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SYNTHESIS AND CHARACTERIZATION OF ZnO NANO PARTICLES BY USING CITRUS SINENSIS PEEL EXTRACT

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ABSTRACT

The synthesis of zinc oxide nano particles with the use of fruit peel is a promising alternative to traditional chemical method. The green synthesis of zinc oxide nano particles using peel extract from Citrus Sinensis (Orange fruit). It acts as reducing agent for synthesis of ZnO because orange fruit contain citric acid, as main source in its peel. This method is non-toxic and eco-friendly. The biologically synthesized ZnO nano particles were characterized by UV-Visible spectroscopy to analyze the absorption patterns, Fourier transform infrared spectroscopy (FTIR) is used for analyzing the functional groups and scanning electron microscopy (SEM) & XRD.

Key words: Citrus Sinensis, UV, FTIR, SEM, XRD

1. INTRODUCTION

Since organic antibacterial agents are sensitive to processing conditions such as high temperature and pressure, in recent years, inorganic antibacterial agents have become a new area of research interest for the control of microbes. Antibacterial activity is still strong even at low concentrations of inorganic materials, particularly metal oxides. Compared to organic antibacterial agents, the main advantages of inorganic antibacterial agents are their good stability at high temperatures and pressures and their long shelf-life. Currently, the most widely used inorganic antibacterial materials are metallic nano particles and metal oxide nanoparticles.

Zinc oxide is a semiconducting inorganic material with three different crystal structures: wurtzite, zinc blende, and rocksalt. At ambient conditions, the structure of wurtzite is thermodynamically stable, with every zinc atom being tetrahedrally coordinated with four oxygen atoms. With a wide band gap of 3.1–3.3 eVzinc oxide has great potential for application in many fields, such as biosensors, cosmetics, drug carriers, and antibacterial agents. ZnO can be synthesized by many different methods, such as sol–gel processing, homogeneous precipitation, mechanical milling, organometallic synthesis, the microwave method, spray pyrolysis, thermal evaporation, and mechanochemical synthesis. However, these kinds of methods usually use organic solvents and toxic reducing agents, the majority of which are highly reactive and harmful to the environment. Therefore, in order to minimize the impact on the environment, green synthesis processes have been used to synthesize ZnO nanoparticles (ZnO NPs). Green synthesis is a method to produce nanoparticles using microorganisms and plants with biomedical applications. This method has many advantages, such as environmental friendliness, cost-effectiveness, biocompatibility, and safety. Additionally, many studies have proved that ZnO NPs made using green synthesis processes have strong antibacterial properties.

Orange fruit is one of the most productive fruit in the world. Orange fruit peel, as the main by-product of citrus, is rich in a variety of natural anti-oxidants. Therefore, the extract of orange peel is considered to be used as a stabilizer to prepare ZnO NPs. However, ZnO NPs green synthesis based on extracts of orange fruit peel are not studied fully. Particularly, the influence of pH value and annealing temperature on morphology and properties of ZnO NPs by green synthesis till lacks of understanding. Herein, ZnO NPs were synthesized *via* a green process using orange fruit peel extract and investigated the influence of pH and annealing temperature on morphology and antibacterial activities. The morphology and structure of the ZnO NPs were characterized using a transmission electron microscope (TEM), X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FTIR). Furthermore, the antibacterial activity of ZnO nanofluids was tested against *S.* aureus and E. coli via a broth dilution method. In order to optimize the bactericidal activity of the ZnO NPs, measurements were carried out with various types of ZnO NPs fabricated at different annealing temperatures and pH levels.

2. MATERIALS

Orange was purchased from local market in uthangarai town. Zinc Sulphate was purchased from krishnagiri, distilled water was purchased and used for further process.

2.1 Synthesis of ZnO:

The synthesis procedure consists of three simple steps**.**

i) Preparation of Orange Peel Extract

ii) Preparation of Zinc Sulphate Solution

iii) Preparation of ZnO Nano particles

2.2 Preparation of Orange Peel Extract:

Orange Peel was collected and crushing it and converted into powder form. 12 g of orange peel extract was added with 100 ml of deionized water in 250 ml of beaker. Then the solution was stirrer for 1 hour. The extract was filtered.

Fig. Crushing orange peel and its extract

2.3 Preparation of Zinc Sulphate Solution:

7g of Zinc Sulphate was added with 100 ml of deionized water and stirrer for 30 min. Then Zinc Sulphate Solution was obtained**.**

2.4 Preparation of ZnO Nano particles

Orange peel extract is added with Zinc Sulphate Solution and stirrer for 4 hours. Then Sodium Carbonate was added drop wise into it, and maintained the pH level 12. Then the nano particles formation occurs and settled at the bottom of the beaker. Then nano particles were filtered and oven dried for 12 hrs. ZnO nano particles was obtained.

3. RESULT AND DISCUSSION:

In this result and discussion section clearly explain about the particle nature, the particle size, shape, and absorption band, functional groups by using the characteristics results of XRD, FT-IR, UV-Visible spectroscopy and SEM analysis.

3.1 X-RAY DIFFRACTION ANALYSIS:

The X-ray diffraction is used to measure of the nano particles. The average grain size of the sample was estimated with the help of Scherer's equation using the diffraction intensity of peak. In fig (5.1) XRD pattern of synthesized ZnO NPs. The ZnO peaks present at (31.71), (34.55), (36.31), (47.48), (56.69), (62.82), (67.79), (76.85)is miller indexed (100), (002), (101), (102), (110) , (103), (112), (202) and it is found Hexagonal crystal structure.

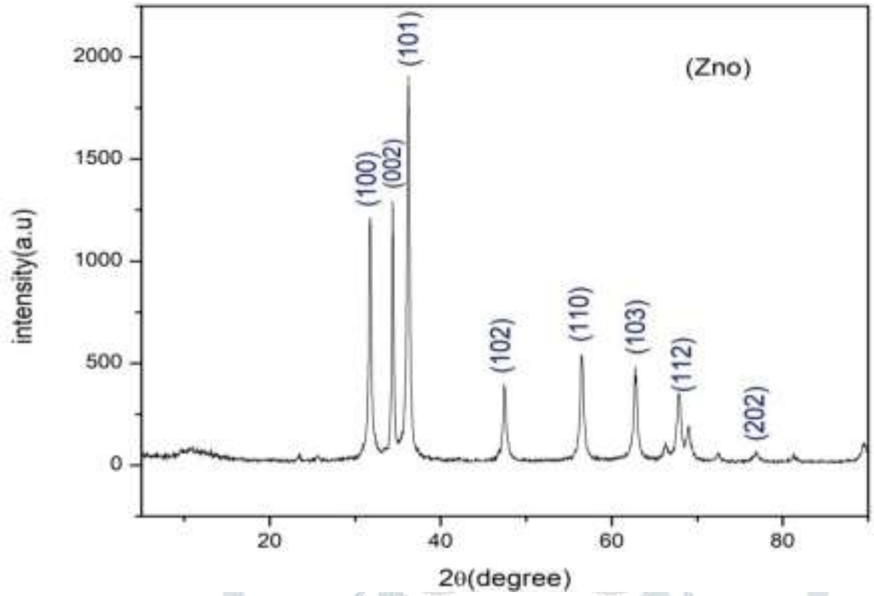

Fig:3.1 :XRD Patten of ZnO nano particels

5.2 FOURIER TRANSFORM – INFRARED SPECTROSCPY:

Fourier transforms infrared spectroscopy measurements are carried out to identify the functional group of synthesized compound. The FTIR spectrum of zinc oxide nano particles was recorded. The peak at 3410.53 cm^{-1}, 2928.23 cm^{-1}, 1602.13 cm^{-1}, 1434.17cm^{-1},1126.23cm^{-1},878.29cm^{-1},553.56cm^{-1}.

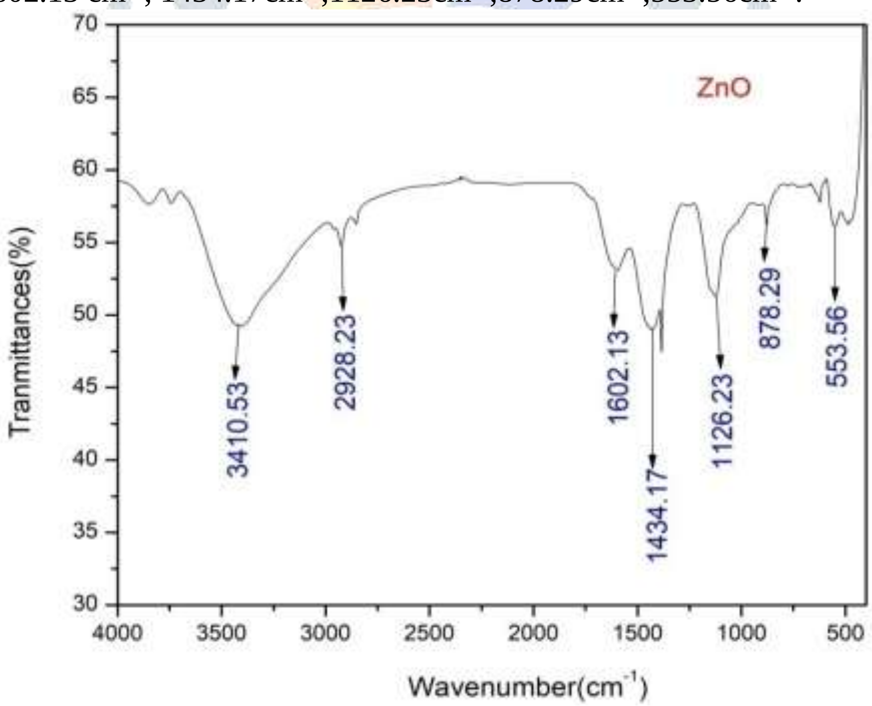

Fig 3.2 Fourier transforms infrared spectroscopy

5.3 UV- VISIBLE ABSORBTION SPECTRUM ANALYSIS:

The absorption spectrum of the synthesized zinc oxide nano particles with the absorption peak around 220nm. It indicates that ZnO nano particles displays excitation absorption (at 220 nm) due to their large excitation binding energy at room temperature. The sharp bands of zinc colloids were observed at 220 nm, which proves that the zinc ion is efficiently reduced by the orange peel extract. The wavelength of 220nm absorption peak confirms the accuracy of blue-shifted absorption spectrum with respect to the bulk value (220nm) of the ZnO nano particles, due to the quantum confinement effect, which is good agreement with the previous report.

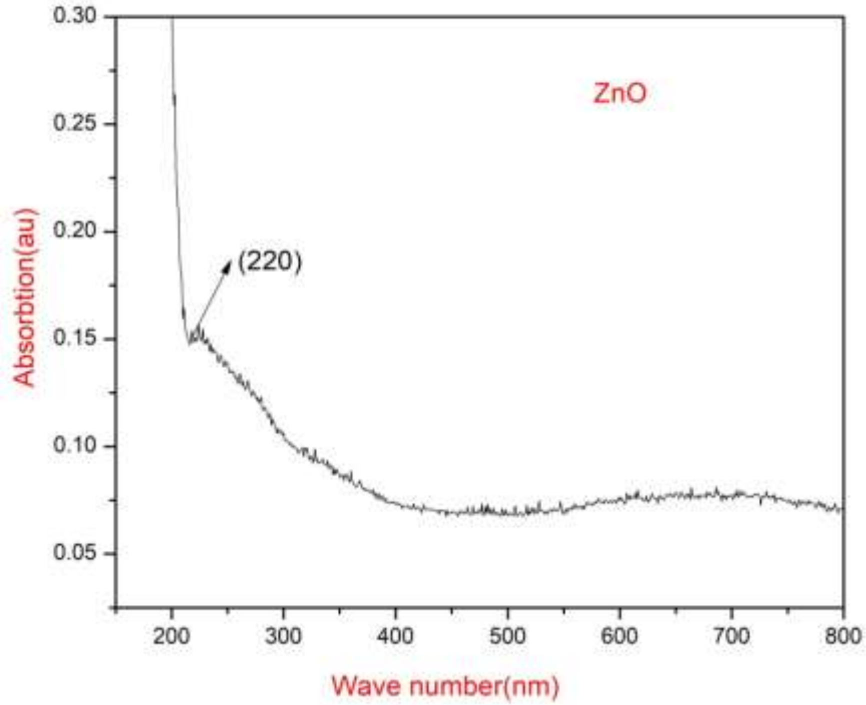

Fig 3.3 UV-visible absorption spectral analysis.

5.4 SCANNING ELECTRON MICROSCOPY ANALYSIS:

SEM is one of the techniques for the surface study of the samples and it gives important information regarding the growth mechanism of the particles the entire SEM picture clearly shows the average size of the nano particles in the order of nanometer size. The morphology of the synthesized particles measured by SEM is given in fig (5.4). The shape of the ZnO nano particles is turned over into spherical shape.

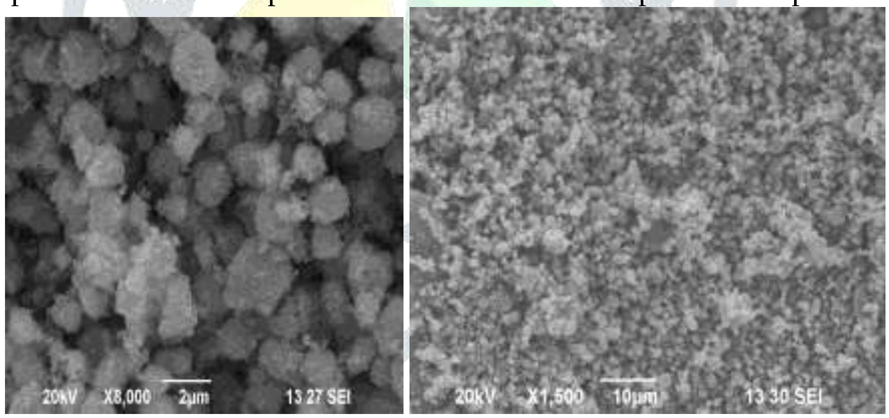

Fig 3.4 SEM images of ZnO nano particle

CONCLUSION

The synthesized nano particles were characterized by different analytical techniques such as UV-visible, FTIR, XRD, and SEM. The UV-visible spectrum finding the band gap energy values 5.6 eV and the absorption peaks at 220. The XRD analysis confirmed the zinc oxide nano particles structure was hexagonal and the particle size was 27.3 nm. The FTIR analysis confirmed the different functional group like amines, alkenes, carboxylic acids. The shape of the ZnO nano particles is turned over into spherical shape.This research provides a Cost – effective and environmentally begin alternative to conventional methods, demonstrating the potential of agricultural waste for the scalable production of ZnO nanomaterial for using various applications, including catalysis, environmental remediation and bio-sensing.

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