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Green Synthesis of Silver Nano Particles using Ageratina Adenophora Leaf Extract

P. Wilson [1], S. Venkateshwari [2]
[1]*Research Scholar,* [2]*Assistant professor, Department of physics, Government Arts College Udhagamandalam, Tamil Nadu , India*

Abstract:** In recent years, the green synthesis of silver nanoparticles using various plant extracts has attracted great attention. This is because these methods are simple, inexpensive, environment benign, nontoxic and large scale up process. Green synthesis method of nanoparticles is evolution from the Nano biotechnology. Development of green nanotechnology is generating interest of researches toward eco-friendly biosynthesis of nanoparticles. In this study, it was observed that silver ions were reduced by Ageratina adenophora leaf extract by refluxing method around 2 hours until leading to the formation of crystalline silver nanoparticles. A.adenophora is known as Crofton weed or sticky snakeroot, Mexican devil, eupatory, eupatorium adenophorum is a synonym. The green synthesized AgNPs were characterized using physical-chemical techniques viz., (UV-Vis) ultraviolet-visible spectroscopy, (XRD) X-ray diffraction, (SEM) scanning electron microscope coupled with (EDX) X-ray energy dispersive spectroscopy and (FTIR) Fourier transform-infrared spectroscopy.

I. INTRODUCTION

Nanotechnology is a rapidly growing and important field of research is the synthesis various nanoparticles, Nanoparticles can be synthesized by various physical, chemical and biological methods [1].Nanoparticles exhibit different color depending upon their size, distribution and morphology [2]. Green nanotechnology gives more effective nanoparticles synthesis with expected products and economical manner [3]. Now- a -days nanoparticles are synthesized using various parts of the plants such as leaf, tuber, bark, buds [4]. Earlier research revealed that silver nanoparticles are highly stable and toxic to bacteria fungus and viruses. Silver is widely used in Nano systems and is used for various biomedical purposes. The most important applications of silver nanoparticles are in biotechnology science and biomedicine [5]. A. adenophora Eupatorium adenophorum, common name: Crofton weed; sticky snakeroot) is a weed plant widely found in the hilly region of the Nilgiris District, Tamil Nadu, India [6]. The leaf juice of A. adenophora is used to stop bleeding of cut wounds, and forming clots [7]. In the present study the leaf of A. Adenophora is used to prepare silver Nano particles.

II. MATERIALS AND METHODS

A. *Scientific Classification*

Fig. 1 Picture of Ageratina adenophora leaves[6]

1) Kingdom : Plantae
2) Clade : Angiosperms
3) Order : Asterids
4) Family : Asteraceae
5) Genus : Ageratina
6) Species : Ageratina adenophora

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B. Plant extract preparation

The fresh leaves of A. adenophora were collected from Government Arts College Campus Ooty.The Nilgiri's District, Tamil Nadu (fig.1).The collected fresh leaves were washed several times with distilled water until the dust particles are removed [8]. The leaves of A.adenophora were measured around 40 gram and cut into small pieces then it was taken in 500ml of round bottom flask. A mixture the leaf along with 400ml of distilled water was made to reflux (fig.2) around 2 hours until extract color changes to pale yellow [9] (fig.3). The extract was collected and filtered using Whats Mann No.1 filter paper. After filtering the extract was stored in room temperature for further process.[10]

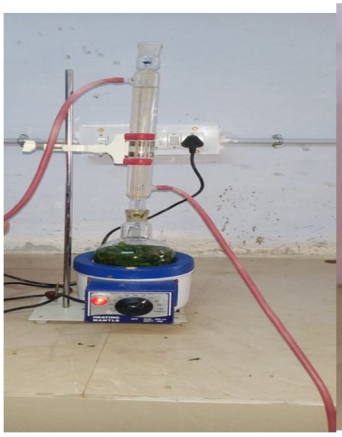


Fig.2 Refluxing method

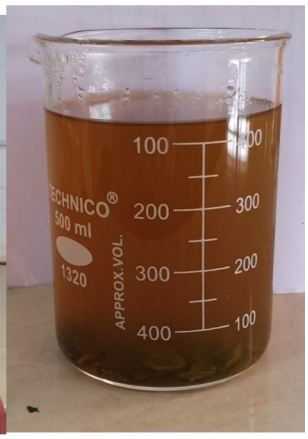
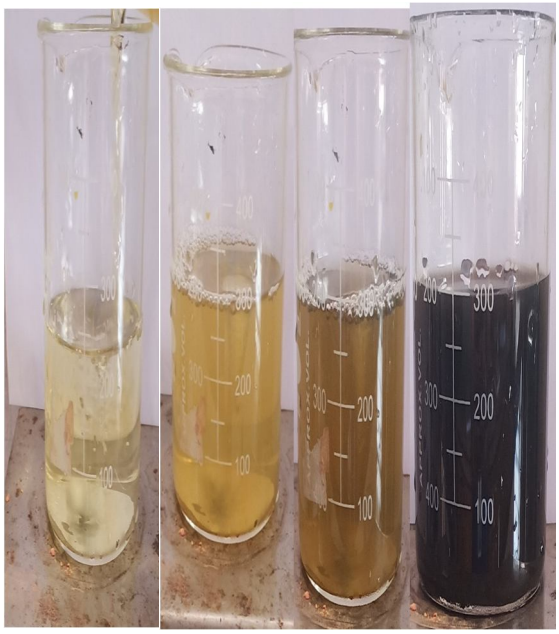


Figure.3 Leaf extract



(a) (b) (c) (d)

Fig5. Change in color of the leaf extract(a) $AgNo_3$ (b)freshly prepared extract (c)after added $AgNo_3$ (d)after 20 minutes

Fig.6. Collected silvernanoparticles in perti dish glass plate

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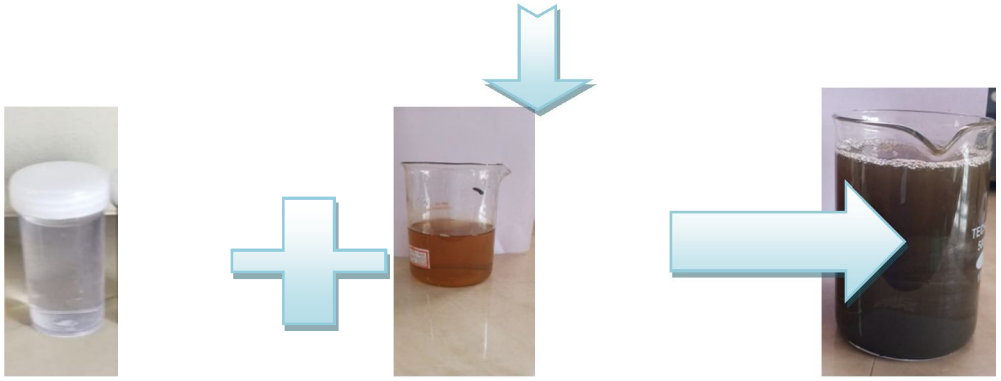
C. Green Synthesis Of Silver Nanoparticles

Silver nitrate ($AgNO_3$) was purchased from Spectrum Reagents and Chemical Pvt.Ltd Edayar, Cochin, India. 100ml of A. adenophora leaf extract and 200ml of 0.01mM solution was added. The mixture was stirred around 20-30 minutes until the color changed from pale yellow to dark brown[11] (Fig.5)and was allowed to rest to precipitate. Then the precipitate was washed with distilled water twice to remove soluble impurities and was collected and centrifuged around 1000 rpm for about 30 minutes . The obtained precipitate was taken into petri dish glass plate (Fig.6) and it was shade dried until the moisture was removed. The change in color indicates the particle size reduction. The powder samples were then collected for further characterization techniques.

Ageratina adenophora leaves



Silver nitrate solution leaf extracts silver nanoparticles

Fig.7. Schematic synthesis procedure of green synthesized silver nanoparticles

Silver nitrate was purchase from spectrum reagents and chemical pvt.ltd Edayar cochin India. All the characterization studies were done from SAIF cochin. Spectra were recorded with UV Vis NIR spectro photometer agilent cary 5000 in the region 200 nm to 3000 nm DRS(diffuse intergrating sphere diameter 150mm angle of incidence 8^0).The X-Ray Diffraction(XRD) measurement was performed on X-ray diffractometer(Bruker D8 Advance) operated at 30 Kv and 100 MA and spectrum was recorder by cukα radition with wave length of 1.506 A^0 in the range 200-800nm.The surface morphology and size were characterized by Scanning Electron Microscope (SEM)(Joel 6390LA)and Energy Dispersive X-ray (EDX) ON oxford XMX N operated at 0.5 kV to 30 kV at magnification 300000 and EDAX resolution at 136 Ev and FTIR analysis was using Thermo Nicolet Avtar)370 range between 4000cm^{-1} to400cm^{-1}

III. RESULTS AND DISCUSSION

A. Xrd Analysis Result

The *XRD* analysis was carried out to determine the known phase of the silver nanoparticles. XRD pattern of the dried synthesized $AgNP_S$ Nano particles prepared by A.adenophora leaf extract is shown in the fig (4).

$$T = K\lambda / \beta\cos\theta \text{ nm}$$

The above given is the scherrer formula[14] .Where T – is the mean size of the ordered crystalline domains –is a dimensionless shape factor, with a value also to unity. The shape factor has a typical value of about 0.9 λ –is the X-ray wavelengthβ –is the line broadening at half the maximum intensity (FWHM)θ –is the Bragg angle. The spectrum exhibited distinct separate maximum peaks at 2θ= 37.970^0[1] and 44.135^0[1], 46.083^0, 57.318^0, 64.286^0 [14], 67.316^0, 77.184^0 that could be indexed to (111) [16]. (200), (200), (222), (220), (112), (311)[1] planes respectively.

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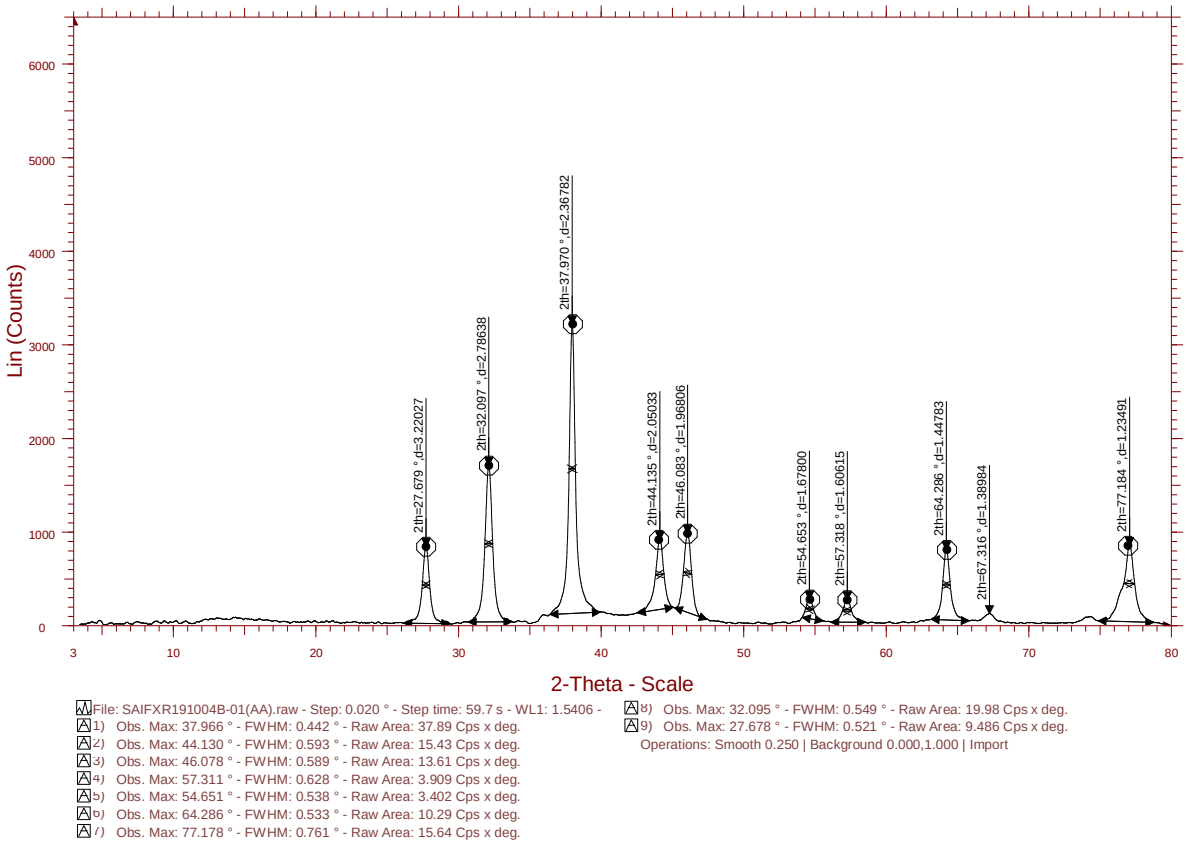
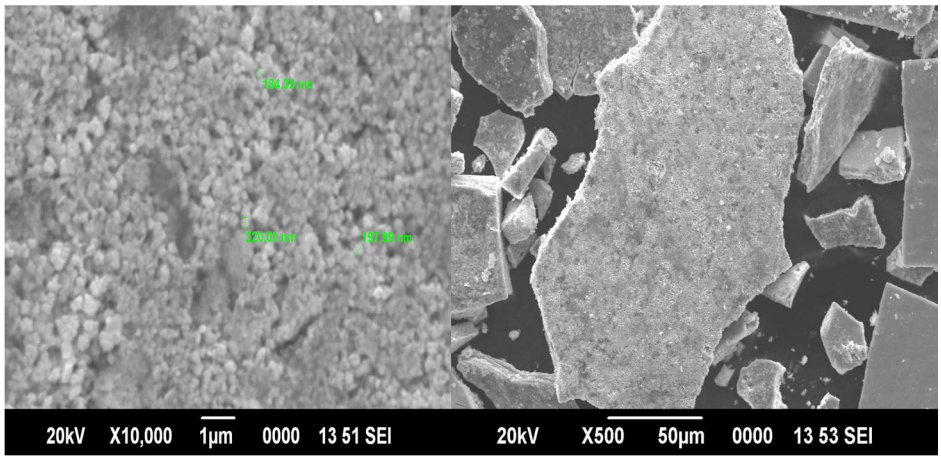
AA



(Fig 8) XRD pattern of greensynthesized silver nanoparticles

The peaks corresponding to (111) plane is more in dense than other planes suggesting it as a predominant orientation .Full Width at Half Maximum (FWHM) data was used with Scherrer's formula to determine the average particle size. The average particles size was estimated as 14 nm [8].

B. Sem Analysis Result



(a) (b)

Fig(9) SEM analysis of (a) silver nanoparticles in 1µm and (b) silver nanoparticles in 50µm

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Fig.9 (a) Show SEM images recorded for silver nanoparticles synthesized with A.adenophora leaf extract. The silver nanoparticles formed were predominatly plate surface shape Fig9(b). It is known that the shape of metal nanoparticles considerably change their optical and electronic properties [19].

C. EDX Analysis Result

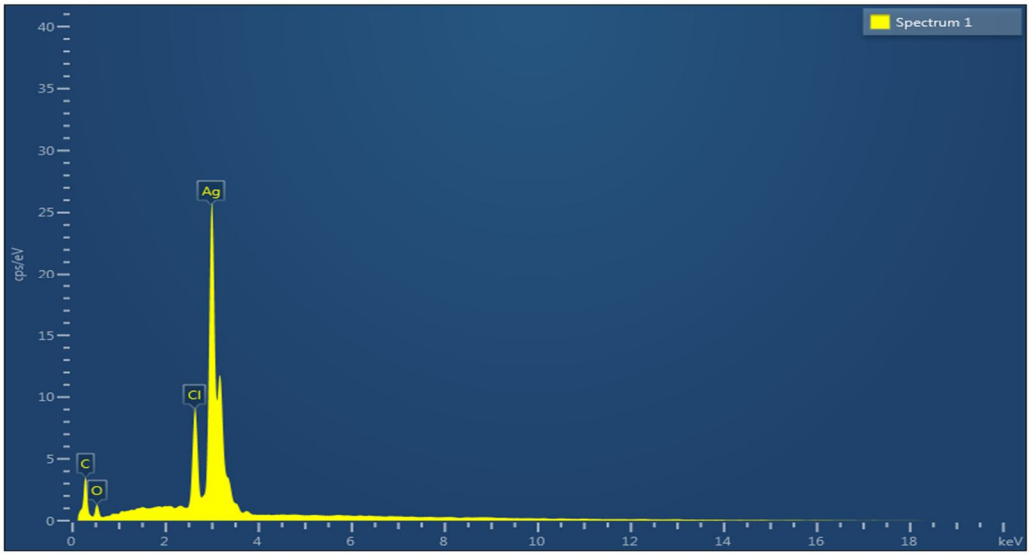

Fig.10 EDX spectrum recorded for prepared silver nanoparticles and different X- ray emission peaks are labeled

Analysis through energy dispersive x-ray (EDX) spectrometers confirmed the presence of elemental silver signal of the silver nanoparticles in high peak (fig.4.5). The vertical axis displays the number of x-ray counts whilst the horizontal axis displays energy in key. Identification lines for the major emission energies for silver (Ag) are displayed and these correspond with confidence that silver has been correctly identified [12].

D. FTIR Analysis Result

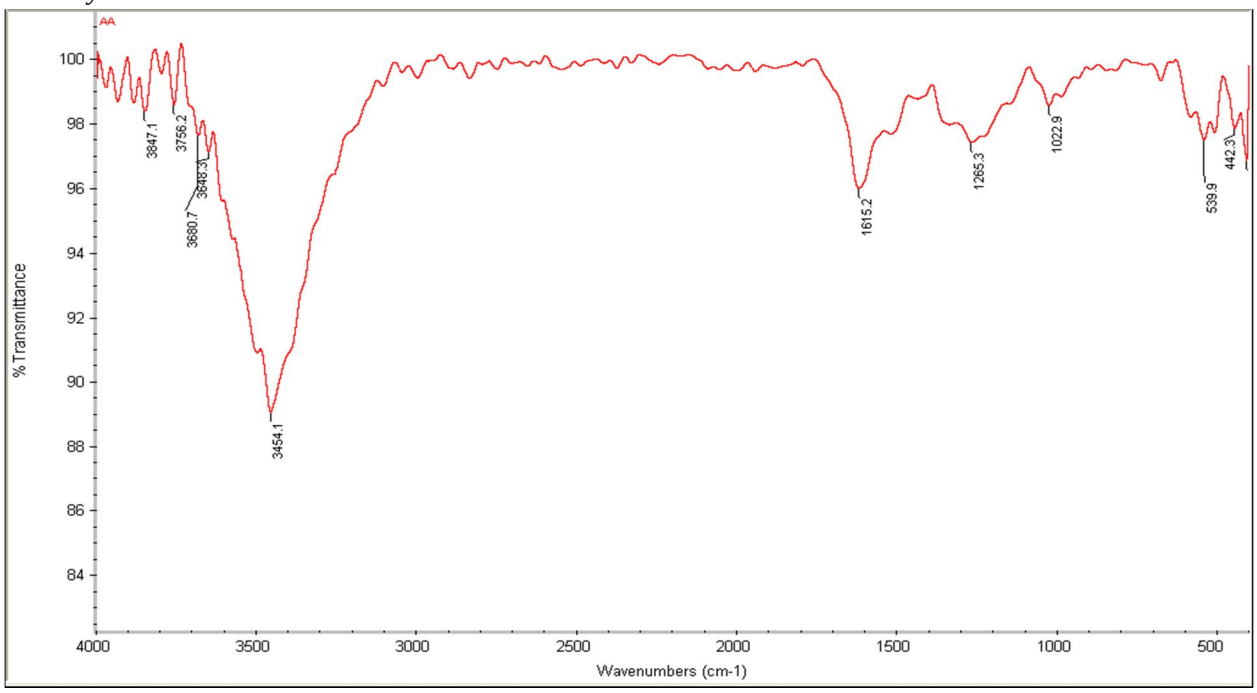

Fig.11 FTIR spectrum of the silver nanoparticles

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Table-1
Fourier Transform Infra- Red Analysis Of Silver Nanoparticles

WAVELENGTH	INTENSITY	ASSINGNMENT	FUNTIONAL GROUP
3454.1	Strong	N-H: stretching mode [15]	Alcohols and phenols
1615.2	Strong	C=O: stretching mode[2]	Aldehyde and ketones
1265.3	Strong	C-O: stretching mode	Alcohols and phenols
1022.9	Strong	C-O: stretching mode [17]	Alcohols and phenols
539.9	Strong	C-Cl: stretching mode [18]	Halogen compound [Chloro-compound]
442.3	Strong	C-I: stretching mode [18]	Halogen compound] [Iodo-compound]

The FTIR measurements of stretching mode nanoparticles were carried out to identify the possible interaction. Result of FTIR study showed sharp absorption peaks located at about 3454.1 wavelengths with O-H: Stretching mode .

E. UV-VIS Analysis Result

UV-Vis is spectroscopy is a valuable tool for structural characterization of AgNPs. It is a fundamental technique to ascertain the formation of stable metal nanoparticles in aqueous medium.

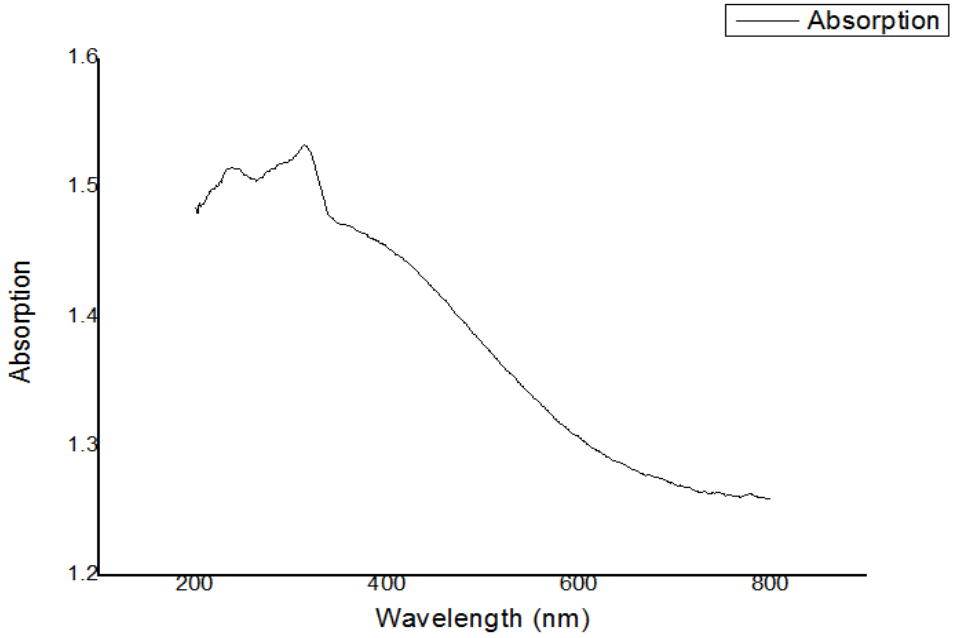

Fig.12 UV-Vis spectroscopy of silver nanoparticles.

Fig(12) shows UV-Vis spectra recorded from the aqueous silver nitrate with A.adenophora leaf extract. It is observed that the silver surface resonance band occurs at 320nm.[13][20] ,which says the particle is in Nano size.

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IV. CONCLUSION

In this study the silver nanoparticles were successfully synthesized using the extract of A.adenophora leaf for the first time. The biosynthesized AgNPs were characterized using UV-Vis, FTIR, SEM, EDX, and XRD have confirmed characteristic features of A.adenophora silver nanoparticles. Furthermore A.adenophora silver nanoparticles were made without any impurities. The results were within approximate ranges of each other and the values reported in previous studies. The UV-Vis analysis confirmed the AgNPs at 320 nm. The average size of the AgNPs prepared was calculated in the range of 14 nm using XRD pattern. The spherical shape and plate surface shape of AgNPs was observed by SEM image. Energy dispersive x-ray (EDX) shows the ED spectrum of the synthesized silver nanoparticles strong silver signal along with weak chlorine (Cl), carbon(C), oxygen (O) peak was observed. The FTIR analysis related the presence of various functional groups. Here in we reported eco-friendly and low cost process for synthesis of AgNPs. The plant source may act as capping agents which control the size and capping agents which control the size and shape of the silver nanoparticles.

V. ACKNOWLEDGMENT

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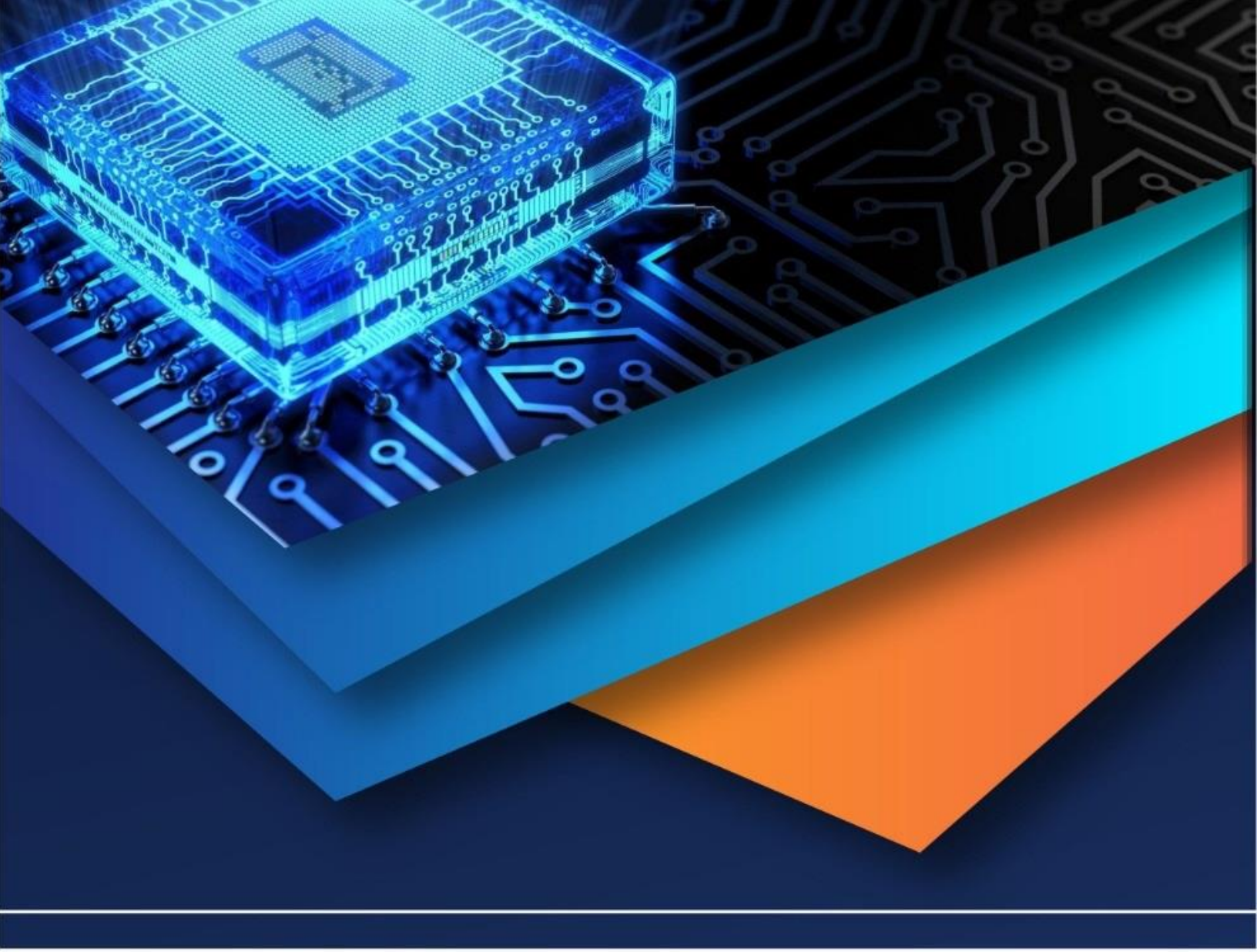

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