International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-3, January 2020

Green Synthesis Method for Applying a Vitex Negundo Leaf Extract with Characterization of Silver Thin Films Organized Through Spray Pyrolysis

K.Ramya, S.Ravi, G.Suresh

Abstract: ***This method of synthesis is an expensive and appropriate application for the statement of a thin film going on uneven surfaces. Into the green synthesis approach for the first time, a bulk portion of a thin silver film is reported. The film of silver nanostructures deposited the use of a solution of silver nitrate with the extract of Vitex negundo leaves. The study confirmed that the response time fulfills an essential function in the rise and manipulation of the shape and size of the thin silver thin films. The property of the silver film is study as a result of UV-Vis spectroscopy, Field Emission Scanning Electron Microscopy [FE-SEM] with Energy Dispersive X-Ray Spectroscopy [EDX], X-Ray Diffraction [XRD], and Atomic Force Microscopy [AFM], Photo-Luminescence Techniques [PL]. Finally, in this application, working with films may be that these films are used adequately for antibacterial studies.***

I. INTRODUCTION

Into latest year's Nobel metal nanoparticles have been scientifically focused because of their particular numerical, magnetic, and chemical properties that can be radically separated in material [1, 2] and It can exist credited to their size with the huge particular plane placement. Metal nanoparticles enclose been used inside several applications in specific field [3].electronic, remediation [4-5]. Today, many types of metallic nanoparticles, as well as silver, and copper enclose be synthesize effectively used for a variety of expected application, including pollution also analysis, vitamins [6- 10]. A sort of methods have suggested for synthesis of Ag film consisting of Spray pyrolysis [11]. Therefore, the derivatives are expected and clear as proof that an imposing metal is fatally fatigued. To understand our knowledge of Ag thin film deposition, we are designing a simple path to extraction. Recently, some organizations have value in the synthesis of a thin film of silver and leaf extracts from vegetation, used as reducing agents. Of these, Vitex negundo leaf extract is an apparent drop inside the synthesis of thin silver film [12]. The presence of excessive amounts of *Vitex negundo* leaf extract is calculated to form thin silver films.

Revised Manuscript Received on January 30, 2020.
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The extracts are advantageous for the negotiation of thin films of (Ag +) to silver ; produces a precipitate. Therefore, the sheet is the comfortable part of the *Vitex negundo* leaf used for silver thin film reduction [13].

For large-space software, it may be desirable to define a technique for synthesizing thin layers of silver on supporting substrate. Thin-film is a solid tool that has a dimensional periodicity.

In large areas, thin layers can be achieved using physical and chemical strategies. Synthesized thin silver films for the application of the chemical reduction method using lowering agents [14]. Synthesized thin films of silver with the resource of the spray coating technique, where the gel is modified by organized using isopropyl alcohol [15].

Silver solution has been termed valuable antimicrobial agents for centuries, which can be attributed toward a spectrum of antibacterial activity since glowing since small cell-like toxicities [16].

Uses of *Vitex negundo* leaf:

Vitex negundo is a medicinal leaf, use in support of treat stored Garlic next to pest also as a cough therapy in the Philippines. It is besides use to control mosquitoes. In Malaysia, it is used in conventional herbal remedy for women's health, as well as treatments for variable the menstrual cycle, fibrocystic breast disease and post-partum remedy.

In this study, the green synthesis route is non-toxic; thin film using the spray pyrolysis method. It targets different concentrations of thin films of silver that accumulate in the glass plates. The effects of this film concentration on the structural, morphological, etc.finally; to supplement the quantity of growth inhibition is used to measure the antibacterial activity of the films.

II. EXPERIMENTAL METHODS

2.1 Collection of chemical and plant material: All reagents were purchased in systematic status with use promote cleansing. Silver nitrate ($AgNO_3$) is purchase since Sigma-Aldrich, purity ≥ 99.5%. Glassware also purchases as of the Pondicherry Scientific company. Fresh leaves of *Vitex Negundo* are collect in the surroundings of Annamalai Nagar Botanical Garden, Chidambaram, Cuddalore District, Tamil Nadu, and India. Distilled water was used to prepare aqueous solutions throughout the experiments.

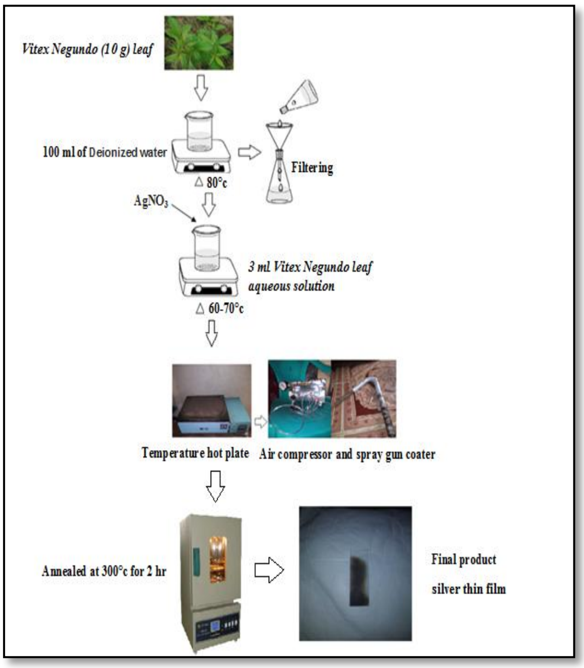
Plant Scientific Name: *Vitex negundo*, **family name**: Lamiaceae, **English name**: five leaved chaste.

2.2 For the preparations of leaf extract: New leaves had been washing sometimes by tap water. Then, the leaves are washed again with distilled water, 10 g of *Vitex Negundo* leaves are cut in small portions. The chops leaves are boil into 100 ml of distilled stream used meant for 30 minutes. The leaf extract is in that case cooled and filtered on filter piece (Whatman # 1). The filtered extract green, pale yellow color was stored in culture tube. This extract changed into used as stabilizing agent for nanoparticles synthesis.

2.3. Preparation of silver thin films: Concentrations of 0.025, 0.05, 0.075 and 0.1 M silver nitrate ($AgNO_3$) use as the precursor solution. It be dissolve inside 50 ml of distilled stream and the stirrer be agglomerated for 10 minutes, taken in a beaker; and 5 ml of *V. Negundo* leaf extort be separately extra, room temperature. After 15 minutes, the solution turned yellow to reddish indicating silver formation. Pro the synthesis of primarily base thin film, the microscopic glass slides the first step nitric acid is poured in the beaker to clean the glass plate for immersed in 12 hours. Glass plates take pot handler used. The glass slides were dried 3 toward 4 portions of glass slide had been saved a warm platter at a 100°C for Spray coated of thin film. Pressure of inlet transporter gas is set on a size of 2 bars. The solution was poured into the spray gun culture. The statement silver delicate film occurred on the glass substrate. The substrates fixed with the dim darker shaded film have been dispensed with, flushed and dried in air. The spray coating conditions had been saved same for all the statement of silver thin films. After cooling, samples be taken and kept in a muffle furnace for 2 hours at 300^0C temperature. Calculations Temperature is one of the most critical parameters within the Green synthesis technique are usually in the matrix of some organic like citric acid or so, but calcine it the particles get assembled the desired particle size. Higher the temperature more the thermal energy gets assembled and results in bigger size. One can obtain smaller size particles at low temperature about 300°C of calcinations temperature fixed. As I increase the calcinations temp particle size will be larger and larger.**Microscopic Glass plate range -** 75 mm.Long×25 mm.wide
Thickness - 1.30 mm

Table 1 Optimum parameter statement of silver thin films

PARAMETER STATEMENT	RATE
Glass temperature	100°c
Height of spraying nozzle	20 cm
Spray rate	5 ml
Spray time	5 minute
Time connecting spray	30 Seconds
Carrier gas	Compressed air of 1 bar



Flowchart for the preparation of a thin silver film

2.5 characterization technique

The crystalline form of their silver thin film be diagnosed as a result of X-ray diffraction evaluation use thin-film samples since the measurement program, the thin film (radiation = 1.5406 Å). Morphology of the Earth is using a scanning electron microscope. Appearance of optical assimilation be obtained a wavelength variety of 200 to 800 mm use a spectrophotometer UV, SHIMADZU, the glass substrate offers a kind of perspective. Topographic views of glass assemblies are record using a contact mode with a center weight (INNOVA-1B3BE).

III. RESULTS AND DISCUSSION

3.1 Structural study

X-Ray Diffraction pattern, silver thin films for 4 concentrations (0.025, 0.05, 0.075 and 0.1 M) is shown in Fig. 1. The overall variability of XRD since the lower concentrations (0.025 M and 0.05 M) is amorphous. The peak indexed as (111) Face-Centered Cubic (FCC) silver by comparing with **JCPDS** (04-0783) card at a concentration of 0.075 M is an optimum molar concentration [18]. The anatase peaks become weak at a concentration of 0.1 M, which may be due to the reorientation effect [19]. The sizes of the crystallites were calculated by Scherer Equation.

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

Wherever k, 0.9 is the shape, wavelength (1.5404 A^0), β are the Full Width Half Maximum (FWHM) radians, θ be the Bragg position. Calculated average crystallite of the silver thin film be 56 nm for the (111) plane at a concentration of 0.075 M. Thus, the strong differences in XRD diffraction certainly nanocrystalline green synthesized thin silver films or amorphous, are evident in the early literature [20].

Retrieval Number: B7495129219/2020©BEIESP
DOI: 10.35940/ijitee.B7495.019320
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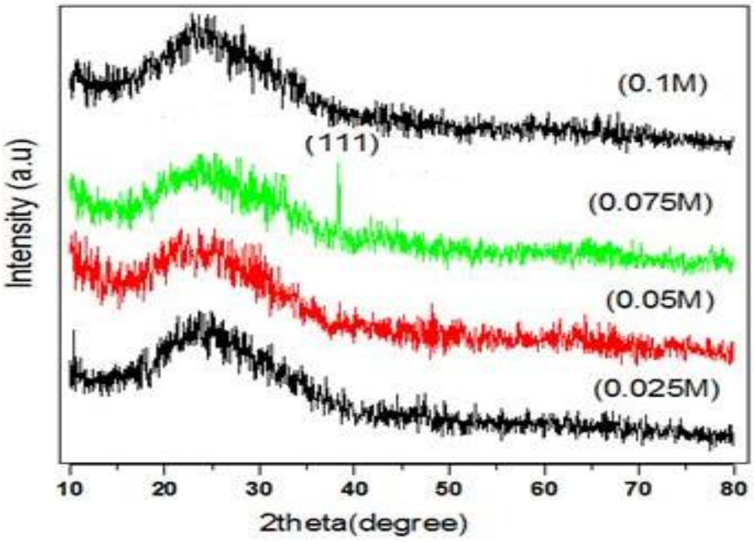

Fig.1. XRD patterns of deposited silver thin films by different concentrations.

3.2 Morphological studies

3.2.1. Surface morphology

Field Emission Scanning Electron Microscopy using light emitted to test the presence of nanoparticles to determine particle size. Morphology of green synthesis silver thin film is viewed by FESEM. First, the formation of the silver thin film was confirmed. There are different 4 concentrations of 0.025, 0.05, 0.075 and 0.1 M. The solution and after deposition over the glass substrate by heating at 100 °C, a film was experimental beneath FESEM. The morphology of the conductive film confirmed the linkage connecting the silver nanoparticles, as shown in Fig.2.At a higher resolution we found a clearer image of the deposited coating and the shape turned into less complicated to interpret. Fig.2 shows FESEM figure of the film at 0.075M inside this case, silver thin films of a spherical Shape were simply visible and the relationship between changes into easy to visualize [21].To discover the exact Size, the changed into in addition superior and the film was observed at 1 μm (Fig.2C). The Particles linked with each other, but the viscosifying Solution became additionally seen. But lower concentration a few particles lost their round identification after agglomeration with other films. Thus, abnormal structures were formed. The diameters of particles were measured to obtain the particle range. Spherical silver thin film by average diameters of 36–94 nm. The glass plate's nearness is protected by evidence point in time [22]. The particle size was obtained exactly using software called **Image J**. Comparative morphology is watched for mass segment silver nanoparticles Synthesis the usage of V. Negundo leaf Extract [23].

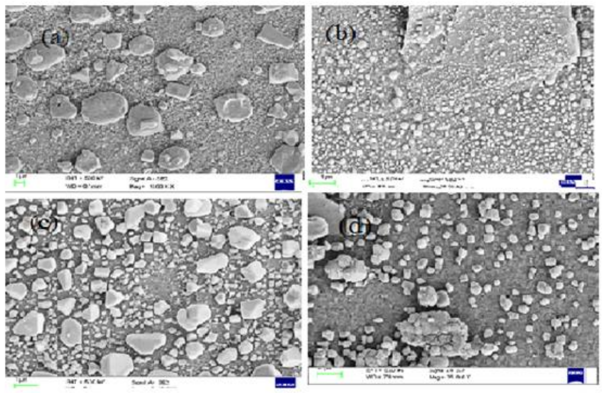

Fig.2. FESEM images of thin films of silver on a glass substrate at different concentrations

3.2.1 Composition analysis.

The synthesized silver thin film has been analyzed by EDX which allows you to show the essential creation of the films. EDX study of an agent sample deposit at 0.075 M suggests the attendance of Ag with O element close near of the silver composite film. From a compositional point of view, we observed that the silver peaks were correctly recognized and that the carbon signal in the EDX spectrum is derived since carbon observations.EDX visual height combination band in range of 2 to 4 KeV is regular for the interest a thin film of silver. The presence of C, S in the EDX spectra is the result of the instant coating on the glass plate of FIG. 3; the spectrum shows the presence and agrees that the money is correctly identified [24].

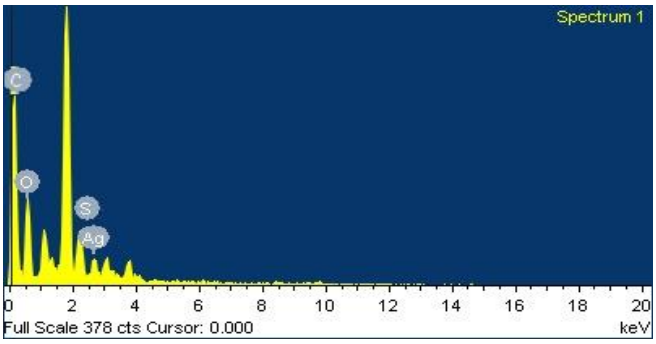

Fig.3.EDX spectrum of silver thin film at 0.075 M concentration

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3.3 AFM studies

AFM images measurements are made toward study their morphological possessions silver thin films deposited at different molar concentrations. Figures show that AFM images of the Ag film with a scanning area of 5µm ×5 µm for the 0.025, 0.05, 0.075 and 0.1 M concentrations. The particles are randomly oriented and have different grain sizes. Average surface roughness (*R*a), height and particle sizes of the deposits were observed in all the films. Presence morphology because an component of Figure. 3 show that development of fixation affects the grain of the scale. The grain presents the circles with a uniform and homogeneous distribution on the ground. During the development of the morality, a progressive irregular dispersion of the grains is superficially dissolved, leading to a higher hardness. Also, it is seen that the waste agglomerate shape, form a purse shape.The size measure from the AFM ground photographs is 15.0 NM, 30.0 NM, 45.6 NM and 60.2 NM for a molecular concentration of 0.25, 0.05, 0.075 and 0.1 M. Respectively. The qualities determined from the XRD information. Where AFM provides data on a micrometer range. Fig. 3 shows the 3D AFM image of Ago thin films, the grains are perpendicular to the ground of the image, indicating that the motion is growing perpendicular to the substrate. Figure.4 shows the general roughness of the surface (RMS). The values vary from 114 NM to 428 NM while the attentions in moles increase as of 0.025 m to 0.1 M. The growth of the surface roughness be due to the grain size [25].

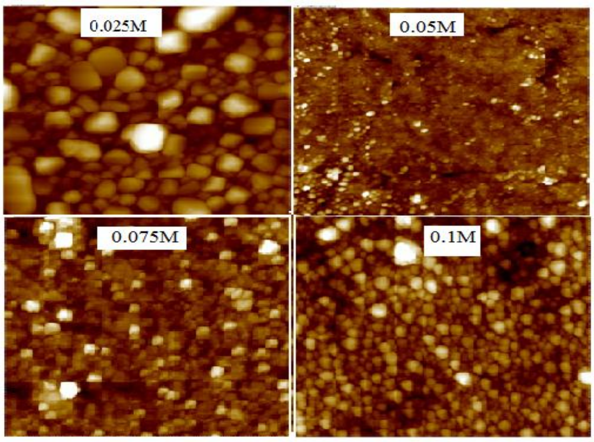

Fig.4 .AFM images of 2D silver thin film at different molar concentrations

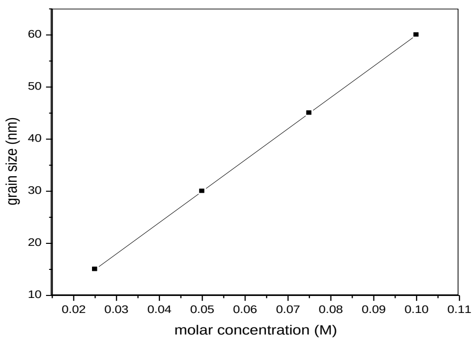

Fig.5. Growth of grain size to molar concentrations

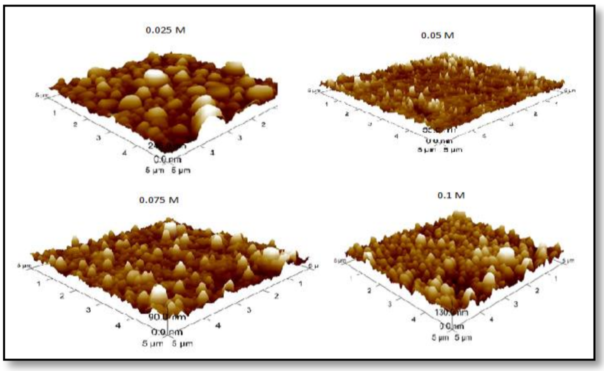

Fig.6. AFM 3D images of thin film of silver at different molar concentrations

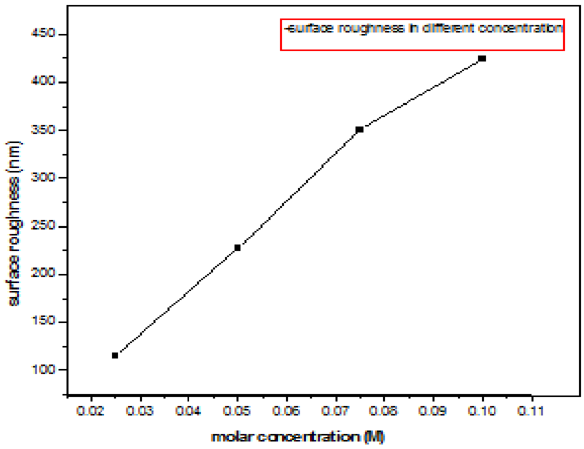

Fig.7. Evolution of Root Mean Square according the molar concentration

3.3. Optical properties

This UV-vis absorption spectrum silver thin film here the variety silver thin film synthesized lying going on a glass plates for a one-to-one concentration is illustrated in FIG. 8. The peak of absorbance at 416 NM (λ max) corresponds to the observance suitable to silver thin film pattern. The peak depth at 416 NM is multiplied by the film concentration. The absorption spectra, the silver thin film confirmed with the purpose of when the character drop of silver through flavones absorption containing Vitex leaf extract stabilized the band (X max) about 416 mm wider and easily moved to the lengthy-wavelength location, indicative of the incidence and composition of round silver-cut thin films through greater than ever awareness. This recording also supports a growing element size of a thin silver film by way of a film focus. The element mass of the silver film be considered since the combination spectra of a thin silver film synthesize next to single concentrations because given away in fig.8. It suggests an excitation inclusion height at 416nm (2.98 EV).

$$\textbf{Band gap energy (e)} = \frac{hc}{\lambda}$$

Where h, is the constant of the boards, c is the speed too low and λ is the wavelength from that, the miles are confirmed that when the focus will increase, the particle size will be reduced, which may well be suitable to blue shear absorbance peak [26]

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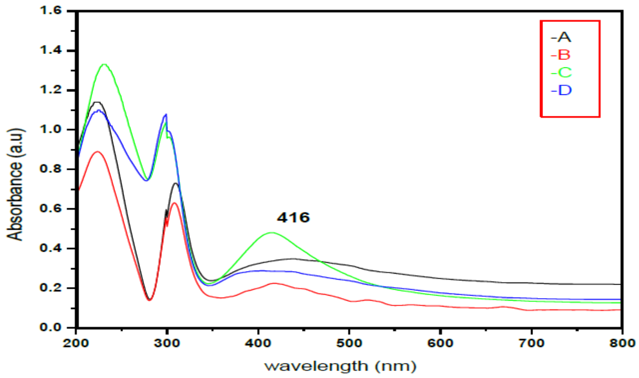

Fig.8.The variation Absorption with a wavelength of thin films of silver on a glass substrate at different concentrations

3.3.1. Optical bandgap

The optical bandgap energy was determined with Tauc model**($\alpha h\nu$) = A ($h\nu$-Eg)^n** Wherever in α be the absorption co-efficient, hν be the photonic energy, A constant for a direct transition, for example, is the optical bandgap, n interval with the purpose of depends the environment of the evolution also have value ½ a pair direct also indirect transition correspondingly. Figure. 9 Suggests a plot of (αhν) 2 in contrast with the photon energy (hν) of the thin silver thin film. The acquired optical bandgap increases beginning 3.65 to 3.74 eV through the enhance of unusual concentrations 0.025, 0.05, 0.075 and 0.1 M., in that order. Standards are a lot elevated than the values the bulkiness rate of anatase and rutile, which is payable near the pattern of nano-size [27, 28]. The difference in band gap cost for a single concentration can be qualified to the morphological alternative and the enhancement of the crystalline section of anatase [29].

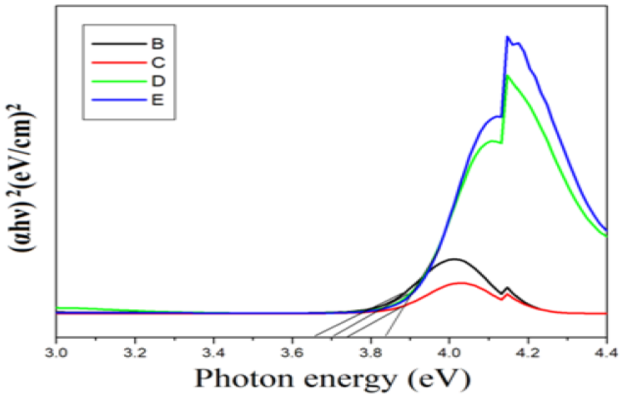

Fig.9. variation of ($\alpha h\nu$)^2 vs hν of silver thin films

3.3.2. Photo Luminescence (PL) spectrum study

The results of the photoluminescence (PL) evaluation of the cultured samples are shown in FIG. 10. There are slight offsets towards a wavelength reduction (blue shifts) decided in the PL spectra. With the growth of concentrations. The variation of the PL spectra with evolutionary concentrations indicates that from localized extended states [30]. PL spectra for thin films of silver to the glass plates. It is see to the peak PL for all special concentrations thin film Ag is considered at 418 nm. The thin film luminescence of thin films of silver has been previously reported and is attributed to electron excitation of the engaged bands in states above the Fermi stage. The successive method of scattering electrons and hollow photons results in a loss of force and finally a luminous radioactive recombination of the image of an electron from a busy hollow cavity [31]. Fig. 10 shows that there can be no change in function (X max = 418 nm) for one-by-one knowledge of the thin silver film, which confirms a stable and continuous deposit of silver thin film.

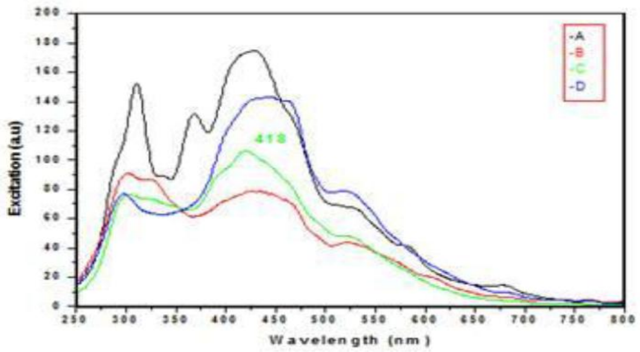

Fig.10. Photoluminescence of thin films of silver synthesized at different concentrations

3.4. Antibacterial activity

The silver thin film antibacterial with a 0.075 M has changed to consider the use of an agar diffusion procedure. The additive agar was poured inside the thin silver film was in the past. Complementary agar diffuse entire plane of the Ag thin film. It was decided that there was an explosion of microorganisms inside the part wherever nearby be Ag film covering and around glass plane. The samples show an efficient antibacterial activity, unlike E. coli and S. aureus. Then, E. coli Lifestyle bacteria spread into the agar plate. It became clear that the silver ion inhibition zones are qualitatively comparable silver thin film inhibition zones.E.coli bacteria's and bigger than those of the thin film inhibition zones. Money in cases of S. aureus. This way that it is difficult to explicate absolutely localized toxicity of the silver thin film suspension and the initial silver [32].Has recommended that the toxicity of thin silver films is specifically due to the oxidative charge and impurity of silver. conversely, it is unclear to what extent the toxicity of the thin silver film sequences the released silver ions with the type of toxic associated with the thin silver film that is about to last. The mechanism of enhancing the inhibition of microorganisms by the thin silver film has been informed that thin films of silver make a way into the cell partitions of batteries, cause degradation within the plasma film, resulting in death bacterial cells [33].

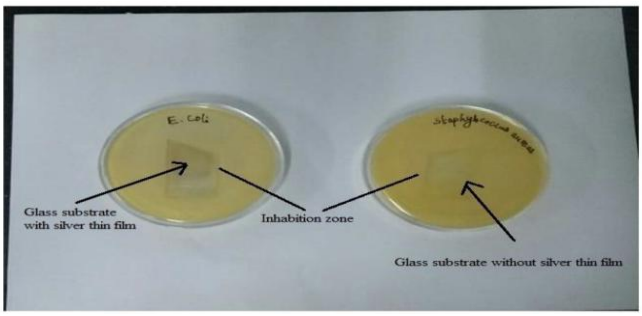

Fig.11. Antibacterial activity against the deposited film at a concentration of 0.075 M

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3.5. Conclusions

The synthesis of a thin silver film by extracting the leaves of *Vitex negundo* because a dipping agent is hasty also uniformly among extraordinary concentrations. A step in the experienced synthesis of a stable silver thin film using Vitex negundo leaf extract at room temperature was changed to once recommend for this work. Thin silver films are effectively biosynthesized thanks to this simple, fast, economical, ecological and ecological approach that excludes external stabilizers or reducing agents.XRD studies confirmed pattern the cubic FCC structure of thin film of Ag.AFM tested noble metal size enlarges with the concentration elevation, and showed that they're on the surface of the film. In addition, the preliminary silver nitrate attention additionally had notable have an impact on the size division of silver thin film. The synthesized silver thin films enclose be characterize near using way of UV-vis absorption spectra, PL, FE-SEM and EDX. The biogenic silver thin film exhibited right antibacterial activities in competition to E. coli and S. Aureus. Further studies at the Ag film bio synthesized the use of *Vitex negundo* leaf extract need to deliver a promising application within the fields of medicine and hygiene.

ACKNOWLEDGMENT

The author is grateful toward the thank University grant Commission in New Delhi, India.

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Blue Eyes Intelligence Engineering
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