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Green Synthesis of Zinc Oxide (ZnO) Nanoparticles Using Ocimum Tenuiflorum Leaves

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Abstract: ***In this research paper, we discussed on the synthesis and characterization of ZnO nanoparticles by green synthesis method. Here we utilized the leaves of Ocimum Tenuiflorum plant as reducing agent in the synthesis of ZnO nanoparticles. Green synthesis method avoids inert gases, high pressure, laser radiation, high temperature, toxic chemicals etc. as compared to conventional method like sol-gel technique method, laser ablation method, solvothermal method, inert gas condensation method, chemical reduction method etc. Prepared ZnO nanoparticles were characterized by X-Ray diffraction (XRD), scanning electron microscope (SEM) technique, Fourier Transform Infrared Spectroscopy (FTIR). The average particle are calculated as 13.86 nm by using Scherrer's formula.***

Keywords: Ocimum Tenuiflorum, ZnO nanoparticles, XRD, SEM, FTIR.

1. Introduction

In nanotechnology world, nanoparticles plays major role in many application because nanoparticles have superior properties than bulk materials like electrical conductivity, mechanical strength, magnetic properties, thermal ability etc. Nanoparticles has large number of application in many areas [l].

Zinc Oxide have many and very impressive properties like large binding energy, wide band gap, high piezoelectric property etc. It is used in large number of applications like laser devices, optoelectronic devices, electromagnetic coupled sensor, surface acoustic wave devices [2]-[7]. Zinc oxide nanoparticles have been used to eliminate sulphur, arsenic from water because bulk ZnO cannot remove arsenic because nanoparticle have great surface area than bulk material [8]. Zinc oxide have amazing application in diagnostics, biomolecular detection, micro electronics [9]

In literature, ZnO nanoparticles are synthesized from conventional methods like chemical reduction [10], laser ablation [11], solvothermal [12], inert gas condensation [13], sol-gel method [14]. This methods require some toxic chemicals, high pressure, laser radiation, inert gases like helium ac compared to green synthesis method. Some of this conventional methods are expensive, not easy to operate, require to much attention during process, also require special type of vessel like polypropylene vessel for nanoparticles synthesis.

In recent, green synthesis of ZnO nanoparticles was achieved by using leaves extract of Ocimum Tenuiflorum plant. Oscimum Tenuiflorum also called as holy basil, tulsi, Ocimum sanctum. It is belong to Lamiacece family. Ocimum Tenuiflorum mostly present in tropical region [15]. The chemical constituents of Ocimum Tenuiflorum are linalool, alkaloids, ursolic acid, glycosides, carvacrol, tannins, rosmarinic acid, aromatic compound etc.[16] Recently Leaves extract of Ocimum Tenuiflorum plant have been utilized in the synthesis of copper nanoparticles, gold nanoparticles, and silver nanoparticles [17], [18]. To the best of our knowledge, the use of leaf extract Ocimum Tenuiflorum plant for green synthesis of ZnO nanoparticles has not been revealed. Hence the present task was carried out to synthesis and characterization of ZnO nanoparticles using leaves extract of Ocimum Tenuiflorum plant. Figure 1 show the plant of Ocimum Tenuiflorum which is use in leaf extract preparation.

Figure 1: Ocimum Tenuiflorum Plant.

2. Experimental

2.1 Material

All the chemicals such as zinc nitrate, distilled water ingredients utilized in this work purchased from Joyti Chemporium, Akola. The leaves of Ocimum Tenuiflorum plant collected form in and around Akola, Maharashtra, India.

2.2 Methods

2.1.1 Preparation Of Leaves Extract Of Ocimum Tenuiflorum.

For the preparation of leaves extract of Ocimum Tenuiflorum first washed leaves many times with water and dried in sunlight. Then taking 10gm of dried leaves in 250 ml borosil beaker along with 100 ml distilled water. The solution mixture of leaves and distilled water boiled for 10 min. until solution colour turns in redish colour. The mixture solution cooled at room temperature. The leaves extract filtered utilizing filter paper and stored in refrigerator for synthesis of ZnO nanoparticles. Figure 2 shows the sample of leaves extract of Ocimum Tenuiflorum plant.

Figure 2: Sample of Leaves Extract of Ocimum Tenuiflorum Plant.

2.1.2 Green synthesis of ZnO nanoparticles using leaf Extract of Ocimum Tenuiflorum Plant

For the ZnO nanoparticles synthesis, 50 ml of Ocimum Tenuiflorum leaf extract was taken boiled to 60-80^{0}C. using magnetic stirrer heater. Then 5 gm of zinc nitrate was added to the leaf extract of Ocimum Tenuiflorm plant when temperature reach at 70^{0}C. and boiled it reduced deep reddish paste. This paste dried in dryer at temperature 100-130^{0}C. for 40-45 mins. Zinc oxide nanoparticles obtained in form of light yellow coloured powder. This powder mashed in ceramic mortar pestle to get finer nature for characterization purpose. Figure 3 show the sample picture of ZnO nanoparticles.

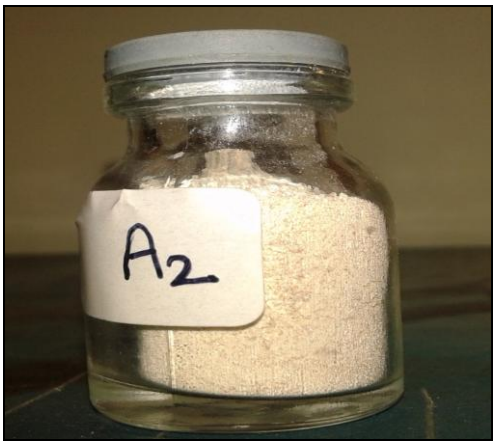

Figure 3: ZnO Nanoparticles

3. Results and Discussion

3.1 X-ray Diffraction (XRD)

XRD pattern of the prepared Zinc oxide nanopowder is shown in figure 4 The observed diffraction peaks of ZnO at 2θ = 36.19° with correspond to lattice plane (101). The similar results were also reported by others [19] The (hkI) values are agreed well with the standard card of ZnO powder sample (JCPDS file No: 36-1451). The crystallite average size Dp of the prepared nanopowder can be calculated by using Scherrer's formula

$$Dp = 0.9\lambda/\beta \text{ Cos } \theta$$

Where λ is the wavelength of X rays used (1.54060 Å), β is the full width at half maximum (FWHM) = 0.63 and θ is the angle of diffraction. The crystallite average size of prepared nano powder is found to be around 13.86 nm which is in the order of nano size. In comparison with the standard card of bulk ZnO with hexagonal structure see Figure 5, no diffraction peaks of other impurities are detected, which testify that the prepared sample is ZnO.

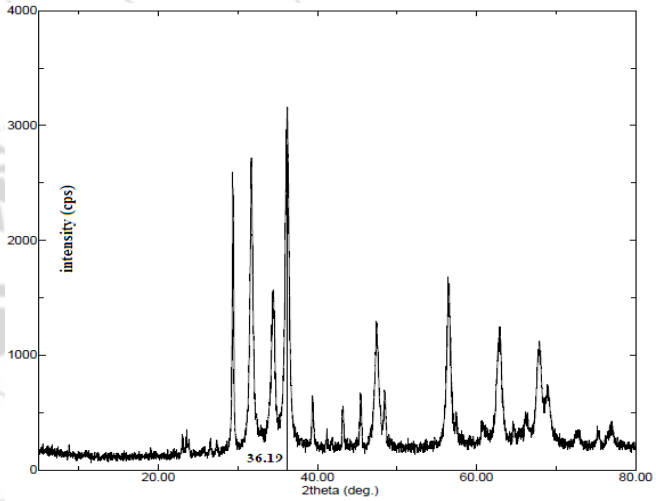

Figure 4: XRD pattern of Zinc Oxide nanoparticles

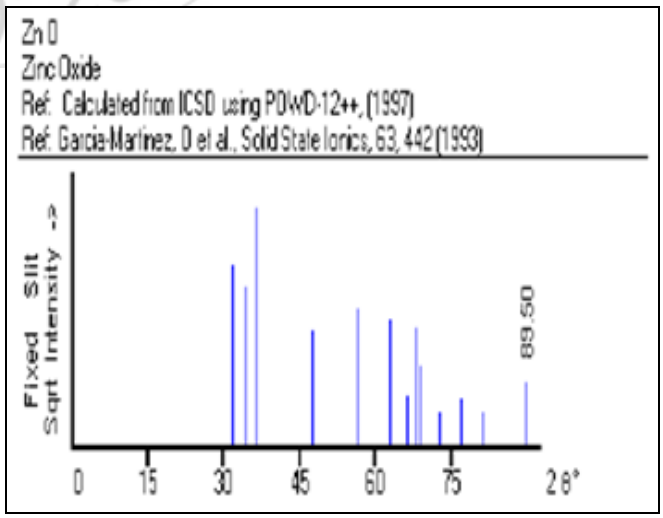

Figure 5: Standard JCPDS card of bulk ZnO with hexagonal structure (JCPDS - 36-1451)

3.2 Scanning Electron Microscope (SEM)

The SEM of ZnO nanocrystalline particles produced by Green synthesis method is shown in Figure 6. The SEM analysis was used to determine the structure of the reaction products that were formed. SEM image has showed individual zinc particles as well as a number of quantity. The SEM image showed hexagonal shape nanoparticle formed with diameter range 11-25 nm.

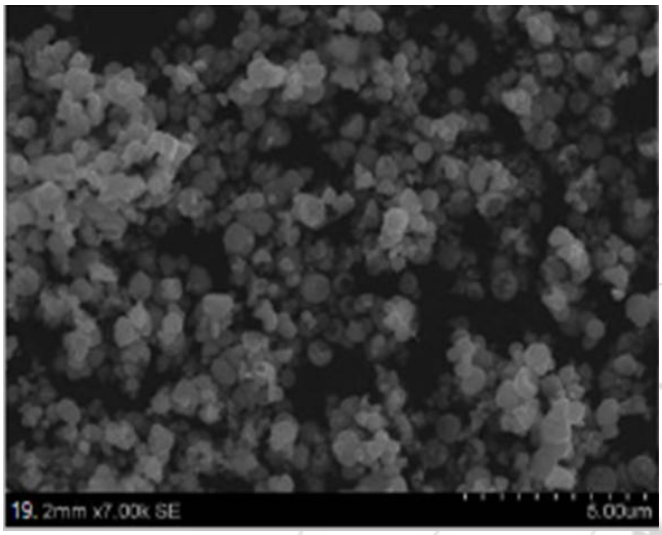

Figure 6: The SEM image of ZnO nanoparticles

3.3 Fourier Transform Infrared Spectroscopy (FTIR)

The FTIR spectrum of ZnO nanoparticles is shown in Figure 7. The fundamental mode of vibration at 3458.04 which correspond to the O-H stretching vibration, 1625.35 which correspond to the N-H bend, 1418.86 which corresponds to C-C stretching vibration of alcohol, carboxlic acid, ether and ester confirmed. 1148.10 corresponds to C-N symmetric stretching vibration. O-H bending of the hydroxyl group at 3458.04 is observed. 913.53 which correspond to O-H bend carboxylic acid present. The absorption at 875.23 is due to the formation of tetrahedral coordination of Zn. The bond at 835.61 is due to the C-Cl stretching vibration. The peak at 668.29 indicates the stretching vibrations of ZnO nano particle which is consistent with that reported before [20]

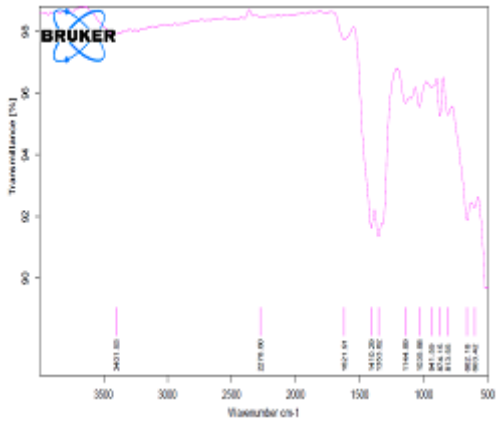

Figure 7: FTIR Spectrum of ZnO nanparticles.

The FTIR spectrum of leaves extract of Ocimum Tenuiflorum is shown in Figure 8. The fundamental mode of vibration at 3276.16 which correspond to the O-H stretch of carboxylic acid group, peak 2122.43 which is correspond to alkynes group, 1635.55 correspond to O-amino group and 510.93 which correspond aromatic in genral. From FTIR of leaves extract of Ocimum Tenuiflorum we can say that this all group play important role in preparation of Zinc Oxide nanoparticles.

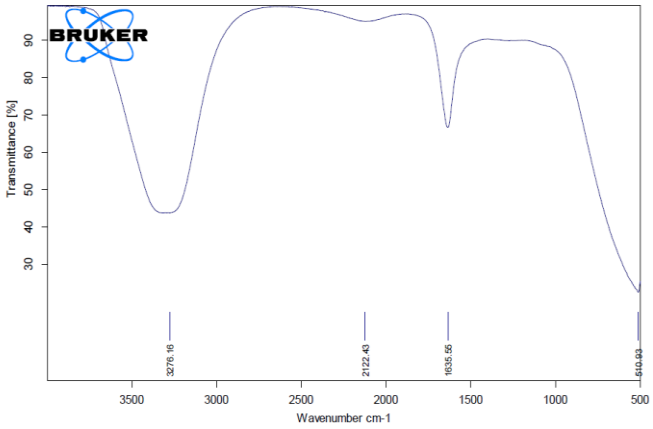

Figure 8: FTIR of leaves extract of Ocimum Tenuiflorum

4. Conclusion

In summary, ZnO nanoparticles are prepared with help of green synthesis method by using leaves extract of Ocimum Tenuiforum. Green synthesis method are simple, non toxic, rapid method. The size and structure of nanoparticles is confirmed with the XRD technique. The synthesized ZnO average particle size is calculated as 13.86 nm by using Scherrer's Formula. The SEM image showed hexagonal shape nanoparticle formed with diameter range 11-25 nm. The characteristic peak of ZnO at 668.29 in IR absorption spectra is also noticed and carboxylic acid group, alkynes group, o-amino group are present in leaves extract of ocimum tenuiflorum. These ZnO nanoparticles can be used in various industrial applications like active medium for lasers, luminescent material for fluorescent tubes, paints, and so forth.

References

[1] H. S. Nalwa, Encyclopedia Of Nanoscience and Nanotechnology, American Scientific Publishers, Vol. 10, pp. 1-46, 2007.
[2] E. Fortunato et. al., "Recent Advances in ZnO Transparent Thin Film Transistors", Journal Of Thin Solid Films Vol. 487, pp.205-211,2005.
[3] X. L. Cheng et. al., " ZnO Nanoparticulate Thin Film: Preparation, Characterization and Gas Sensing Property", Journal Of Sens. Actuators, Vol. 102, pp. 248-252,2004.
[4] M. Fonrodona et. al., "PEN as Substrate For New Solar Cell Technologies", Journal Of Sol. Energy Mater. Sol. Cells, Vol. 89, pp. 37-47, 2005.
[5] R. P. Wanga et. al., "Ultraviolet Lasing With Low Excitation Intensity In Deep Level Emission Free ZnO

Films", Journal Of Cryst. Growth, Vol. 282, pp.359-364, 2005
[6] M. Vaseem, A. Umar, ZnO Nanoparticles: Growth, Properties, and Applications, American Scientific Publishers, Vol. 5, pp.2-3, 2010.
[7] M. Vafee, M. S. Ghamsari, "Preparation and characterization of ZnO nanoparticles by a novel sol-gel route", Journal of Material Letters, Vol. 61, pp. 3265-3268, 2007.
[8] D. Tiwari et. al., "Application Of Nanoparticles In Waste Water Treatment", Jouranal Of World Applied Science, Vol. 3(3), pp. 417-433, 2008.
[9] Gananasangeetha D. et.al., "One Pot Synthesis Of Zinc Oxide Nanoparticles via Chemical and Green Method", Research Journal Of Material Science, Vol. 1(7), pp. 1-8, 2013.
[10] M. Guzman et.al., "Synthesis Of Silver Nanoparticles By Chemical Reduction Method And Their Antibacterial Activity", International Journal Of Chemical And Biomolecular Engineering, Vol. 2(3), pp. 104-111, 2009.
[11] J. M. Cho et.al., "Characterization Of ZnO Nanoparticles Grown By Laser Ablation Of a Zn Target In Neat Water", Journal Bull. Korean Chem. Soc., Vol. 30(7), pp. 1616-1618, 2009.
[12] Doungporn Yiamsawas et.al., "Preparation Of ZnO Nanostructures By Solvothermal Method", Journal Of Microscopy Society Of Thailand, Vol. 23(1), pp. 75-78, 2009.
[13] Ho Chang et.al., "Synthesis And Characterization Of ZnO Nanoparticles Having Prism Shape By A Novel Gas Condensation Process", Journal Of Rev. Adv. Mater. Sci. Vol. 18, pp. 734-743, 2008.
[14] H. Li et.al., "Zinc Oxide Film Prepared By Sol-Gel Method", Journal Of Cryst. Growth, Vol. 275, pp. 943-946, 2005.
[15] M. Rama et.al., "Phytochemical Constituent And Antioxidant Activity Of Extract From The Leaves Of Ocimum Sanctum Green And Purple", International Journal Of Chemical And Pharmaceutical Research, Vol. 2(2), pp. 55-65, 2013.
[16] http://en.wikipedia.org/wiki/Ocimum_tenuiflorum
[17] V. D. Kulkarni et.al., "Green Synthesis Of Copper Nanoparticles Using Ocimum Sanctum Leaf Extract", Internationa Journal Of Chemical Studies, Vol. 1(3), pp. 1-4, 2013.
[18] D. Philip et.al., "Extracellular biosynthesis of gold and silver nanoparticles using Krishna tulsi (Ocimum sanctum) leaf," Physica E Low-dimensional Systems and Nanostructures, Vol. 43(7), pp. 1318-1322, 2011
[19] Ampritpal singh et.al, "Preparation of ZnO nanoparticles by solvothermal process" International Journal for Science and Emerging Technologies with Latest Trends, Vol. 4(1), pp.49-53, 2012
[20] K. Ravichandrika et.al, "Synthesis, Characterization And Antibacterial Activity Of Zno Nanoparticles," International Journal Of Pharmacy And Pharmaceutical Sciences, Vol 4, Issue 4, pp. 336- 338, 2012