Digest Journal of Nanomaterials and Biostructures Vol. 7 No. 3, July - September 2012, p. 1117 - 1123

# PLANT-MEDIATED SYNTHESIS OF SILVER NANOPARTICLES USING *Elaeagnus latifolia* LEAF EXTRACT

PROBIN PHANJOM*, AZMIN SULTANA, HIMAKSHI SARMA, JAHNABI RAMCHIARY, KONGKANA GOSWAMI, PITAMBAR BAISHYA.

*Department of Biotechnology, Regional College of Higher Education (affiliated to North Eastern Hill University,Shillong,Meghalaya), Guwahati-781038,Assam,India.*

In nanotechnology, particles sized between 100 and 1 nanometres are considered to be nanoparticles. Nanoparticles have a wide variety of potential applications in biomedical, optical and electrical fields. Due to these applications research in nanoparticles is an area of intense scientific interest. There are several methods for synthesizing nanoparticles like wet chemical method where harmful and toxic chemicals are used. In this work we have synthesized silver nanoparticles using the leaf extract of *Elaeagnus latifolia*. In this method, silver nanoparticles were formed by the treatment of 1mM silver nitrate ($AgNO_3$) with the leaf extract of *Elaeagnus latifolia*. For characterisation of the silver nanoparticles UV-Vis absorption spectroscopy, X-ray diffractometer (XRD) and Transmission electron microscope (TEM) were used.

(Received March 28, 2012; Accepted August 1, 2012)

*Keywords*: Elaeagnus latifolia, green synthesis, silver nanoparticles,TEM, UV-Vis, XRD.

## 1. Introduction

Nanobiotechnology is an upcoming branch of nanotechnology which have been playing an important role in the field of medical science and electronics. Nanotechnology refers broadly to a field of applied science and technology whose unifying theme is the

control of matter on the atomic and molecular scale. Nanoparticles have properties which are based on the characteristics such as size and shape. There is a wide range of application of nanoparticles and its uses is emerging rapidly[1,2,3].Silver nanoparticles has significant role in the field of diagnostic[4],antimicrobial and therapeutics[5,6], catalysis and electronics [7,8].

Synthesis and characterization of nanoparticles is an important area of research as selection of size and shape of nanoparticles provide an efficient control over many of the physical and chemical properties [9, 10]. Biological materials like plant leaf extract [11], bacteria[12], fungi [13]and enzymes[14] are used for the green synthesis of silver nanoparticles. Green synthesis process offers numerous benefits of eco-friendliness and compatibility for pharmaceutical and other biomedical applications as they do not use toxic chemicals for the synthesis protocol. Toxic chemicals are used in the chemical synthesis process of nanoparticles which gets absorbed on the surface that may have adverse effect in the medical applications. Green synthesis is cost effective, environment friendly, easily scaled up for large scale synthesis and in this method there is no need to use high pressure, energy, temperature and toxic chemicals as in case of chemical and physical method.

Some examples of green synthesis are synthesis of gold nano triangles by using Lemmon grass extract and tamarind leaf extract [15, 16], geranium leaf assisted biosynthesis of silver nanoparticles[17], synthesis of silver nanoparticles using Fungus[18,19], synthesis of silver nanoparticles by using soluble starch[20], extra cellular synthesis of silver nanoparticles by a silver

*Corresponding author: phanjom@gmail.com

tolerant yeast strain MKY3[21], synthesis of Au, Ag and bimetallic Au core-Ag shell nanoparticles using Neem (*Azadirachta indica*) leaf broth [22], biosynthesis of silver based crystalline nanoparticles of well defined composition and shapes(such as equilateral triangles and hexagons) within the periplasmic space of bacteria *Pseudomononas stutzery* AG259 isolated from silver mines[23,24].Silver toxicity towards wide range of micro-organisms has long been known. Among all the well known activity of silver ions and silver-based compounds is that they kill microbes effectively [25]. Silver nanoparticles interact with the bacterial membrane proteins and DNA as they possess sulphur and phosphorus compounds and silver have higher affinity to react with these compounds [26].

Here we report the synthesis of silver nanoparticles by reducing aqueous silver nitrate solution by using leaf extract of *Elaeagnus latifolia.*It was observe that *Elaeagnus latifolia* leaf extract has potential for the synthesis of silver nanoparticles.The silver nanoparticles were characterised using UV-visible spectrophotometer,Transmission electron microscope (TEM) and X-ray diffractometer (XRD).

## 2. Materials and methods

### 2.1 Preparation of leaf extract

40gm of the *Elaeagnus latifolia* leaf was washed thoroughly with sterilised distilled $H_2O$ and then air dried. The leaves were then cut into fine pieces and then boiled with 100 ml distilled $H_2O$ for 10 minutes. The leaf extract was allowed to cool at room temperature and then filtered using Watmann filter paper No.1 (25 μm pore size).

### 2.2 Synthesis of silver nanoparticles

For the synthesis of silver nanoparticles 1mM aqueous solution of silver nitrate solution($AgNO_3$) was prepared. To 60 ml of *Elaeagnus latifolia* leaf extract,10 ml of the prepared silver nitrate solution was mixed and kept at room temperature to react.

### 2.3 UV-Vis Spectra analysis

Monitoring of the reduced silver particles was done by measuring the UV-Vis spectrum of the reaction medium after 3 hours. UV-Vis spectral analysis was done by using PC Based Double Beam Spectrophotometer 2202(Systronic).

### 2.4 XRD measurement

The biosynthesized silver nanoparticles thus obtained were purified by repeated centrifugation at 8000 rpm for 15 minutes followed by redispersion of the pellet of silver nanoparticles into 10 ml of deionised water. After freeze drying of the purified silver particles, the structure and composition were analyzed by XRD. The dried mixture of silver nanoparticles was collected for the determination of the formation of Ag nanoparticles by XRD (D8 ADVANCE,BRUKER).

### 2.5 TEM analysis of silver nanoparticles

Samples for transmission electron microscopy (TEM) analysis were prepared by drop coating biologically synthesized silver nanoparticles solution (24 hours reaction of the silver nitrate solution with the *Elaeagnus latifolia* leaf broth) on to carbon-coated copper TEM grids. The films on the TEM grid were allowed to stand for 2 minutes, following which extra solution was removed using a blotting paper and grid allowed to dry prior to measurement. TEM measurements were performed on a JEM 2100, 200 kV, Jeol.

## 3. Results

On mixing the *Elaeagnus latifolia* extract with 1mM $AgNO_3$ solution, the colour of the solution changes from pale yellow to yellowish brown colour indicating the formation of silver nanoparticles [Figure 1].The UV-Vis spectra of the reaction medium recorded after 3 hours of reaction is shown in [Figure 2]. Absorption spectra of the reaction media have absorbance at 450 nm.

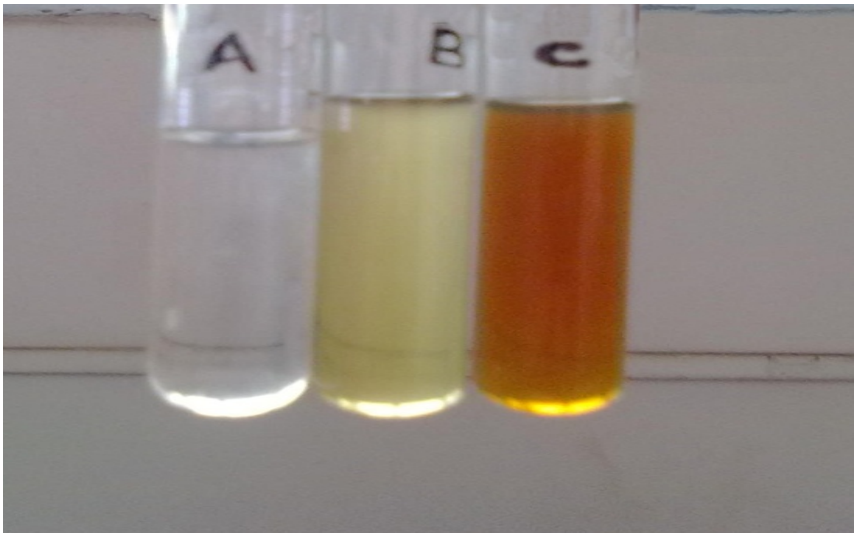


*Fig. 1. Digital photographs of (A) 1 mM $AgNO_3$ without leaf extract (B) Elaeagnus latifolia leaf extract (C) 1 mM $AgNO_3$ with Elaeagnus latifolia leaf extract after 3hours of incubation.*

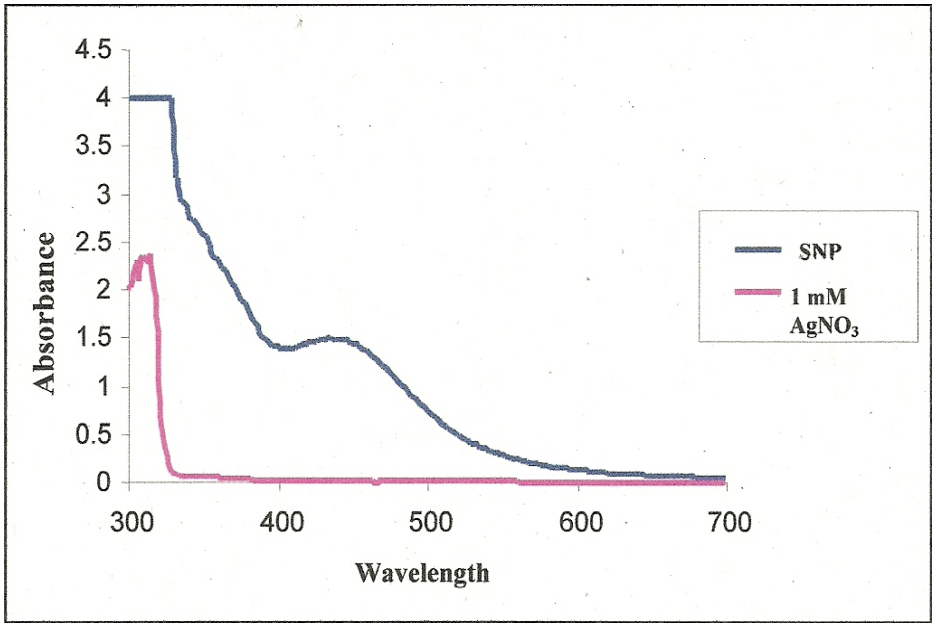


*Fig. 2. UV-Vis absorption spectrum of silver nanoparticles (SNP) synthesized by treating 1mM aqueous $AgNO_3$ solution with Elaeagnus latifolia leaf extract after 3 hours.*

Further demonstration and confirmation of the presence of silver nanoparticles biosynthesised by using the leaf extract of *Elaeagnus latifolia* in the reaction media was observed by X-Ray Diffraction (XRD) images. The characteristic peaks obtained in the XRD pattern is

shown in [Figure 3].The XRD pattern showed four intense peaks in the whole spectrum of 2 theta values of 38.06°, 44.64°, 64.58° and 77.62°, corresponds to 111,200, 220, and 311 planes for silver nanoparticles.

The TEM images shown in [Figure 4(a) and 4(b)] reveals that the silver nanoparticles obtained by the reduction of $Ag^+$ by the *Elaeagnus latifolia* leaf extract were predominantly spherical shaped. The size of the silver nanoparticles ranges between 30 nm to 50 nm.

The selected area electron diffraction (SAED) pattern of the silver nanoparticles representing the face centered cubic (fcc) crystalline structure of silver nanoparticles is shown in [Fig. 4(c)].

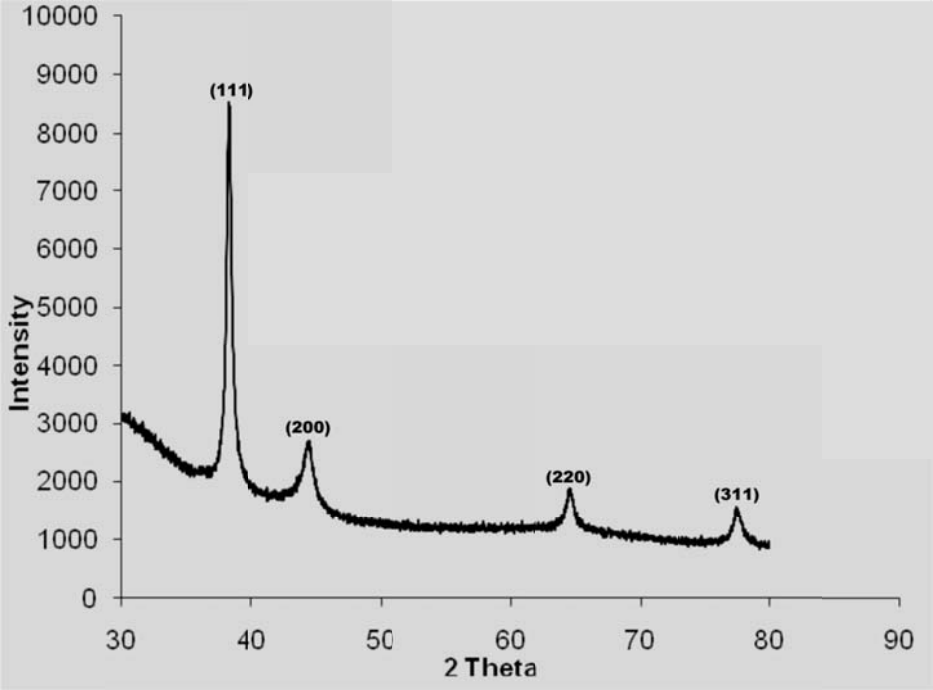


*Fig. 3. XRD pattern of silver nanoparticles synthesized by treating Elaeagnus latifolia leaf extract with 1 mM aqueous $AgNO_3$ solution.*

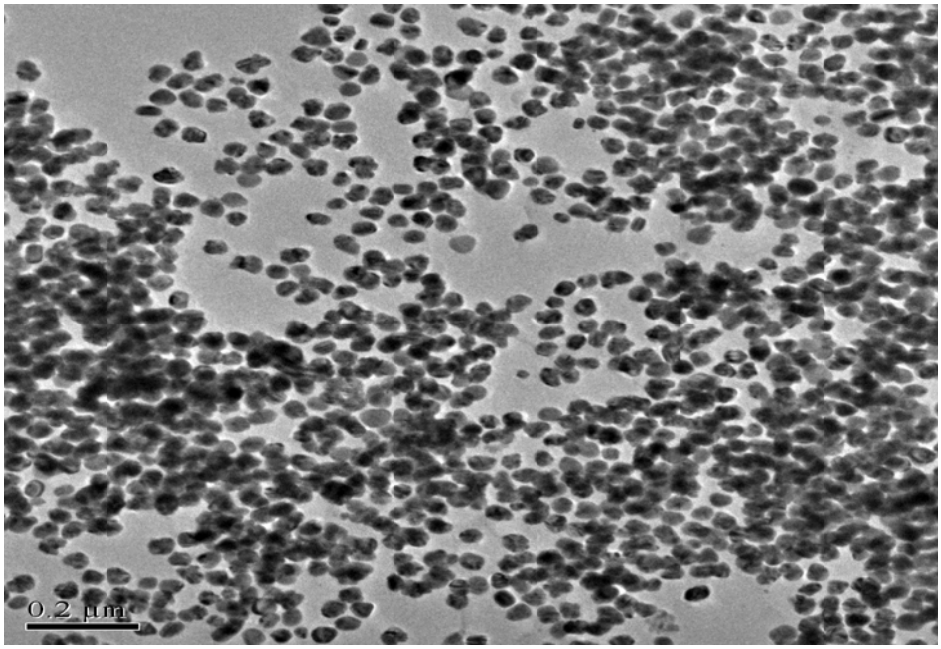


*Fig. 4(a): TEM image of the biosynthesized silver nanoparticles.*

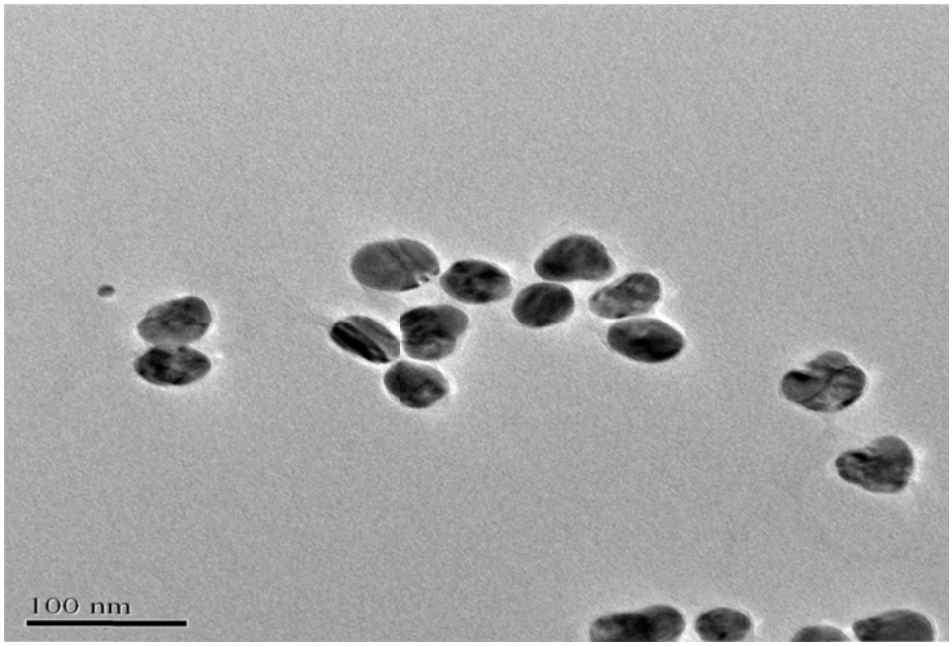


*Fig. 4(b): TEM micrograph of the sample centrifuged at 1500 rpm up to 10 minutes shows particles of spherical shape with nearly homogeneous size between 30nm and 50nm.*

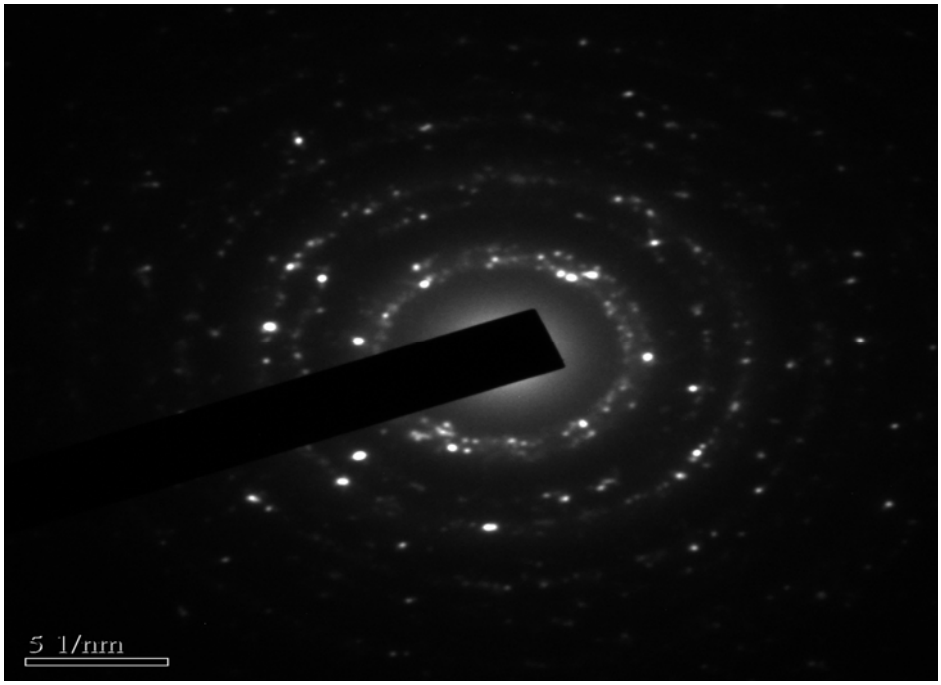


*Fig. 4(c): SAED- pattern of the silver nanoparticles.*

## 4. Discussion

The silver nanoparticles exhibit yellow brownish colour in aqueous solution due to excitation of surface plasmon vibrations in silver nanoparticles [27]. To determine the formation of the nanoparticles in the colloidal solution,UV-Vis spectroscopy was used [28]. The broadening of the peak indicated that the particles are polydispersed. The XRD pattern showed four intense peaks in the whole spectrum of 2θ values ranging from 30 to 80 for silver nanoparticles biosynthesised by *Elaeagnus latifolia* extract respectively. The typical XRD pattern revealed that the sample contains a mixed structure of silver nanoparticles. A number of Bragg reflections corresponding to the (111), (200), (220) and (311) sets of lattice planes are observed which may be indexed based on the face centered cubic (fcc) structures of silver, peaks were also observed suggesting that the crystallization of bio-organic phase occurs on the surface of the silver nanoparticles [29,30].Transmission electron microscopy (TEM) has provided further insight in the morphology and size details of the silver nanoparticles.

## 5. Conclusions

In the present study, the biosynthesis of silver nanoparticles using the leaf extract of *Elaeagnus latifolia* has been successfully demonstrated. We found that the leaves of *Elaeagnus latifolia* can be a good source of synthesis of silver nanoparticles. Large scale synthesis of silver nanoparticles can be done by eco-friendly method as mentioned above. In this method there is no need to use high pressure, energy, temperature and toxic chemicals as in case of chemical and physical method. These nanoparticles have a great application in the field of pharmacological and electronical industries and many more. We were able to get highly stable almost spherical shaped silver nanoparticles in the average size range from 30 nm to 50 nm.

**Acknowledgement**

We are grateful to (SAIF) North Eastern Hill University, Shillong for TEM analysis, Institute of Advanced Study in Science and Technology (IASST),Guwahati for XRD analysis and the Department of Biotechnology, Regional College of Higher Education (RCHE), Guwahati.

## References


[1] W. Jahn, J. Struct. Biol. **127,**106-112 (1999).
[2] H. S. Nalwa, Hand Book of Nanostructural Materials and Nanotechnology Academic Press New York **1-5**(2000).
[3] C.J.Murphy, J.Mater Chem.**18,**2173–2176(2008).
[4] S.Schultz, D.R.Smith, J.J.Mock, D.A.Schultz, PNAS **97**, 996-1001(2000).
[5] M.Rai, A.Yadav, A.Gade, Biotechnol.Advances **27,**76–83(2009).
[6] J.L.Elechiguerra, J.L.Burt, J.R.Morones, A.Camacho-Bragado, X.Gao, H.H.Lara, M.J.Yacaman, J. Nanobiotechnol. **3**,6(2005).
[7] R.M.Crooks, B.I.Lemon, L.Sun, L.K.Yeung, M.Zhao, Top.Curr.Chem. **212,**82-135 (2001).
[8] D.I.Gittins, D.Bethell, R.J.Nichols, D.J.Schiffrin, J Mater Chem **10,** 79–83(2000).
[9] Steven, R.Emory,W.E.Haskins, S.Niel, J.Am.Chem.Soc.**120**,8009(1998).
[10] Alivisatos, A.P., J. Phys. Chem. **100**(31), 13226–13239 (1996).
[11] V.Parashar, R.Parashar, B.Sharma, A.C.Pandey,Digest Journal of Nanomaterials and Biostructures **4(1),** 45 – 50 (2009).
[12] N.Saifuddin, C.W.Wong, A.N.Yasumira, E-Journal of Chemistry **6(1),**61-70 (2009).
[13] K.C.Bhainsa, S.F.D'Souza, Colloids and Surfaces B: Biointerfaces **47,**160–164 (2006).
[14] B.Willner, B.Basnar, B.Willner, FEBS J **274**, 302–309(2007).
[15] S.ShivShankar. A.Rai, B.Ankamwar, A.Singh, A,Ahmad and Muraly Sastry, Nature Materials **3**,482(2004).
[16] Balaprasad Ankamwar, Synthesis and Reactivity in Inorganic, Metal-Organic and Nano-Metal Chemistry **35**,19(2005).
[17] S.Shiv Shankar ,A.Ahmad and Muraly Sastry, Biotechnol.Prog. **19**,627(2003).
[18] P.Mukherjee,A.Ahmad, D.Mandal, S.Senapati, S.R.Sainkar, M.I.Khan, R.Parishcha, P.V.Ajaykumar, M.Alam, R.Kumar, and M.Sastry, Nano Lett.**1**, 515(2001).
[19] A.Ahmad,P.Mukherjee,S.Senapati,D.Mandal,M.I.Khan, R.Kumar, and M.Sastry, Colloids Surf., B **28**, 313 (2003).
[20] N.Vigneshwaran, R.P.Nachane, R.H.Balasubramanya and P.V.Varadarajan, Carbohydrate Research **341**, 2012 (2006).
[21] M.Kowshik, S.Ashtaputre, S.Kharrazi, W.Vogel, J.Urban, S.K.Kulkarni, and K.M.Paknikar, Nanotechnology **14** , 95 (2003).
[22] S.ShivShankar, Akhilesh Rai, A.Ahmad and M.Sastry, Journal of Colloid and Interface Science **275**, 496 (2004).
[23] Klaus.T, Joerger.R, Olsson.E, Granqvist. C. G, Proc. Natl. Acad. Sci. U.S.A. **96**,13611 (1999).
[24] Klaus.T, Joerger. R, Olsson. E, Granqvist. C.G, Trends Biotechnol. **19**,15 (2001).
[25] Chopra.I, J. Antimicrob Chemother. Apr; **59**(4):587 (2007).
[26] Feng QL, Wu J, Chen GQ, Cui FZ, Kim TN, Kim JO, J Biomed Mater Res.Dec **15**,52(4),662(2000).
[27] Mulvaney.P, Langmuir **12**,788 (1996).
[28] B.J.Wiley, S.H.Im, J. McLellan, A.Siekkinen. Y.Xia, J. Phys. Chem. B **110,** 15666 (2006).
[29] Raut W.R, Kolekar S.N, Jaya R, Lakkakula R. J, Mendhulkar D.V, and Kashid B.S, Nano-Micro Lett, **2(2),**106-113,(2010).
[30] Sathyavathi,R, Krishna B.M, Rao V.S, Saritha R and Rao N, Adv. Sci Letters,. **3**,1 (2010).