"CHARACTERIZATION OF NANOPARTICLES BASED ON GUARGUM SYNTHESIS"

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD

OF THE DEGREE OF MASTER

OF SCIENCE

IN

BIOTECHNOLOGY

BY

SHILPA SHARMA

Roll no. 2k21/MSCBIO/46

Under the Supervision of

Prof. JAI GOPAL SHARMA

DEPARTMENT OF BIOTECHNOLOGY

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

Bawana Road, Delhi-110042

JUNE,2023

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly DelhiCollege of Engineering)

CERTIFICATE

I hereby certify that the Project Dissertation "Guar Gum based Synthesis and Characterization of Nanoparticles" which is submitted by SHILPA SHARMA (2K21/MSCBIO/46), Department of Biotechnology , Delhi Technological University, Delhi in partial fulfillment of the requirement for award of the Master of Science, is a recorded for the project work carried out by the student under my supervision. To the best of my knowledge this work carried out by the student under my supervision. To the best of my knowledge this work has not been submitted in part or full for any degree or any diploma to this university or elsewhere.

Prof. Jai Gopal Sharma

(SUPERVISOR)

Department of Biotechnology

Delhi Technological University

Delhi-110042

Candidate Declaration

I , SHILPA,ROLL No. 2k21/MSCBIO/46, student of M.Sc. Biotechnology ,hereby declare that the Project Dissertation titled **" Guar Gum based Synthesis and Characterization of silver nanoparticles"** which is submitted by me to the Department of Biotechnology , Delhi Technological University , Delhi, in partial fulfillment of the requirement for the award of the degree of Master of Science in Biotechnology , is original and not copied from any source without proper citation. This work has not previously formed the basis for the award of any Degree, Diploma, Associate ship , Fellowship or other similar title or recognition.

Date:02-06-2023 ***Shilpa Sharma***

Place: Delhi Roll No. 2k21/MscBio/46

Acknowledgements

I would like to express my gratitude towards my Supervisor **Prof. Jai Gopal Sharma,** for giving me the opportunity to do research and providing invaluable guidance throughout this research. His dynamism, vision, sincerity and motivation have deeply inspired me. He has motivated to carry out the research and to present my works as clearly as possible. It was a great privilege and honor to work and study under his guidance. I am extremely grateful for what he has offered me. His insightful feedback pushed me to sharpen my thinking and brought my work to a higher level.

I express my kind regards and gratitude to Professor **Pravir Kumar,** Head of Department, Department of BIOTECHNOLOGY, DTU, and all the faculty members for helping in my project.

I would like to thanks PhD scholars **Ms. Neha Tiwari, Ms. Megha Bansal,** for their continuous assistance during my practical work

I am extremely grateful to my parents for their love , prayers, caring and sacrifices for educating and preparing me for my future.

Finally , I am thankful to all the people who have supported me to complete my research work directly or indirectly

SHILPA SHARMA

(2K21\MSCBIO/46)

Date: 02-06-2023

ABSTRACT

Because of their distinct chemical and physical characteristics, small silver particles (Ag NPs) as a subject of ongoing research. They are useful for the variety of uses visual, antibacterial, catalytic, and electric capabilities, and they may be made utilising a number of green chemical methods.

Guar gum (GG), an organic material that we used an oxidant in our experiment, was used to create silver nanoparticles. A capping agent is another function of guar gum. Using straight forward method of dip and spinning the coating on glass substrates, Ag/GG composite thin films were created. To determine the structural, chemical, and optical characteristics of the materials that were synthesised, various characterization techniques were applied.

Particle size was determined by SEM images to be between 100 and 150 nm. Guar gum is present and serves as a capping agent, according to the FTIR analysis. The absorbance peak occurs within the UV-visible spectrum occurs around 450 nm, and the energy of the optical band gap, Eg, is approximately 1.86 eV. The tiny particles have uses in sensors and physical semiconductor.

CONTENTS TABLE

1. INTRODUCTION

1.1 Nanotechnology Concept

1.2 Nanotechnology's historical antecedents

1.3 Nanoparticles

1.4 Numerous nanoparticle fabrication techniques

2. A LITERARY REVIEW

1.5 The Development of Nanosilver

1.6 The rationale behind the creation of silver nanoparticles

1.6.1 1 Silver and silver nanoparticle characteristics

1.6.1.1 The characteristics of light

1.6.1.2 Antibacterial characteristics

1.6.1.3 Electrical characteristics

1.7 Different ways to make silver nanoparticles

1.8 Green chemistry methodology

1.9 Guar gum-based reduction of silver salts

2. METHOD AND MATERIALS

2.1 Synthesis-related resources

2.2 A flow chart and experimental approach

2.3 An experimental procedure and flowchart

3. CONCLUSIONS AND RESULTS

3.1 UV, Vis, and NIR spectroscopy

4. CONCLUSION AND ANALYSIS OF FURTHER WORK

5. REFERENCES

1. INTRODUCTION

1.1 Concept of nanotechnology

A method of modifying material at the molecular and atomic levels is known as nanotechnology. The majority of the time, it involves creating materials, tools, or other objects having a minium of one single width between 1 and 100 nanometers in length. Quantum mechanical effects also become significant at this fundamental reality production. Nanotechnology encompasses a wide range of topics, from modifications of existing device physics to entirely novel methods based on molecule self-assembly. Investigating whether we have direct influence over matter at the atomic level is useful in the development of novel materials with nanoscale dimensions. Research, chemical science, molecules, the sciences, tiny manufacturing,can only a few of the scientific disciplines that can be applied to nanotechnology.

1.2 Historical aspects of nanotechnology

The essential concepts of nanotechnology research have been developed over a longer period of time, despite the fact that this field of study is still relatively new. Norio Taniguchi created the term "Nanotechnology" in 1974 to signify extremely high precision and extremely small dimensions. He also predicted breakthroughs in integrated circuits, optoelectronic devices, and computer memory components. The advent of nanotechnology in the 1980s was the result of an experimental convergence that included the invention of the scanning tunnelling microscope in 1981 and the discovery of fullerenes in 1985. The scanning tunnelling microscope was developed by IBM Zurich Research scientists Gerd Binning and Heinrich Rohrer. For their laboratory work, they received the 1986 Nobel Prize in Physics. The 1996 Nobel Prize in Chemistry was shared by Harry Kroto, Richard Smalley, and Robert Curl.

K. Eric Drexler invented and popularised the concept of nanotechnology about the same time that he was a pioneer in the field of molecular nanotechnology. In 1979, Drexler came across Richard Feynman's 1959 speech, "There's Plenty of Room at the Bottom" [2]. The concept of a nanoscale "assembler" that could create copies of itself and other objects of arbitrary complexity was put forth in Drexler's book "Engines of Creation: The Coming Era of Nanotechnology"[3] in 1986. Norio

Taniguchi was the one who first created the phrase "nanotechnology" in 1974. Drexler refers to nanotechnology as "Molecular Nanotechnology" (MNT) or "molecular manufacturing," two words that are frequently used to characterise it.

Nanotechnology applications include transparent sunscreens made of nanoparticles, stain-resistant fabrics made of carbon nanotubes, and antimicrobial silver nanoparticles. However, these were simply broad-based uses of nanomaterials. The Royal Society's report on nanotechnology provides as an illustration of how the subject of the discipline was the subject of significant discussions concerning both its potential consequences and the viability of the applications envisioned by advocates of molecular nanotechnology. The public argument between Richard Smalley and Eric Drexler in 2001 and 2003 served as the debate's climax. Many nations have taken steps to support and finance nanotechnology research with the assistance of programmes like the National Nanotechnology Initiative and the Centre for Nanotechnology.

1.3 Nanoparticles

Less than 100 nm in radius atomic or molecular structures. As a cluster gets bigger, more atoms are contained within it

drops at first glance. When compared to bulk structures, nanostructures act differently because they have a higher percentage of atoms on their surface.

- A nanometer (nm) is one billionth of a metre, or 10-9. The diameter of a DNA double helix is about 2 nm, although the average range of carbon-carbon bond lengths, or the distance between these atoms in a molecule, is between 0.12 and 0.15 nm. On the other hand, the Mycoplasma bacterial species are the tiniest cellular life forms and have a length of roughly 200 nm. According to the National Nanotechnology Initiative's definition in the US, nanotechnology is typically understood to cover the sizes I to 100 nm. The lower bound is determined by atom size since nanotechnology must build its devices from atoms and molecules. The upper limit is essentially arbitrary, but it is around the
- Higher Surface - Volume Ratio
- Quantum Contention
- States of Quantized Energy

1.4 Various approaches for nanoparticles synthesis

There have been many documented synthesis methods for nanomaterials so far. Generally speaking, all methods might be categorised as

Top down method

Bottom up method

A solid substance can be broken up using the top-down approach, which can be further separated into dry and wet grinding. Using such common techniques as a jet mill, hammer mill, shearing mill, roller mill, shock shearing mill, ball mill, and tumble mill, the solid substance is ground in the dry grinding method as a result of a shock, a compression, or by friction. As opposed to this, wet grinding of a solid substrate is done using a tumbling ball mill, vibrating ball mill, planetary ball mill, centrifugal fluid mill, agitating beads mill, flow conduit beads mill, etc.

The bottom-up strategy falls into two broad categories: gas phase approaches and liquid phase procedures. In contrast to the former, which calls for a chemical reaction known as chemical vapour deposition (CVD), the physical vapour deposition method (PVD) employs cooling to condense the evaporated material. The gaseous phase procedures, when compared to liquid phase methods, lower the presence of organic pollutants in the particles, but they also require the use of specialised hoover equipment, which has the disadvantages of being expensive and having low productivity. During the CVD process, ultrafine particles smaller than 1 m can be formed because of the chemical reaction

occurring in the gaseous phase. It is feasible to create nanoparticles with sizes between 10 and 100 nm by carefully controlling the process. In the One benefit is the ease with which particles with different shapes, including hollow nanoparticles, nanorods, nanowires, nanoprisms, and nanoplates, can be made. By adjusting the reducing agent, the dispersing agent, the reaction time, and the temperature, it is feasible to precisely control the form (shape) and size of the nanoparticles when using the chemical reduction process.

The chemical reduction method that we use for synthesis in this report involves chemically reducing the metal ions to their 0 oxidation states (i.e., Mn+M0). This method uses simple equipment or instruments and can produce large quantities of nanoparticles quickly and affordably. Other reduction techniques, such as photoreduction employing gamma rays, ultrasonic waves, and liquid plasma, are known and can be used to prepare nanoparticles in addition to the chemical reduction approach (direct reduction method), which involves the addition of a reducing agent. These techniques are appealing since they don't add any additional contaminants to the nanoparticles, which is achieved without the need of a chemical reduction agent. Other techniques include solvothermal synthesis, spray drying, and spray pyrolysis.

A sol-gel approach, which has been widely used to create metal oxide nanoparticles, serves as the general methodology for the sedimentation method. Using this method, a metal alkoxide solution is converted from a solution to a sol by hydrolysis and then to a gel by polycondensation.

2. REVIEW OF LITERATURE

2.1 History of nanosilver

As a view point of history perspective , the synthesis of citric.

In 1889, M.C. Lea published the first description of stable colloidal silver. In the early 1890s, colloidal science, which deals with the creation and characterization of exceedingly small particles, was among the first fields to be inspired by nanosilver.After the creation of gelatin-stabilized silver nanoparticles in 1953, commercial production of this form of nanosilver under the trade name "Collargol" began in 1907 after the stabilisation of silver nanoparticles with proteins in 1902.

2.2 Motivation for synthesis of silver nanoparticles

2.2.1 Properties of silver and silver nanoparticles

Although it is a scarce and naturally occurring element, silver is a key component of our planet. Silver is more ductile, malleable, and durable than gold. Pure silver is the metal with the finest thermal, electrical, and contact resistance characteristics. Silver can exist in four different oxidation states: Ag0, Ag2+, Ag3+. While the last is unstable in an aquatic environment, the first two are the most typical. Metallic silver is not soluble in water, but metallic compounds like AgNO3 and Silver chloride are. Because of their unique properties, such as tunable optical, electrical, and magnetic properties, silver nanoparticles are of interest because they can be used to create antimicrobial applications, biosensor materials, composite fibres, cryogenic superconducting materials, and more.

It is becoming more and more common to use the optical properties of silver nanoparticles as a functional component in various products and sensors. Silver nanoparticles are very good at both absorbing and dispersing light because, unlike many dyes and pigments, their colour depends on their size and form. Silver nanoparticles show a high interaction with light because conduction electrons on the metal surface fluctuate collectively in response to light of specific wavelengths. Surface plasmon resonance (SPR) oscillations produce extremely powerful scattering and absorption properties. In fact, for silver nanoparticles, the effective extinction cross sections (scattering plus absorption) can be up to ten times larger than their physical cross sections. Because of the substantial scattering cross section,

2.2.1.1 Antimicrobial properties

Due to its strong toxicity towards bacteria like Escherchia coli (E. coli) and Staphylococcus aureas, silver is a safe and effective anti-bactericidal metal. In recent years, applications like burn treatment have employed chemicals based on silver to stop bacterial development. Due to the high surface to volume ratios, nano silver has been employed as an anti-bacterial in the form of powders and solutions. This makes the product more affordable by allowing for the loading of small amounts of silver. When silver nanoparticles adhere tightly to the surface of microorganisms, they cause obvious cell damage and have a good ability to self-assemble, which makes them hazardous to bacteria.

While many bacterial species are strongly biocided by silver ions (Ag+) and its products, mammalian cells are only moderately poisonous to these microorganisms.Nanoparticles' bactericidal behaviour is

related to the existence of electronic effects, which are brought about by changes in the surface's local electronic structure brought about by smaller sizes. According to the effects, the surface reactivity of silver nanoparticles has been improved. Important enzymes' thiol groups interact extensively with silver in its ionic form, rendering them inactive. When silver ions are used to treat the bacteria, the lead DNA's capacity for replication is lost.

2.2.1.2 Catalytic properties

Metal nanoparticles are efficient catalytic mediums due to their huge surface area and high surface energy. More effective catalysts than stable colloidal particles have been found to be silver nanoparticles that are still growing. Numerous organic dyes were reduced by borohydride thanks to the catalysis provided by these growing particles. When compared to the final, more stable and substantial silver particles that grow into them, the reduction rate catalysed by growing particles is noticeably faster. Due to the fact that redox potential depends on nanoparticle size, silver nanoparticles' catalytic activity can be adjusted by their size.

2.2.1.3 Electrical properties

It has been a significant area of study to examine the conductivity of different metal nanoparticles placed in polymer matrixes. The electrical conductivity of bulk silver is quite good. In the case of silver nanoparticles, it has been noted that the conductivity of thin films depends on the film thickness and particle loading; films with a thickness less than 150 nm exhibit dielectric behaviour, and as thickness increases, a transition from the dielectric region to the semiconducting and conducting zone occurs.

In this report, silver nanoparticles embedded in a natural polymer are being studied because the majority of research on silver nanoparticles focuses on their antibacterial activity and optical characteristics. However, electrical properties are also receiving more attention these days.

2.2.2 Application of silver nanoparticles

Numerous fields use silver nanoparticles in various ways. Pharmaceutics, medicine, and dentistry are the fields in which silver nanoparticle uses are most thoroughly studied. Due to their antibacterial qualities, they can be utilised to treat a variety of infections. The therapy of dermatitis, ulcerative colitis, remote laser light-induced opening of microcapsules, silver/dendrimer nanocomposite for cell labelling, and molecular imaging of cancer cells are among the uses they identify for their technology.

Direct writing technologies, which deposit material with suitable electronic properties in particulate form on the substrate and then turn it into conductive components, have been introduced to the electronic industry. Silver nanoparticle-based inks are great candidates for inkjet printable electronics due to their strong electrical conductivity. The ink formulation is one of the biggest issues with inkjet printing technology. To ensure that the printing system operates as efficiently and reliably as possible and to produce high-quality printed patterns, the inks must adhere to specific physicochemical parameters (such as viscosity, surface tension, and substrate adherence). Metallic nanoparticles have a number of unique properties that make them particularly appealing for the field of electrochemistry, including increased surface reactivity of atoms, a melting temperature that decreases with size, and strong electric conductivity. Similar to all other nanomaterials, top-down and bottom-up methods can be used to create silver nanoparticles. Reports of physical, chemical, biological, and photochemical techniques exist. While sputtering, PVD, and CVD are all widely used deposition processes, they are not particularly economical. In terms of simplicity and cost-effectiveness, chemical reduction is the method that works best for noble metals.

2.3 Strategies for Green Chemistry

Green chemistry promotes the creation of goods and procedures that reduce the usage and generation of dangerous and harmful substances. Chemical engineering, biotechnology, nanotechnology, and physical chemistry are all included in green chemistry. It encourages the use of natural, nontoxic, and environmentally friendly raw

materials and products.

Numerous synthesis methods utilising green chemistry have been reported. Silver nanoparticles (NPs) have been produced utilising a variety of plant extracts (phytochemicals), including those from aloe vera, grapefruit, mulberry, Azadirachta indica, and Ocimum tenuiflorum leaves.

2.4 Reduction of silver salts using guar gum

The pulverised endosperm of guar beans is what makes guar gum. For the purpose of producing guar gum, guar seeds are dehusked, ground, and screened. A light-colored powder, it flows freely.

The most crucial characteristic of guar gum is its quick hydration in cold water, which allows it to reach uniformly high viscosity at low concentrations. The fact that guar gum is absorbed in both cold as well as hot water and gives fluidity extremely in frigid temperature is another benefit. In addition to improving texture, binding water, and controlling crystal formation, it is the most economical stabiliser and emulsifier. It has an inert nature.

Guar gum performs the roles of capping, stabilising, and reducing during the synthesis of silver nanoparticles utilising this material. Guar gum can be used act as stabilising agent or reagent; an order to reduce silver salt, we combined guar gum (Cyamopsis tetragonolobus) with turmeric (Curcuma longa).

According to reports, composites made of silver and guanium can be used to make gas sensors for ammonia detection. These nanocomposites may have further uses that are currently being researched.

3.1.1 3.1 Synthesis-related materials

3.1.2 Silver (AgNO3)nitrate

Silver nitrate, a precursor and source of silver, was employed and originated in the central drug house (CDH), New Delhi. AgNO3 is a high purity (99.98%) scientific reagent.

The crystalline solid AgNO3 has a molecular weight of 169.87 and is colourless or white. Because it darkens when exposed to radiation or organic chemicals, it is maintained in a dark, opaque container and under a black sheet to avoid degradation.

.

Fig. 3.1 silver nitrate ($AgNO_3$)

3.1.3 Reducing substances

used guar gum, a natural polymer, to lower the concentration of silver nitrate solution in elemental silver. Guar gum functions in the mixture as a capping and reducing agent. Rajat dyes and chemicals, New Delhi, provided laboratory-grade guar We gum for purchase. Turmeric (curcuma longa), another green and non-toxic reducing agent, is also being studied.

Fig 3.2 (a) guar gum (b) turmeric powder

2.5 Experimental procedure and flow chart

3.2.1 Experimental approach

Guar gum particles were dissolved and added 10 ml of filtered water at a concentration 2% (w/v) with the use of a magnetic stirrer for the creation of silver nanoparticles because guar gum is entirely soluble in both hot and cold water. The temperature of the reaction medium was increased to 500C after complete dissolution. After adding 10 ml of the 20 mM solution of silver nitrate drop within the aid of a pipette, the resultant mixture is constantly agitated thereafter, using a iron stirrer. For sodium alginate powder and turmeric powder, the same process was used. Guar gum served utilised the stabilising or the reagent in the reduction process using turmeric powder. Different concentrations of AgNO3 solution, such as 20mM, 40mM, 60mM, and 80mM, were also tested for guar gum.

Using the YJ5120-1 ultrasonic cleaner for 10 minutes at 400 C, all of the glassware that was utilised was cleaned.

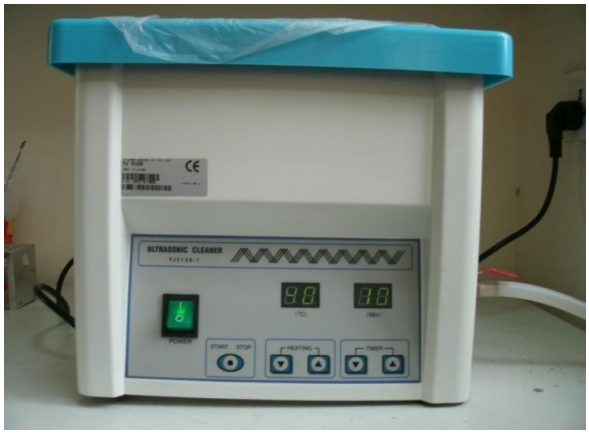


Fig. ultrasonic cleaner

Guar gum and sodium chloride responses were created through simply combining turmeric with liquid, whereas haldi mixture required additional filtering by create a clean remedies devoid of insoluble contaminants.

Figure 3.4 shows a magnetic stirrer and a heated plate.

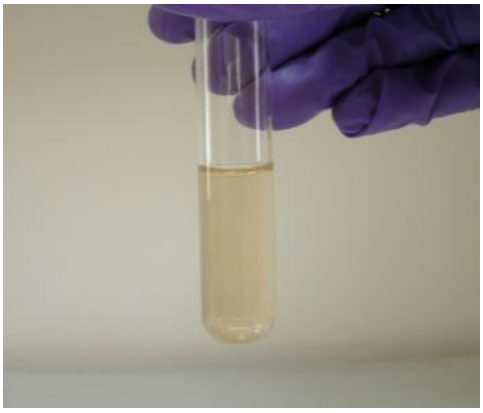
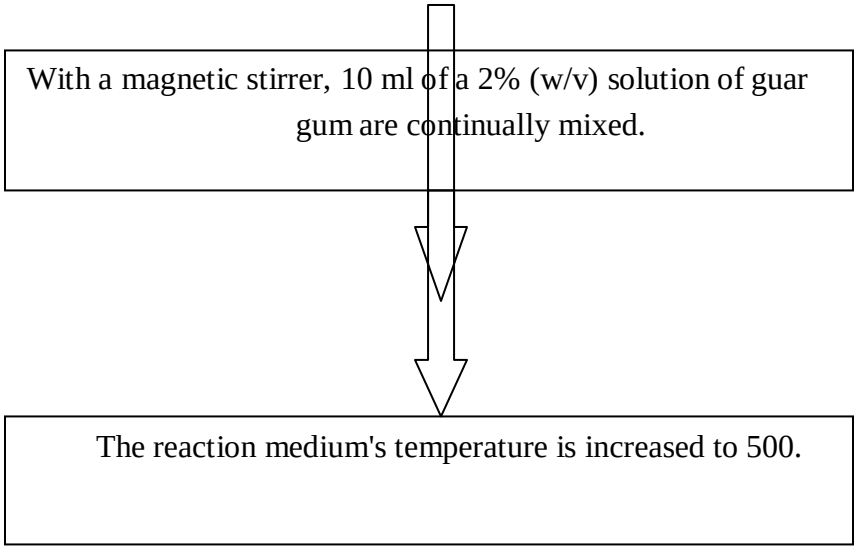
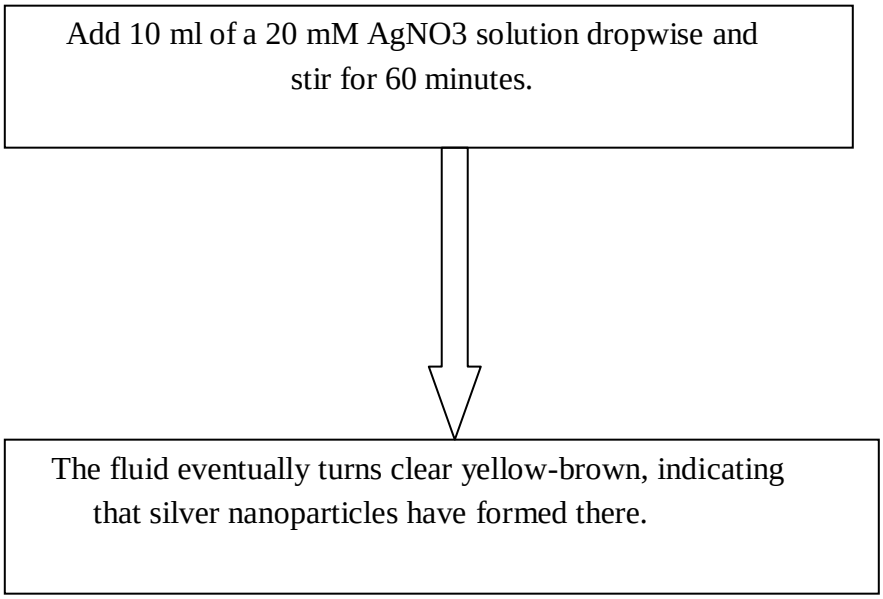


Fig 3.5 shows dissolved silver nanoparticles

.

3.2.2 A Flowchart for the Experiment




Add 10 ml of a 20 mM AgNO3 solution dropwise and stir for 60 minutes.
The fluid eventually turns clear yellow-brown, indicating that silver nanoparticles have formed there.

2.6 Characterization techniques and sample preparation

Nanomaterials' description was just as crucial at that creation. Nanoscience imaging includes both the generation of the image and its in-depth comprehension and analysis. There are numerous ways to photograph nanostructured objects as describe both their physical and chemical characteristics. Description methods could generally be divided into the following major categories:

- Imaging methods using microscopic scales.
- Techniques for spectroscopic investigation of chemical and physical characteristics.

The characterisation methods used in this experiment to assess the properties of synthesised silver nanocomposite materials are listed below. Additionally, the procedures for sample preparation are discussed, noting that various approaches call for variously specimen.

3.3.1. UV-Vis-NIR spectroscopy

For the past 35 years, researchers have used ultraviolet and visible spectroscopes to characterise materials. A beam of radiation can either be consumed, distributed, dispersed,expressed , and may generate light when hits an object. It is possible to think of scattering as the radiation being first absorbed and then practically instantly entirely reemitted uniformly in all directions, but else being unchanged. When a molecule exhibits light, a sunlight needs to be taken or heated it to a higher energetic state. A atom re-emits a photon to return to its initial intermediate energy level. Absorption and transmission are the processes that are involved in absorption spectrometry. The conditions under which the sample is analysed are often selected for minimise refraction, disperse, and light.

It is typically discovered that a solid sample's substance is inappropriate for direct spectrometry because it is in an improper state. Because of the high refractive index of the substance, a significant amount of energy can be avoided due to spontaneous absorption and dispersion on the outside and near the bulk. It is difficult to remove they are frequently dissolved the sample near the clear solution,unless the sample can be quickly converted into a homogenous polished block or film.

A cuvette is a clear receptacle used to hold liquids that can be made of silica, glass, or plastic. To minimise scatter and reflection losses, these cells' radiation-passing faces have been thoroughly polished.We have used a Perkin Elmer lambda 750 spectrometer to record the absorption spectra of silver samples.

Fig 3.6 UV Vis spectroscopy

Creation of Samples

Since the samples we got were liquids and displayed a high degree of viscosity, a 1:10 solution of the data made using purified water as the sound. Ultrasonication was done on spectrum samples prior to recording. The absorption spectrum was measured at 1 nm intervals between 250 and 700 nm.

3.3.2 Scanning electron microscope (SEM)

Almost every material's surface can be imaged using the effective and well-liked scanning electron microscopy (SEM) technology, which has a resolution of just 1 nm. In order to generated a variety of bands near the outermost layer of , the scanned particle microscope (SEM) a high-energy electron beam. It makes use of the primary particles and returned particles released between various parts of the specimen along with the paths that travel with respect with the position of the detection. Information about the sample's size, shape, and exterior morphology (texture) can be learned from the signals produced by electron sample contacts. A Scanning Electron Microscope can also access do evaluations evaluate particular specific positions within the material, the technique is very helpful in qualitative research.

Using a scanning electron microscope (Hitachi s-3700N), the surface morphology of the material is investigated.

3.3.3 Energetic dispersive analysis of X-rays (EDAX)

To examine the chemical elements of a material under SEM, EDAX is an extensively utilised technology. When an electron beam interacts with a material, it emits X-rays that can be detected using this technique. The distribution of the various chemical components that make up the specimen can be mapped. The amount of each detected element present in each individual particle is calculated from the X-ray data. Data analysis is then performed using both the compositional andmorphological

and The SEM was equipped with EDAX apparatus, and the same samples were examined for energy dispersive analysis.

3.3.2 Atomic force microscopy (AFM)

AFM works on the fundamental tenet that it monitors interaction forces (attractive or repulsive) between the probe tip and the sample surface. At the tip of a flexible cantilever is a probe. A cantilever is used to scan the surface, and variations are recorded as the deflection of a laser beam as it hits the cantilever's reflecting back and is picked up by an optical detector. Cantilever deflection is continuously monitored while the probe is continuously pushed across the surface. In order to maintain atomic force constant, a feedback loop modifies the height of the probe on the sample surface; this vertical movement of the tip is then recorded to produce a topographic image of the sample surface.
Park Systems XE-100 and spin-coated films of the sample on glass substrates were utilised to obtain a 3D image of the sample.

3.3.4 Fourier transform infrared spectroscopy (FTIR)

A best method for determining whether substances are organic or inorganic is called FTIR (Fourier Transform Infrared), sometimes known as FTIR analysis. It is applicable to the study of gases, liquids, and solids. The visible light of the origin are simultaneously detected during the scan time of an FTIR spectroscopy experiment, which is a multiplexing approach. This method collects all the data and transforms to the structure of a wavelength.

The thermal absorbance band can be used to determine a material's molecular structure, chemical bonds, or functional groups, whether they are in an organic or inorganic molecule. Most pure compounds exhibit spectra from FTIR that are differently distinctive approach chemical "fingerprint." At specific frequencies, links and pairs of bonding move. While an atom gets subjected the infrared beams, the substance takes the infrared bonds at rates that are specific to that molecule, frequencies where the infrared light impacts a polar in nature. Accordingly, homopolar diatomic (H2, N2, O2, etc.) and monatomic (He, Ne, Ar, etc.) molecules do not absorb infrared light. The specimen is exposed to a modulated IR beam at a specific location during FTIR examination. The IR absorption plot, which consists of reverse peaks, is derived from the specimen's transmittance and reflectance of infrared light at various frequencies. Following analysis and comparison with recognised signatures of specified a substance in the FTIR library, the generated FTIR spectral pattern is used to create a report.FTIR spectra are typically split into two sections for analytical purposes.

1. A functional group area between 4000 and 1450 cm-1
2. A portion of the fingerprint that stretches between 1450 cm-1 to 400 cm-1

3.3.5 X-ray diffractive Index (XRD)

A flexible, non-destructive analysis technique called X-ray diffraction (XRD) can be gathered to identified and quantified a many crystalline forms, or "phases," of chemicals that are present in liquid and solid materials. An XRD pattern or diffractogram is the output of an XRD measurement. The pattern can be used to determine the following information.

- Phases are evident relative to peak positions
- Peak height phase concentrations
- Bumpy background with amorphous content
- Peak width measurements of crystallite size

None crystalline is flawless because it has a finite dimension because it perfect crystal might be infinite every sense to infinity. The diffraction peaks broaden as a result of this departure from complete crystallinity. This kind of broadening, however, is little above a certain size (100-500nm). The possibility tiny crystallite size might result in lining lengthening was discovered for a first time by Scherrer in 1918. He created an equation known as the Debye-Scherrer ormula, which is presented by

$$D = \frac{k\lambda}{\beta \cos \theta} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

Where

D typical clarity sized

The wavelength of the radiation employed is

represented by the constant k, whose value ranges from

0.89 to 1.

For a specific peak position, is equal to full breadth at half maxima in radians.

3. CONCLUSIONS AND OUTCOMES

3.1 UV Visible Range

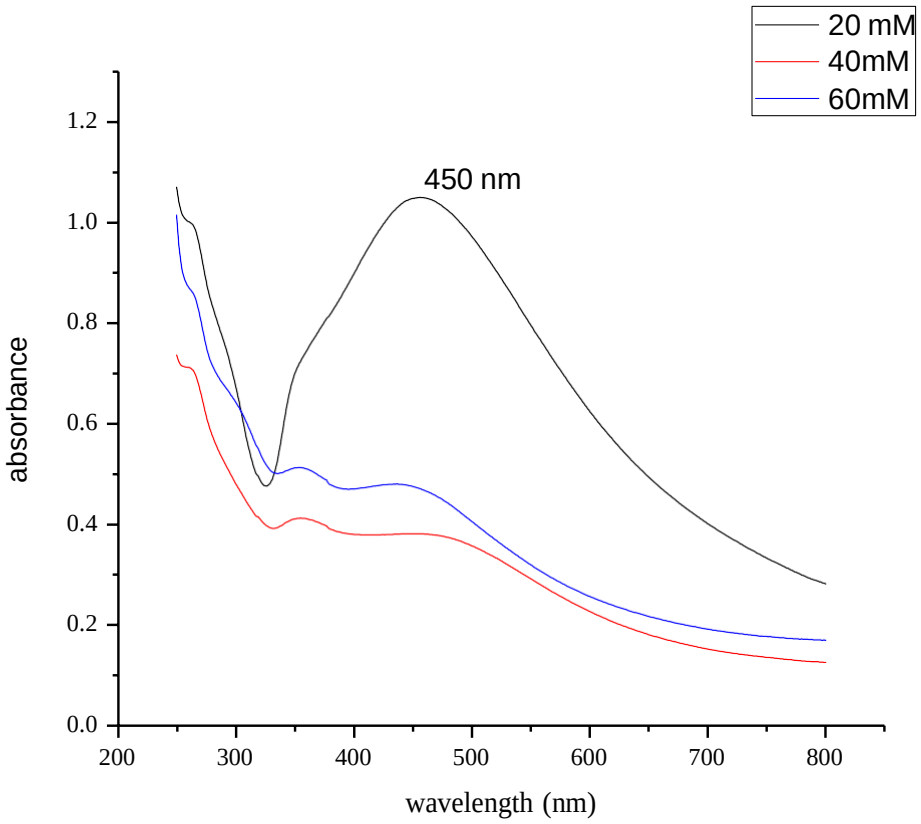
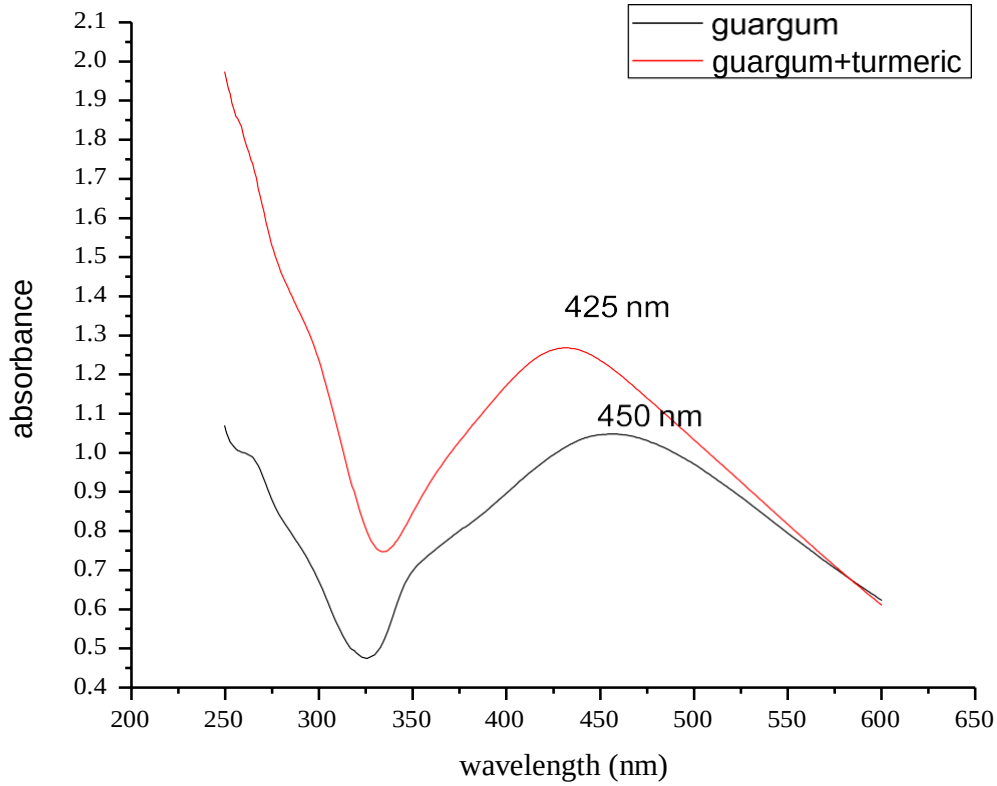


Fig. shows the absorption spectra of samples of guar gum.

For a 20 mM sample, the absorption spectra has a clear peak at 450 nm. Double peaks form as AgNO3 concentration is increased further. AgNO3 is present in the sample but has not been decreased, as evidenced on a appearance of the second appears at about 320 nm, was caused by insufficient guar gum concentration. Pure AgNO3 solution exhibits an absorption peak at 310 nm.


guargum
guargum+turmeric
425 nm
450 nm
absorbance
wavelength (nm)
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
200
250
300
350
400
450
500
550
600
650

While mustard is used as a reducer, the range of colours shifts bluish. A approximate optical band gap value is calculated from the max cut off value.

max = 664 nm for the guar gum sample

1.86 eV is the optical band gap energy value.

Max = 649 nm for the guargum+turmeric sample.

1.91 eV is the optical band gap energy value.

3.2 X- ray differactogram (XRD)

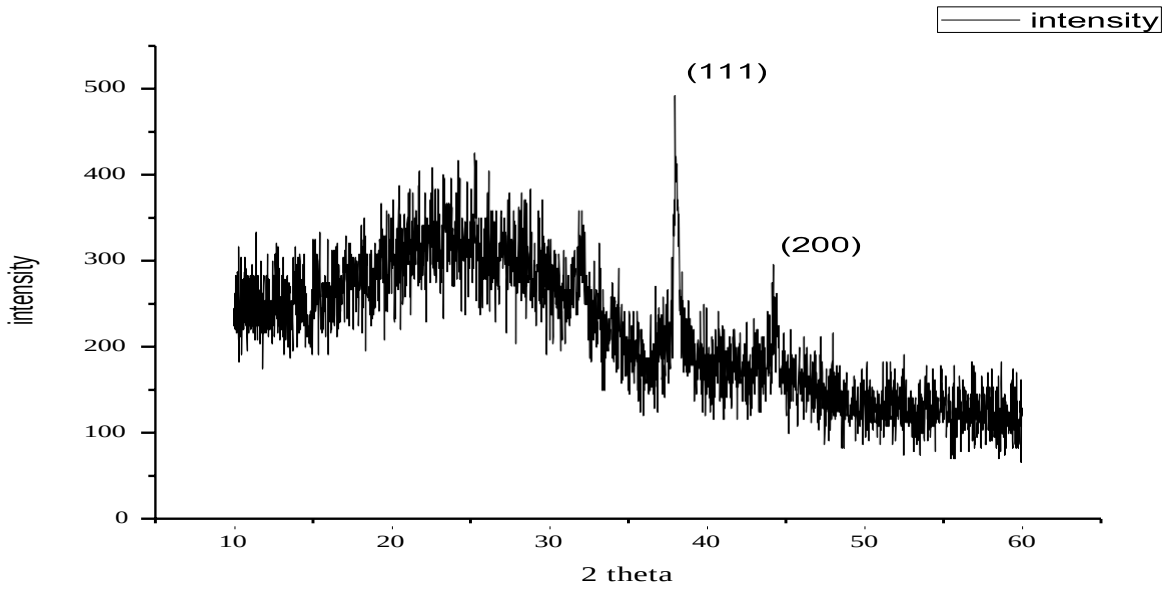


Fig . X ray diffraction pattern of guar gum sample

Plotted here is the guargum sample's UV-ray diffraction structure. The occurrence of peaks at 38.070 and 44.210, which match to the planes (111) and (200) in the JCPDS files, indicates the existence of the elemental silver's face-centered cubic phase.

Crystallite size corresponding to the first peak is calculated as 2.43 A0 using Sherrer's method and the values of k = 0.9 and = 1.54 A0. Utilizing the following equation, further calculate the lattice parameter.

$$a = d * (h^2 + k^2 + l^2)^{1/2} \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$

results in 4.20 A0, which is reasonably close to 4.08 A0.

5. AIMS AND IMPACT OF RESEARCH WORK

Finally, we developed tiny materials of silver and the guar gum nanoparticles (Ag/GG nanocomposites) via coated dip or coated spin.

To ascertain the chemical and physical features of the samples, sample characterization carried out. The band gap energy can be roughly inferred from the UV-VIS spectra, which offers information about the absorption peak and semiconducting characteristics. To find out how these films conduct electricity and how that may be used in semiconductor devices and sensing ,more research can be done.

6. REFERENCES

1. Kingon, A. I.; Maria, J.-P.; Streiffer, S. K. Nature 2000, 406, 1032–1038.

2. Cohen-Tannoudji, C.; Diu, B.; Laloe, F. Quantum Mechanics; 1st edn.; John Wiley & Sons: New York, 1997.

3. Atkins, P. W. Physical Chemistry; 3rd edn.; Oxford University Press: Oxford, 1986.

4. M.C. Lea, "*On Allotropic Forms of Silver*", American Journal of Science, 37 (1889) 476.

5. Bernd Nowack, Harald F. Krug, and Murray Height, "*120 Years of Nanosilver History: Implications for Policy Makers"* environmental science and engineering.

6. M Ramya, M.S.S., "*Green Synthesis of Silver Nanoparticles*". Int. J. Pharm. Med. & Bio. Sc., 2012.

7. Steven J. Oldenburg, "*Silver Nanoparticles: Properties and Applications*" sigma alderich material science nanomaterials.

8. Lubick, N. Environ. Sci. Technol., 2008, 42 (23), p 8617

9. R. Janardhanan, M. Karuppaiah, N. Hebalkar, T.Narsinga, *Polyhedron*, **2009**, 28, 2522.

10. Amany A. El-Kheshen and Sanaa F. Gad El-Rab, "*Effect of reducing and protecting agents on size of silver nanoparticles and their anti-bacterial activity*" Der Pharma Chemica, 2012, 4 (1):53-65

11. RO, B., *"Silver ions in the treatment of local infections."*. Met Based Drugs, 1999. **6**: p. 297-300.

12. Klaus T, J.R., Olsson E, Granqvist C-G, *"Silverbased crystalline nanoparticles, microbially fabricated."*. Proc Natl Acad Sci USA, 1999. **96**: p. 13611-13614

13. Haoyan Wei, Hergen Eilers, "*Electrical Conductivity of Thin-Film Composites Containing Silver Nanoparticles Embedded in a Dielectric Teflon® AF Matrix"*

14. Quang Huy Tran1, Van Quy Nguyen2 and Anh-Tuan, "*Silver nanoparticles: synthesis, properties, toxicology, applications and perspective"s*

15. T. Ivanova a,⇑, A. Harizanova a, T. Koutzarova b, B. Vertruyen c, *"Optical and structural characterization of TiO2 films doped with silerv nanoparticles obtained by sol–gel method"*

16. S Elumalai and R Devika " *bio synthesis of silvernanoparticles using curcuma longa*"

17. Jha, A., Prasad, K, Prasad, K, Kulkarni, AR, *"Plant system: nature's nanofactory"*. Colloids Surf. B Biointerfaces, 2009. **73**: p. 219-223.

18. Parasharu K, S.a.S.A., *"Bioinspired Synthesis of Silver Nanoparticles".* Digest Journal of Nanomaterials and Biostructures, 2009. **4**: p. 159-166.

19. Iravani, S., *"Green synthesis of metal nanoparticles using plants"*. Green Chem, 2011. **13**: p. 2638-2650.

20. Ankamwar, B.D., C.; Ahmad, A. & Sastry, M., *"Biosynthesis of gold and silver nanoparticles using Emblica officinalis fruit extract, their phase transfer and transmetallation in an organic solution"*. J Nanosci Nanotechnol, 2005. **5**: p. 1665-1671.

21. Pandey, S., Goswami, G.K. & Nanda, K.K. *"Nanocomposite based flexible ultrasensitive resistive gas sensor for chemical reactions studies*." Sci. Rep. 3, 2082;DOI:10.1038/srep02082 (2013)

22. . Pandey, S., Goswami, G. K. & Nanda, K. K " *Green synthesis of biopolymer-silver nanoparticle nanocomposite": an optical sensor for ammonia detection*. Int. J. Bio. Macromolecules 51, 583–589 (2012).

23. Nelson D, P.D., Oswaldo LA, Gabriel IHDS, Elisa E., *"Mechanical aspects of biosynthesis of silver nanoparticles by several Fusarium oxysporum strains."*. Journal of Nanobiotechnology, 2005. **3**: p. 8.

24. Mohanpuria, P., Rana, KN, Yadav, SK, *"Biosynthesis of nanoparticles: technological concepts and future applications"*. J. Nanopart. Res., 2008. **10**: p. 507-517.

25. Jha, A., Prasad, K, Prasad, K, Kulkarni, AR, *"Plant system: nature's nanofactory"*. Colloids Surf. B Biointerfaces, 2009. **73**: p. 219-223

26. . Krishna Balantrapu, Meaghan McMurran, Dr. Dan V. Goia "*Inkjet Printing of Silver Nanoparticles for Electronic Applications"* Center for Advanced Materials Processing, Potsdam, NY 13699-5814.