such as the surface morphology, elemental or chemical composition, crystal structure and positions of atoms or materials that makes up the sample [14].

RESULTS AND DISCUSSIONS

The reduction of silver ions silver nanoparticles occurred after mixing silver nitrate with different plant and spices extract, followed colour change of the solutions due to reduction of silver ion, which may be indication of formation silver nano particles the synthesized silver nanoparticles were characterized by UV- Visible spectroscopy, XRD and SEM. the important parameters,viz. FWHM (full width half maximum),particle size, structure of compounds the value of energy gap, presence of compounds were discussed.

UV- Visible Spectroscopy

The bioreduction of silver in aqueous solution was monitored by periodic sampling of aliquots of the mixture and subsequently measuring uv-visible spectra. UV- visible spectra analysis was done by using shimatzuUV-1800 double beam spectrophotometer. The absorption peaks are measured in the range of 200-800nm [15].

UV-Visible spectroscopy analysis showed that the wavelength of silver nano particles synthesized using *moringa olifera, red oleander* extract centered at 400-500 nm due to the excitation of surface

Plasmon vibrations in the silver nano particles. The figures 1 and 2 represent the UV-VISIBLE spectrum of silver nano particles.

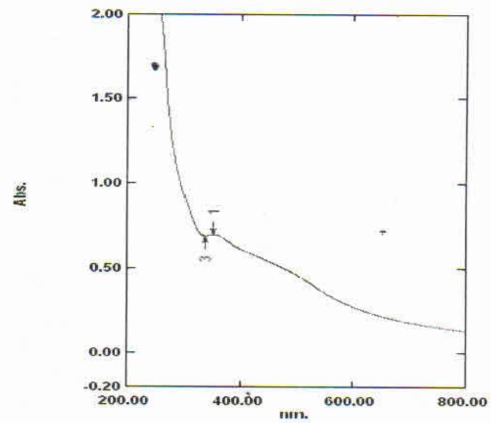


Figure.1 UV-Vis Spectrum of silver nanoparticles from moringa olifera

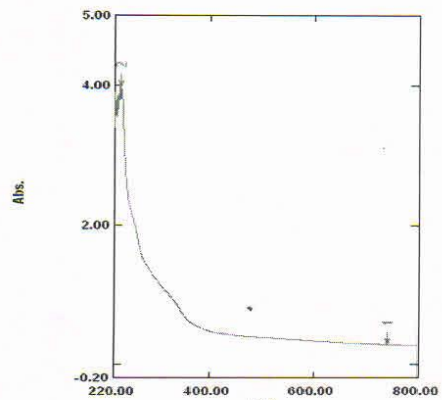


Figure.2 UV-Vis spectrum of silver nanoparticles from red oleyander

X-Ray diffraction studies

The siver nanoparticle solution obtained was purified by repeated centrifugation at 5000 rpm for 20 minutes followed by redispersion of the pellet of silver nano particles into 1ml of deionized water. After freeze drying of the purified silver nanoparticles, the structure and composition were analyzed by XRD. The crystallite domain size was calculated from the width of the XRD peaks, assuming that they are free from non-uniform strains, using the Scherer formula. Figures 3 and 4 show the XRD spectrum for silver nanoparticles [16].

$D=0.94\lambda/\beta \cos\theta$

Where D is the average crystallite domain size perpendicular to the reflecting planes, λ is the X-ray wavelength, β is the full width at half maximum (FWHM) and θ is the diffraction angle.

To eliminate additional instrumental broadening the FWHM was corrected, using the FWHM from large grained Si sample.β corrected=(FWHM2 sample-FWHM2Si)

Determination of structure and parameter: From the XRD-profiles, the interplanar spacing dlnk was calculated using the Bragg's relation, $dlnk=n\lambda/2\sin\theta$.

The crystalline size (D) was calculated using the formula from the full width at half maximum (FWHM).$D=k\lambda/\beta\cos\theta$.

Where, The constant k is the shape factor 0.94, 'λ' is the wavelength of the X-rays (1.5406Å for Cu kα), 'θ' is the Bragg's angle and 'β' is the FWHM.

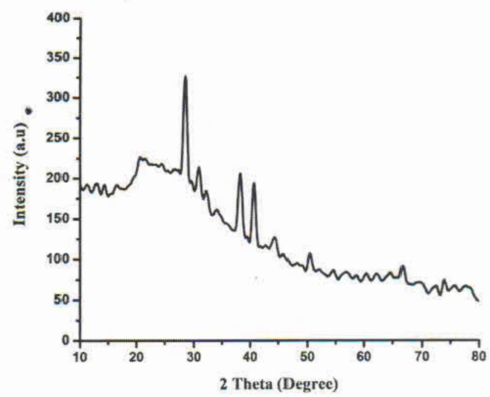


Figure.3 XRD Pattern of silver nano particles form *moringa olifera*

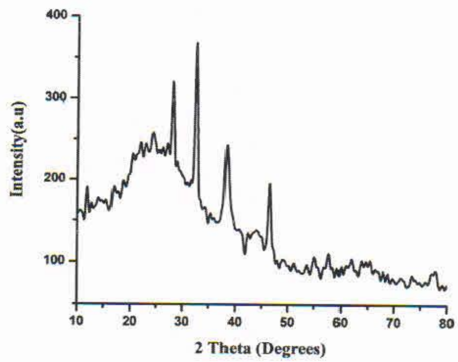


Figure.4 XRD pattern of silver nano particles form *red oleander*

Calculation of silver nanoparticle particle size for leaves *moringa olifera*

$$D = \frac{0.94X1.546}{0.40120X\cos114.872}$$

D=8.5052nm

This XRD value confirms that the synthesized were nanometric in size. The size of the silver nano particles thus estimated was found to be 8.5052nm.

Calculation of silver nanoparticle size for leaves *red oleander*

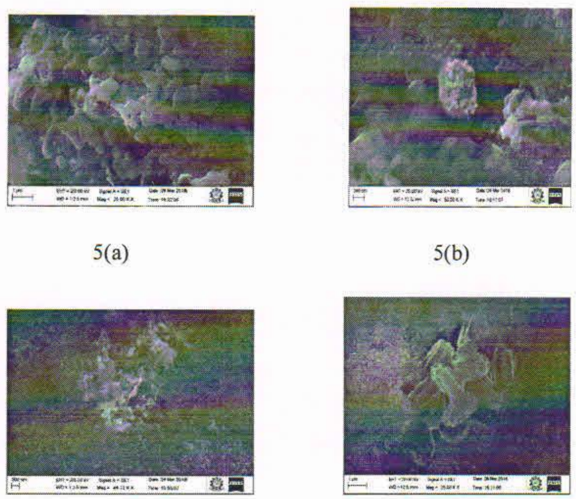
$$D = \frac{0.94X1.546}{0.25210X\cos852.078}$$

D=8.5707nm

This XRD value confirms that the synthesized were nanometric in size. The size of the silver nanoparticles thus estimated was found to be 8.5707nm.

Scanning Electron Microscopy

Size, shape and distribution of green synthesized silver nano particles were characterized by scanning electron microscope. The particle morphology of the silver nano particles fabricated using Moringa olifera plant extract. Figure.5 shows the particle morphology of silver nanoparticles at low and high magnification respectively. The particle aggregation was clearly viewed and it indicates the uniform particle dimension of the nanoparticle synthesis process and no action of stabilization of nanoparticles. However, in the higher magnification, some smooth solid blocks are identified which may be due to very close packing of the silver nanoparticles[17].



5(a) 5(b)

5(c) 5(d)

Figure.5 SEM images of silver nanoparticles of moringa olifera and red oleander at low high magnification.

CONCLUSION:

A critical need in the field of nanotechnology is the development of reliable ecofriendly process for synthesis of metallic nanoparticles. Here, we synthesized a simple biological and low cost approach for preparation of stable silver nanoparticles by reduction of silver nitrate solution with a bioreduction method using moringa olifera leaf of red oleander and seeds of aqueous extract as the reducing agent. Biologically synthesized silver nanoparticles could be of immense use in pharmaceutical field for their efficient antibacterial and antimicrobial properties. The characteristics obtained silver nanoparticles were studied using UV-Vis, XRD, and SEM techniques. The result confirmed the reduction of silver nitrate to silver nanoparticles with high stability and without any impurity. The UV-Vis spectrum showed a broad peak located at 400-500nm for silver nanoparticles. X-Ray diffraction pattern (XRD) revealed that the result and nanoparticles were nanometric in size and the particle size was found less than 20nm.the SEM picture revealed the morphology of the particles.

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