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Consolidate and Performance of Zinc Oxide Nanocomposite

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ABSTRACT: Zinc oxide and Zinc Oxide-Polyvinyl alcohol (PVA) -Polyvinylpyrrolidone (PVP) composites have been prepared by co-precipitation method. It is a simple and low-cost method for preparing composites. The concentrations of PVA and PVP were varied during the process of synthesis. FTIR characterization was performed to study the characteristic functional group. The presence of metal oxide group were conformed using FTIR graph and several other functional group were also been conformed using FTIR graph.UV-VIS characterization was performed to observe the absorption bands. UV-VIS spectra of the sample in the range 200-800nm is recorded. Using antibacterial studies, it is known that the prepared sample acts as a good antibacterial agent.

KEYWORDS: ZnO; Polyvinyl alcohol; Polyvinylpyrrolidone; Nanocomposites;

I. INTRODUCTION

A nanocomposite is a material with dimensions in the nanometer range. A structure formed when two or more materials, such as ceramics and polymers, are combined rather than as separate structures is called a composite. The challenge in developing nanocomposites is to find ways to create macroscopic components that take advantage of the unique physical properties and durability of the smaller particles within them. Sensing device performance and opening up new horizons for their applications. Nanoparticles and nanotubes made of various materials are already impacting the field of chemical sensors. Nanocomposites are used to detect proteins, acids, and pollutants. The properties associated with nanowires allow us to replace them with other elements such as polymers or matrices, thus obtaining highly selective materials. Sensors using nanocomposites should have a great impact on medical diagnosis, environmental monitoring, safety monitoring, and food safety. Metal oxide nanoparticles placed in a polymer matrix can be easily obtained by reducing metal oxide ions from salt solutions at the polymer interface. Many metals have a reducing power for certain metal ions when in reduced form; therefore, some metal ions with good redox potential, such as gold, silver, platinum, and copper, can be polymerized in the electronic physical phase. Composite materials with polymer shell-coated metal nanoparticles can also be prepared by chemical or electrochemical polymerization of nanoscale polymer thin layers for composites (Ahmed 2019).

Synergistic and hybrid energy have attracted the attention of many researchers. The ability of organic polymers to be easily processed, together with the better optical properties and optical properties of nanoparticles, has led to a wide range of applications. These are nanocomposites based on polymer materials in any matrix and are better defined as nanofilled polymer composites that can be prepared using polymers materials. (Ahmet2019).

In this work we prepared Zinc oxide- Polyvinyl alcohol (PVA) – Polyvinylpyrrolidone (PVP) composite is been prepared. The method used for preparation is co-precipitation method. These polymers have been chosen as they are water soluble. The composites are prepared to study their characteristics by varying the percentage of the polymers incorporated. FTIR characterization was performed to study the characteristic functional group. The presence of OH group were conformed using FTIR graph and several other functional groups were also been conformed using FTIR graph. UV-VIS characterization was performed to observe the absorption bands. A UV-VIS spectrum of the sample in the range 200-800 nm is recorded. It is evident that the sample has transparency window from 220nm to 800 nm. The antibacterial activity was also been performed and states that the prepared sample is not sensitive to the E.coli bacteria and resists its growth.

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II. EXPERIMENT

Preparation of ZnO

The following chemical were used in this synthesis processes: zinc acetate, Sodium hydroxide. Firstly 2 grams of zinc acetate is added to the distilled water and is stirred using the magnetic stirrer for one hour. Now 2 grams of sodium hydroxide is added drop by drop to the above solution and it is kept in magnetic stirrer until the formation of a clear solution. The newly formed solution is allowed to precipitate and then rinsed with deionized water for several times. Then it is dried and the powder is collected. The powder is then kept in crucible and placed inside muffle furnace for 2½ hours and it is maintained at 200°C.

III. PREPARATION OF ZNO –PVA-PVP COMPOSITE

The following chemical were used in this synthesis processes: Zinc oxide, Sodium hydroxide, Polyvinyl alcohol (PVA), Polyvinylpyrrolidone (PVP).The polymer solution is prepared by adding 0.10 grams of PVA in 50ml of deionized water and kept in magnetic stirrer for 50 minutes. Then 0.10 grams of PVP is dissolved in the above solution. After 10 minutes 2 grams of zinc acetate is added to the polymer solution. Now 2 grams of sodium hydroxide is added drop by drop to the above solution and it is kept in magnetic stirrer until the formation of a clear solution. The newly formed solution is allowed to precipitate and then rinsed with deionized water for several times. Then it is dried and the powder is collected. The powder is then kept in crucible and placed inside muffle furnace for 2½ hours and it is maintained at 200°C. Different samples are made by varying the percentage of PVA+PVP using the co-precipitation method. Then the resultant powders are given for characterization.

IV. SAMPLE DETAILS:

Characterization Methods

FTIR characterization was performed to study the characteristic functional group. The presence of OH group were conformed using FTIR graph and several other functional group were also been conformed using FTIR graph. UV-VIS characterization was performed to observe the absorption bands. A UV-VIS spectrum of the sample in the range 200-800 nm is recorded. It is evident that the sample has transparency window from 220nm to 800 nm. The antibacterial activity was also been performed and states that the prepared sample is not sensitive to the E. colibacteria and resists its growth.

Sample No.	Percentage of (PVA+PVP)	Amount of Zinc Acetate	Amount of NaOH	Amount of PVA	Amount of PVP
S-1	10 %	2	2	0.10	0.10
S-2	25 %	2	2	0.25	0.25
S-3	50%	2	2	0.50	0.50
S-4	75%	2	2	0.75	0.75
S-5	100%	2	2	1.00	1.00

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V. RESULTS AND DISCUSSION

FTIR analysis

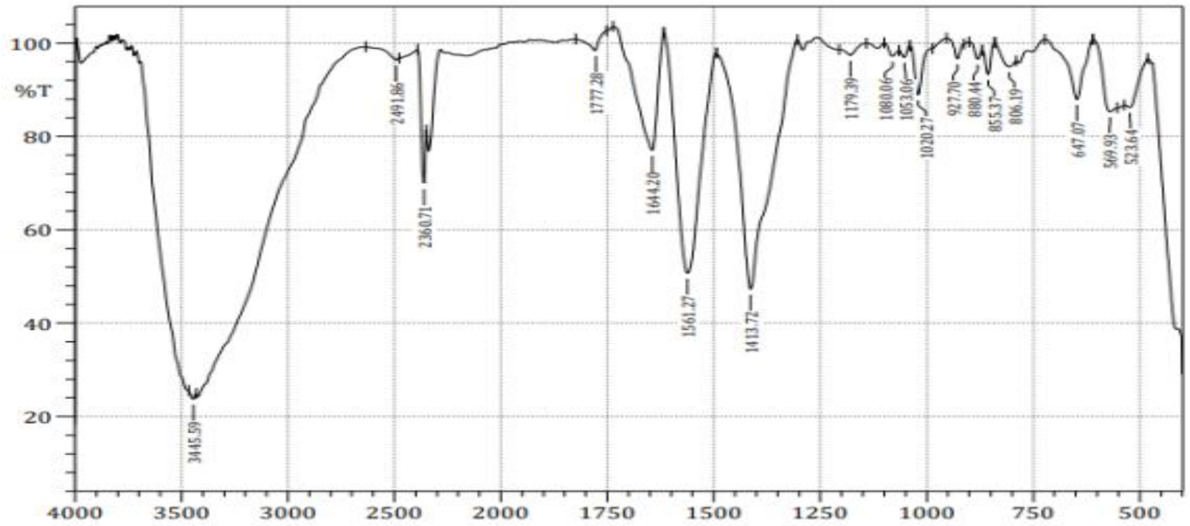

Fig.1- FTIR spectra of S-3 sample

FTIR characterization of the S-3 sample was performed to study the characteristic functional group and FTIR spectra of S-3 sample are shown in fig.1. The peak at 3445 cm−1 is due to OH groups in the polymer backbone, the peaks at 2491 cm^{-1} and 927 cm^{-1} are due to CH_2 asymmetric and symmetric stretching, respectively. The peak observed around 1413 cm^{-1} is due to C–C stretching of ZnO (Taiwo W.2017)

UV-VIS ANALYSIS.

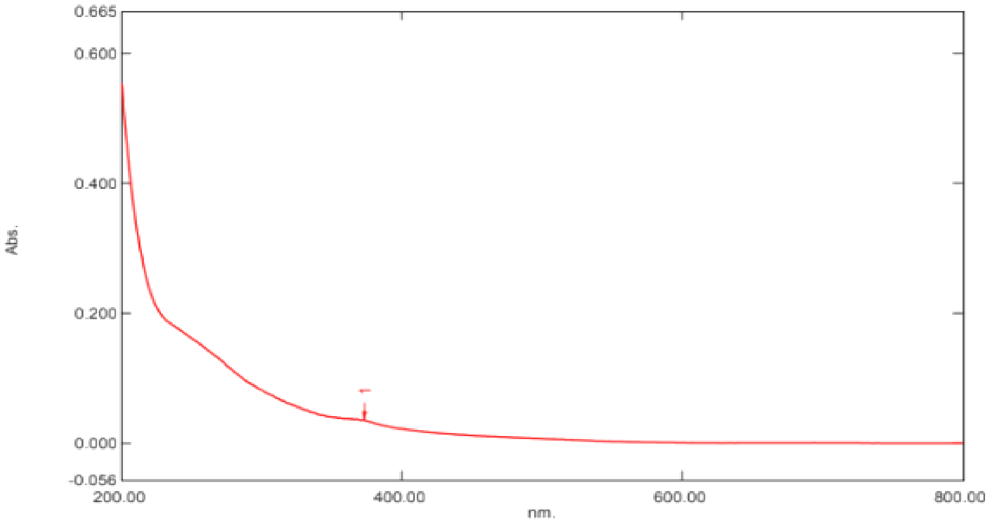

Fig. 2-UV-Vis absorption spectra of S_3 sample UV-Vis

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Absorbance spectra of S3 sample, measured at room temperature is shown in fig.2. The UV-Vis spectra of sample in the range 200-800nm is recorded. It is evident that the sample has transparency window from 220nm to 800nm.There is an absorption peak observed at 373 nm. The sharp increase in absorbance below 373nm is typical of zinc oxide. The ZnO particle spectrum exhibits an obvious blue-shift excitation. From the fig.2 it is possible to observe an absorption band at 225 nm attributed to PVA polymer, this band arises due to the presence of carbonyl containing structures connected to the PVA polymeric chains (Luca Spitaleri 2019).

Antibacterial Studies

Fig. 3- Formation of zone of inhibition of S_4 sample

The method of Well diffusion assay was used to observe the antibacterial activity of theS4 sample. Nutrient agar was prepared and poured in the sterile Petri dishes and allowed to solidify. 24 hours growing bacterial culture of bacterial pathogens was swabbed on it. Then, the test sample in 375 µg concentration was loaded in the wells made using cork borer. Tetracycline (20µL) was used as positive control. The plates were then incubated at 37ºC for 24hours. After incubation the inhibition diameter was measured and units are denoted as mm. the pathogen used was E.colibacteria. This is a gram negative bacterium. Their zone of inhibition was found to be 18mm.This states that the prepared sample is not sensitive to the E.colibacteria. The zone of inhibition of the prepared sample is near to the standard value and this indicates that the sample works as an antibacterial agent and resists its growth (Taiwo W.2017).

VI. CONCLUSION

ZnO-PVA-PVP nanocomposites have been prepared by co- precipitation method using zinc acetate as starting material. Different samples are made by varying the percentage of PVA+PVP using the co-precipitation method. FTIR characterization conforms the functional group present in the samples. UV-VIS characterization was performed to observe the absorption band and the sample shows very good transmittance in the entire visible region. Using antibacterial studies it is known that the prepared sample acts as a good antibacterial agent.

VII. ACKNOWLEDGEMENTS:

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