DOI : 10.15613/sijrs/2018/v5i1/188671
ISSN (Print): 2349-8919
ScieXplore: International Journal of Research in Science, Vol 5(1), 27-29, January–June 2018 ISSN (Online): 2350-0999

Preparation and Characteristics of ZnO Nanoparticles using Orange Peel Extract

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Abstract

Zinc oxide (ZnO) is an inorganic compound which is insoluble in water. This is used as an additive in many materials. Due to its antibacterial activity ZnO used in many medical applications. ZnO nanoparticles can be synthesised using green method, and characterized. For the analysis of particle size and structure XRD is used. FTIR is used to analyse the functional group. The surface morphology of the material analysed using SEM. EDAX is used to analyse the elemental group present in the material. In antibacterial activity the zone of inhibition for different bacteria are measured.

Keywords: Inorganic, EDAX, FTIR, SEM, XRD

1. Introduction

Nanomaterials are most commonly synthesised using chemical roots. But nanomaterials can also prepared by biological roots instead of chemical roots. This is called green synthesis method. This involves producing nanomaterial using plant, fruit extract or this extract can be used as reducing or stabilizing agent. Here orange peel extract is used as reducing agent to produce ZnO nanoparticles[1,2].

ZnO is a non-toxic material and this is synthesised using eco-friendly green synthesis method. Nanosize material properties are different from their bulk material. So this nano ZnO can be used in many applications[3].

ZnO nanoparticles have good antibacterial, anticorrosive, antifungal and UV filtering properties. ZnO used as a filter in manufacture of rubber and cigarettes and food products. In various paints it is used as a coating agent. To treat skin disease ZnO used in calamine lotion, creams and oinments[4].

2. Experimental Details

2.1 Orange Peel Extract

Fresh orange peel extract is prepared by adding 100g of orange peel in 250ml distilled water and boiled for 2hrs in 100°c and filtered. Finally, the filtered extract is used in the preparation of nanoparticles.

2.2 ZnO Nanoparticles

10g of zinc acetate dehydrate is added to 40ml of orange peel extract and stirred for ½ hr. then NaOH Soln is added and stirred for 2hrs. Then aged for 24hrs in room temperature and dried at 100°c in oven, grained and calcinated for 4hrs in furnace. Finally, ZnO nanoparticles were obtained.

3. Result and Discussion

3.1 X-Ray Diffraction

Figure 1 shows the XRD pattern of ZnO. The sharp peaks present in the XRD pattern shows that ZnO is highly crystalline in nature. From the graph, lattice plane values compared with the standard JCPDS values and the hexagonal wurzite structure of ZnO was conformed. Using Schere's formula the crystalline size is calculated and it was 25.575nm. This conforms that Zno is in nanosize. From the XRD pattern some more parameters were found they are lattice constant value a = 3.24 & b = 5.19, Dislocation density = 1.53 x 10^{15}m and microstrain = 1.3556.

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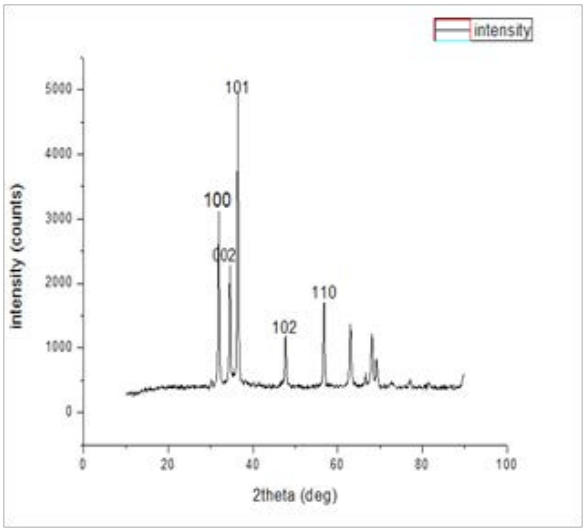


Figure 1. XRD pattern of ZnO.

3.2 Fourier Transform Infrared Spectroscopy (FTIR)

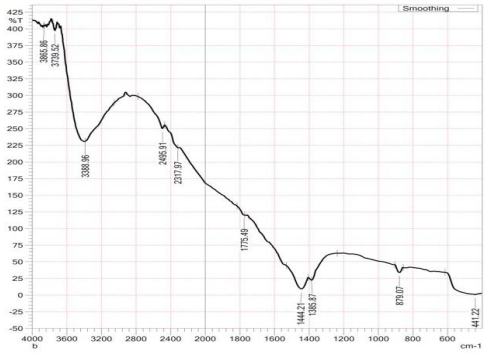


Figure 2. FTIR pattern of ZnO.

Figure 2 shows FTIR spectroscopy of ZnO. The peaks represents the functional groups present in the material. The peak at 3739cm^{-1} and 1385cm^{-1} corresponding to OH stretching and bending, CH stretching at 1444cm^{-1} bending at 1775cm^{-1}, NH stretching at 3388cm^{-1} and the metal oxide linkage is at 441cm^{-1}.

3.3 Scanning Electron Microscope (SEM)

SEM image of ZnO is shown Figure 3. This shows the surface morphology of ZnO is spherical in shape.

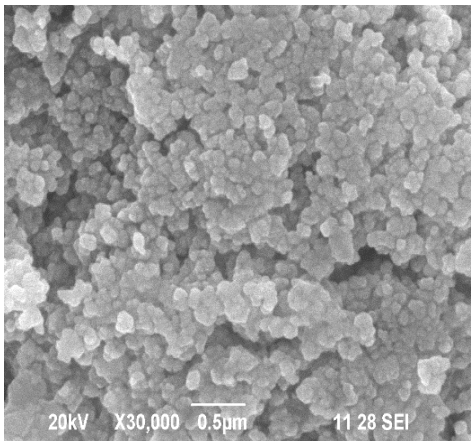


Figure 3. SEM image of ZnO.

3.4 Energy Dispersive X-Ray Spectroscopy (EDAX)

EDAX of ZnO is shown in Figure 4. This conforms the elemental groups such as zinc and oxygen. And the weight percentage of Zn and O are also obtained.

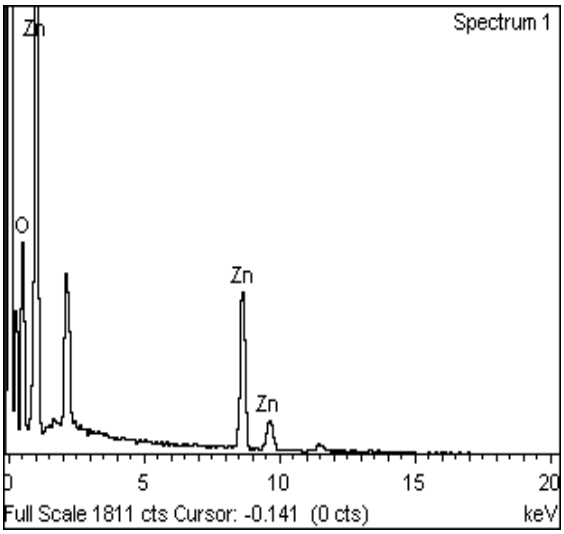


Figure 4. EDAX of ZnO.

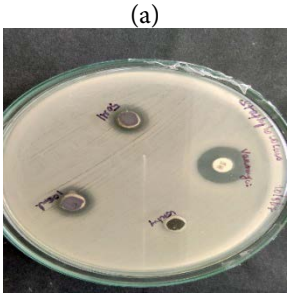
3.5 Antibacterial Activity

The antibacterial activity for both gram positive and gram-negative bacterias were investigated. This is done using augar well diffusion method. The microorganisms and their zone of inhibition are tabulated. Here *Bacillus cereus* and *Staphylococcus aureus* are taken as gram positive bacteria, and *Escherichia coli* and *Klebsiella pneumonia* are gram negative bacteria. ZnO shows good zone of inhibition for all the bacterias.

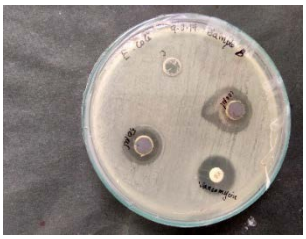
Table 1. zone of inhibition values of ZnO

S.NO.	MICROORGANISMS	ZONE OF INHIBITION (ZnO) IN DIAMETER (MM	
		50 µL	100 µL
1	*Bacillus cereus*	17	19
2	*Staphylococcus aureus*	13	15
3	*Escherichia coli*	20	24
4	*Klebsiella pneumoniae*	18	20

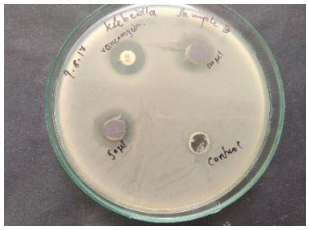
(a)



(b)



(c)



(d)

Figure 5. (a). ZnO vs. *Bacillus cereus*, (b). ZnO vs *Staphylococcus aureus*, (c). ZnO vs. *E.coli*, (d). ZnO vs. *Klebsiella pneumonia.*

4. Conclusion

- The ZnO nanoparticles are symthesised using green method and characterized. The results are,
- The crystalline nature and the crystalline size are conformed using XRD, and the cubic structure of ZnO was confirmed by the lattice constant value.
- The functional groups are conformed by using FTIR spectroscopy.
- SEM analysis provides the surface morphology of ZnO which is nearly spherical in shape.
- EDAX conforms that the prepared sample is ZnO, by sharp peaks which indicates the elemental groups Zinc and Oxygen.
- The antibacterial activity shows good zone of inhibition for all the bacterias. By using the green synthesis method the antibacterial activity increased.

5. Reference

1. Narayanan KB and Sakthivel N. Green synthesis of biogenic metal nanoparticles by terrestrial and aquatic phototropic and hetrrotropic eukaryotes and biocompactible agents. Advances in Colloid and Interface Science. 2011; p. 59-79. https://doi.org/10.1016/j.cis.2011.08.004 PMid:21981929
2. Singh M, Manikandan S and Kumaraguru AK. Nanoparticles: a new technology with wide applications. Research Journal of Nanoscience and Nanotechnology. 2011; p. 1-11. https://doi.org/10.3923/rjnn.2011.1.11
3. Shah MA and Shah KA. Nanotechnology - the science of small. New Delhi, Wiley.
4. Available from: http://www.azonano.com/article.aspx?ArticleID=3348.