International Journal of Engineering Research And Management (IJERM)
ISSN : 2349- 2058, Volume-01, Issue-09, December 2014

Synthesis Characterization and Application of Sn (IV) Phosphorous Acid in the Nano form

Chithra P G, Vijayalekshmi V

***Abstract*— We report on synthesis of Sn (IV) Phosphorous acid nanoparticle by chemical capping synthesis. The characteristics of the obtained nanoparticle was studied using XRD, UV-Vis absorption spectroscopy, and SEM. The average diameter of the prepared nanoparticle was 25 nm. Antibacterial materials are widely used in everyday life and plays important roles in the public health system. In this paper, we aim to provide a study on the antibacterial and antifungal applications of the prepared nanomaterial**

I. INTRODUCTION

Nanomaterial's are at the leading edge of the rapidly developing field of nanotechnology. Nanotechnology is a reliable and enabling environment friendly process for the synthesis of Nano scale particles. Nano size results in specific physicochemical characteristics such as high surface area to volume ratio, which potentially results in high reactivity [1].
The nanoparticles have diverse applications [1].The field of nanotechnology is one of the most active areas of research in modern materials science. Nanoparticles exhibit completely new or improved properties based on specific characteristics such as size, distribution and morphology. New applications of nanoparticles and nanomaterial's are emerging rapidly[**2**]. Nano crystalline silver particles have found tremendous applications in the field of high sensitivity bimolecular detection and diagnostics, antimicrobials and therapeutics [3,4], Catalysis and micro-electronics. Certain metals, including copper and silver, have long been known to possess broad-spectrum antimicrobial activities [5,6]**.**

In the present study the Nano form of an Inorganic material tin (IV) Phosphorous acid (SnP) is prepared by the chemical co-precipitation method by using EDTA as a template. Nanoparticles of desired size and shape have enormous importance in nanotechnology. Depending on their size in Nano scale range, there occurs deviations of their physical-chemical properties.

The synthesized material has been characterized for SEM, X-ray diffraction studies and UV studies . In this report we demonstrate the antibacterial activity of the nanoparticle against Gram positive (Bacillus subtitles and Staphylococcus aureus) and Gram –negative bacteria (Pseudomonas aeruginosa and E-coli). We also used this nanomaterial to evaluate the antifungal activity of the material against Candida albicans and Saccharomyces cerevisiae.

Manuscript received Dec 06, 2014
Chithra P G, S N College for Women Kollam
Vijayalekshmi V, S N College for Women Kollam

II. EXPERIMENTAL

Synthesis of Tin (IV) phenyl phosphorous acid (SnPN)
It was prepared by the chemical co-precipitation method by using EDTA as a template. The function of the template being a structure directing agent and regulating the pore size. Also the chelating agent,EDTA, kept the Sn^{4+} ions in homogeneous solution leaving enough flexibility for the system to exist homogeneously throughout the reaction and prepared more homogeneous Nano sized materials of high purity.

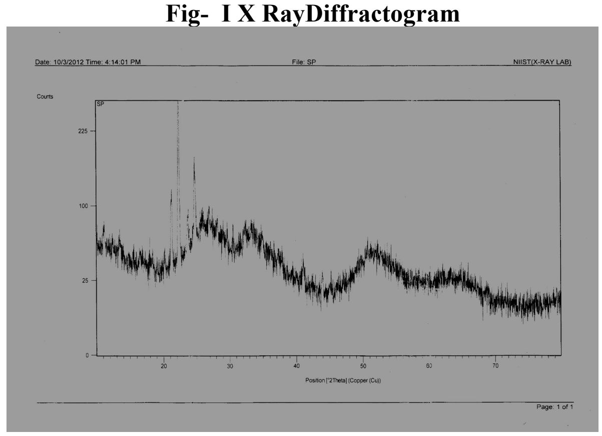
III. CHARACTERIZATION

The particle size was determined from X-ray diffraction data using Scherer equation. SEM image of the sample was obtained using a scanning electron microscope.. UV-Vis spectral analysis was done by using double beam UV-Vis spectrophotometer .Antibacterial activity of the material was determined against Gram positive bacteria Bascillus Subtilis and Staphyloicoccus aureus and Gram negative bacteria Pseudomonas aeruginosa and E.Coli. Antifungal activity of the material was determined against Candida albicans and Saccharomyces.It was assayed by so called halo method as follows. A melted beef agar medium was poured into a Petri dish and solidified. Then, the medium containing bacteria was layered over it. The samples were poured into a well cut on the surface. Samples were added in four different amounts viz,5,10,15,20 microliters into each well and then incubated for one day at 37^0C.Antibacterial activity was evaluated by the transparent halo circle around the specimen after incubation. When an agent has antibacterial activity, a halo circle is formed along the periphery of the specimen. When material has an excellent antibacterial activity, the halo ring formed will be very wide.

IV. RESULT AND DISCUSSION

The nano form of tin (IV) Phosphorous acid (SnPN) was obtained as a white fine powder.

Fig- I X RayDiffractogram



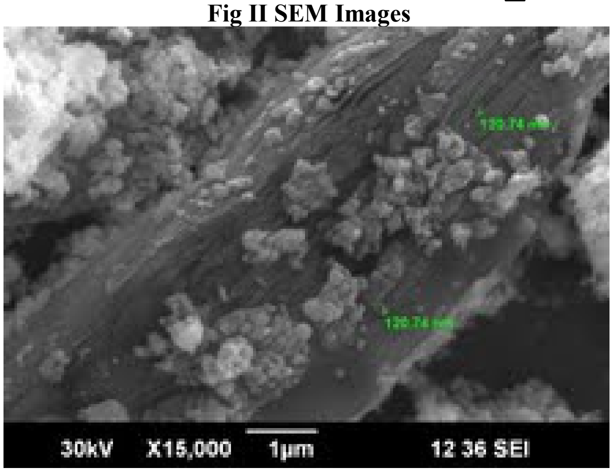
The crystal size can be calculated according to De bye-Scherer formula

$$D = 0.9\lambda/\beta \cos\theta$$

λ is the wavelength of the Cu – Kα radiations,β is the full width at half maximum and θ is the angle obtained from 2θ values corresponding to maximum intensity peak in XRD pattern.

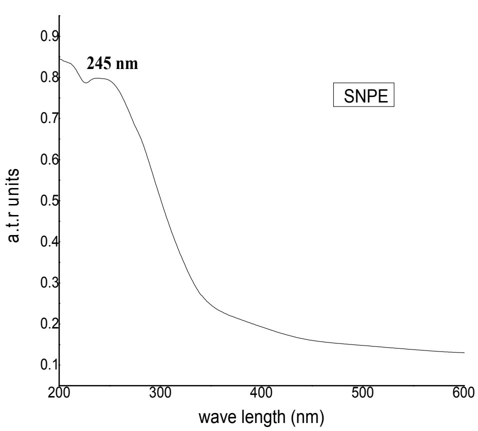
The X-ray diffractogram in Fig I shows sharp well defined peaks. The average particle size from the diffraction pattern determined by using Scherer equation is found to be 25 nm indicating the Nano dimension of the material.

Fig II SEM Images



The surface morphological features of synthesized nanoparticle was studied by scanning electron microscope. Fig II shows the SEM image of Sn (IV) phosphorous acid nanoparticle. The appearance of some particles is in spherical shape and some are in rod shape. We can observe that the particles are highly agglomerated and they are essentially cluster of nanoparticles. The observation of some larger nanoparticles may be attributed to the fact that the nanoparticle has a tendency to agglomerate due to their high surface energy and high surface tension of the ultrafine nanoparticles.

Fig III Absorption Spectrum

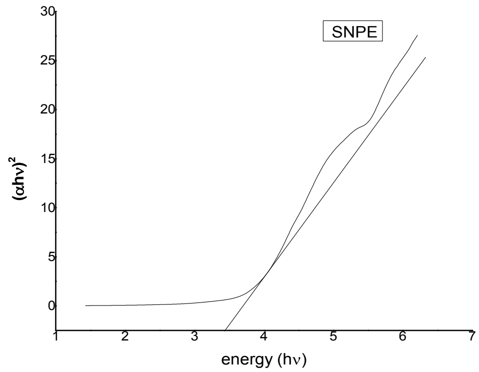


Wave length =245 nm

The room temperature UV-Vis absorption spectrum of the Nano material in Fig 3 gives information about excitonic or interband transition of Nano crystalline material. The spectrum was recorded in the wavelength range of 200-600nm.The UV spectra provide important information about the details related with optical band gap of the material. The energy band of the material is related to the absorption coefficient α by the Taue relation.

$$A h\nu = A (h\nu - Eg)^n$$

Where A is a constant, $h\nu$ is the photon energy, Eg is the band gap and n=1/2 for an allowed direct transition. Plotting a graph between $(\alpha h\nu)^2$ and $h\nu$ gives the value of direct band gap. The extrapolation of the straight line to $((\alpha h\nu)^2=0$ gives the band gap.



bandgap =3.4 eV

From the UV spectra , it is clear that the absorbance decreases with increase in wavelength. This decrease in the absorption indicates the presence of optical band gap in the material. This corresponds to the excitation of surface Plasmon's in the Nano particle. UV spectra shows absorption at 245 nm which corresponds to an energy gap of 3.4 ev.The fundamental absorption which corresponds to electron excitation from the valence band to the conduction band is used to determine the nature and the value of optical band gap.

Figure IV

Fig: IV Represents the antibacterial assessment of Sn(IV)Phosphorous acid against Pseudomonas aeruginosa (Gram negative bacterium)

Figure V

Figure VI

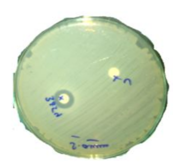


Fig V represents the antibacterial assessment of Sn(IV)Phosphorous acid against Bascillus Subtilis(Gram positive bacterium)

Figure VI represents the antibacterial assessment of Sn(IV)Phosphorous acid against Staphylococcus aureus (Gram positive bacterium)

Fig VII

Fig: VII Represents the antibacterial assessment of Sn(IV)Phosphorous acid against E-coli (Gram negative bacterium)

Fig VIII

Fig:VIII Represents the antifungal assessment of Sn(IV)Phosphorous acid against Saccharomyces cerevisiae.

Fig IX

Fig: IX Represents the antifungal assessment of Sn(IV)Phosphorous acid against Candida albicans

Halo ring diameter obtained from antibacterial assessment

Parameters	Results (mm)
Staphylococcus aureus	13
Bacillus subtilis	21
Pseudomonas aeruginosa	13
E-coli	10
Candida albicans	-
Saccharomyces cerevisiae	-

The nanomaterial possess antibacterial property against both Gram positive and Gram negative bacteria.In this case it was suggested that an adsorption of cations onto the negatively charged cell surface by electrostatic interaction takes place[7,8].Then the long lipophilic chains diffuse through the cell wall,which leads to a weakening of the cytoplasmic constituents and the death of the cell.Cell walls of the bacteria are usually negatively charged due to functional groups such as carboxylates present in lipoproteins at the surface[9]. The presence of cation increases the electroststic forces of attraction.Greatest antibacterial property is shown against Gram positive bacteria.This may be related to the cell structure of the bacteria: Gram positive bacteria have thick cell wall and no outer membrane, whereas Gram –negative bacteria have thin cell wall and its layers have outer membranes[10].

Conclusion

In the present study Tin Phosphorous acid was prepared in the Nano form by the chemical Co precipitation method by using EDTA as Capping agent. Characterization of the material was done by using XRD, SEM and UV-Vis. The particle size was studied from XRD using Scherrer formula. Owing to the size, their electron structure is easily affected by environments, such as structure and nature of support, substrate etc.

The nanoparticle prepared is of great scientific interest as they effectively bridge between bulk materials and atomic or molecular structures. The prepared nanomaterial is an effective antibacterial agent. Hence this material can be used as an antibiotic to treat bacterial infections.

References

[1] J Turkevich ,G Kim , Science,169,873 (1970).
[2] B C Regan ; S Aloni ; K Jensen;R O Ritchie, Nanoletters 5(9),(2005) 1730-3 (2005).
[3] Thresiamma George,Sunny Joseph & Suresh Mathew,Pramana,J.Phys 65,793-99 (2005).
[4] R. M. Jose, L. E. Jose, C. Alejandra Nanotechnology **16**, 2346–2353, (2005).
[5] C. Lok, C. Ho, R. Chen, Q. He, W. Yu, H. Sun, P.K. Tam, J. Chiu, C. Che J. Biol. Inorg.Chem. **12**, 527–534 (2007)
[6] M. Ip, S. L. Lui, V. K. M. Poon, I. Lung, A. Burd J. Medical Microbiol. **55**, 59–63 (2006)
[7] C. J. Murphy, J. Mater Chem., **18**(1)**,** 2173–2176, **(2008).**
[8] M. Rai and A. Yadav, A gade biotechnology.Advan.**27**(1), 76–83 **(2009).**
[9] N. A. Begum, S. Mondal, S. Basu, R. A.Laskar and D. Mandal, Colloids and Surfaces B :Biointerfaces,**71**(1), 113-118,**(2009).**
[10] H. Bar, D. K. Bhui, G. P. Sahoo, P. Sarkar,S. P. De and A. Misra, Colloids and SurfacesA :Physicochem. Engin. Aspects,**339**(1)**,**134–139, **(2009)**.