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Synthesis of Zinc oxide Nanoparticles by Wet Chemical Method

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ABSTRACT: Nanotechnology is an emerging interdisciplinary technology that has been used in many areas in the last decades. A Zinc Oxide nanoparticle (ZnONPsNP's) has a great importance due to different properties like anti-wrinkle, anti-microbial, fire retarded etc. It can be used for the various applications in textiles. ZnONPsNP's can be synthesized by various methods like wet chemical methods, sol-gel method, co-precipitation and biological methods etc. In this work ZnONPsNP's were synthesized by wet chemical method. Zinc acetate (0.1M) and potassium hydroxide (0.1M) are mixed together in presence of 50% ethanol at room temperature give precipitates and filtered. The precipitated was then heated in muffle furnace at 300°C to for 3-4h. Different concentration of Ethanol was used as a solvent for homogeneity of the solution and it help to make a stoichiometric solution in order to obtain ZnONPsNP's. As obtained ZnONPsNP's are characterized Using Ultraviolet visible spectroscopy (UV-Vis), Particles size analyzer (CPS), X-ray Diffraction (XRD). The antimicrobial activity of ZnONPsNP's was carried out using agar-well diffusion method. The results shows that UV-Vis absorption wavelength 365nm,CPS shows the average particles size 88nm and XRD data gives the crystalline structure of ZnONPsNP's. The antimicrobial activity against Gram positive and gram negative organisms was found 17mm and 10mm respectively. Theses ZnONPsNP's were used for rayon textiles applications.

Keywords: Zinc oxide nanoparticles; Wet chemical method; Ethanol; Antibacterial activity; Textiles.

INTRODUCTION: Recent advances in the field of nanotechnology, particularly the ability to prepare highly ordered qualitative and quantitative nanoparticles of different size and shape [1]. Noble metal oxide nanoparticles have been the subject of focused research due to their electronic, optical, mechanical, magnetic and chemical properties [2]. Application of metal oxide nanoparticles within size range of 1-100 nm has novel and various properties. Nanotechnology is the production and use of particles at the smallest scale. Textile industry is also experiencing the benefits of nanotechnology in its diverse field of applications [3]. Nanoparticles are very interesting because of their surface properties, different from bulk materials. Such properties make possible ordinary products with new functionalities [4].

ZnONPs is an inorganic compo generally in a crystalline form. The ZnONPsNP's has found wide ranging applications in various areas due to its unique and physical and chemical properties compared with bulk ZnONPs. The large specific surface area, high pore volume, Nano structured properties, low cost and less toxicity of nano ZnONPs make it a promising candidate, particularly in catalysts, photo catalysis, electrostatic dissipative coating, transparent UV protection films, and chemical sensors[5]. Zinc oxide is a semiconductor with wide band gap (3.37eV), high excitation binding energy (60 meV) at room temperature and has unique optical and as well as excellent thermal and chemical stability. ZnONPsNP's have gathered the increasing interest of the scientific and industrial community due to diverse application in sensors, catalysis, cosmetics, paints, fibers, drug-delivery antibacterial and luminescence properties [6].

Different methods have been reported in the literature for synthesis of ZnONPs nanoparticles, categorized into either chemical or physical methods, such as nanolithography, physical vapour deposition (PVD), chemical vapour deposition, spray conversion processing, sol-gel process, wet chemical method. and precipitation method[7].

In this work ZnONPsNP's were synthesized by wet chemical method. Zinc acetate (0.1M) and potassium hydroxide (0.1M) are mixed together in presence of 50% ethanol at room temperature give precipitates and filtered. After the dry on oven heating we will characterized the sample. As obtained ZnONPsNP's

are characterized Using Ultraviolet visible spectroscopy (UV-Vis), Particles size analyzer (CPS), X-ray Diffraction (XRD). The antimicrobial activity of ZnONPsNP's are done by Disk well diffusion method. And it can be further used in application for the textile.

MATERIALS AND METHODS: Recent advances in the field of nanotechnology, particularly the ability to prepare highly ordered qualitative and quantitative nanoparticles of different size and shape [1]. Noble metal oxide nanoparticles have been the subject of focused research due to their electronic, optical, mechanical, magnetic and chemical properties [2]. Application of metal oxide nanoparticles within size range of 1-100 nm has novel and various properties. Nanotechnology is the production and use of particles at the smallest scale. Textile industry is also experiencing the benefits of nanotechnology in its diverse field of applications [3]. Nanoparticles are very interesting because of their surface properties, different from bulk materials. Such properties make possible ordinary products with new functionalities [4].

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RESULTS AND DISCUSSION: ZnONPsNPs were successfully synthesized via the wet chemical method using equimolar solutions of zinc acetate and KOH.

UV-Vis spectroscopy Analysis: UV-Vis spectroscopy showed a decrease in intensity of the characteristic surface plasmon band in the spectrum for the range of 355-372nm for ZnONPsNPs. As mentioned earlier the range of the spectrum 365nm gives the confirmation for the ZnONPsNP's shown in fig. 1. below.

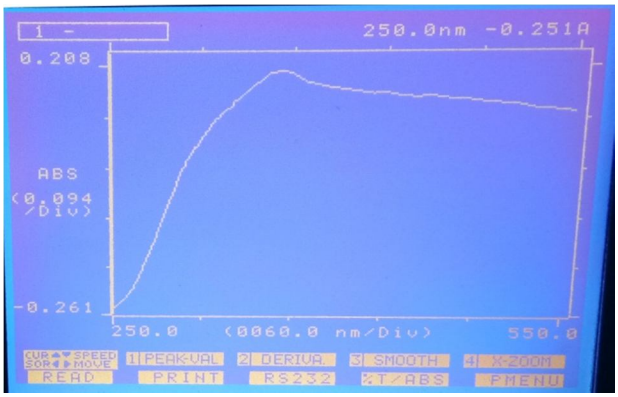

Figure 1: UV-Vis spectrum of ZnONPsNPs obtained by wet chemical method.

X-ray diffraction (XRD) analysis: The X-ray diffraction (XRD) pattern of ZnONPsNP's prepared by wet chemical method using Zinc acetate is shown in fig.2. X- ray diffractogram confirms the crystalline pattern of ZnONPsNPs which is concluded by JCPDS data.[9]

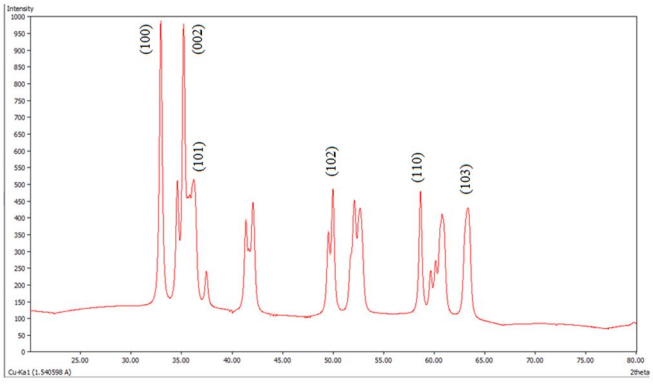

Figure 2: X-Ray spectrum of ZnONPsNPs obtained by wet chemical method.

The XRD patterns of these samples give six distinctive peaks which are the characteristics of ZnONPsNPs.

Particles size analysis: The CPS has ability to measure the size of nanoparticles 1nm to 75µm. Synthesized white powder of ZnONPsNP's is used to particle size analysis. A homogenous solution of ZnONPsNPs in distilled water was obtained by ultra sonication for 30 min. Aqueous solution ZnONPsNPs (1 micro liter) solution is injected into the particle size analyzer (Disc centrifuge).

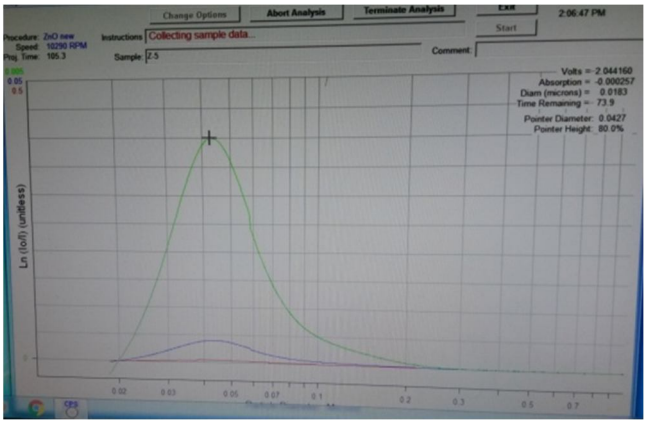

Figure 3: Particle size analysis of ZnONPsNPs obtained by wet chemical method.

A broad peak with maximum intensity shows the particle size ZnONPsNPs is 42-100nm. The peak analysis confirms the particle size is uniformly distributed shown in fig.3.

Antimicrobial activity: Materials used for antimicrobial activity of zinc oxide nanoparticles are Nutrient broth 1.3g, Nutrient agar 5.6g, Agar-agar 0.5g, petriplates, antibiotic discs, cotton swabs, zinc oxide nanoparticles sample, Bacillus *subtilis, Escherichia coli* .Disc diffusion method used for antimicrobial activity of zinc oxide nanoparticles.

Disc diffusion method for Antimicrobial Activity: Antibacterial tests were carried out by the disc diffusion method using the suspension of bacteria spread on nutrient agar. Antimicrobial activity of ZnONPsNPs obtained by wet chemical method against Gram positive and Gram negative bacteria shown in fig.4. The results show the excellent antibacterial activity of the samples which was found to be improving with increase in concentration of ZnONPsNPs. The antibacterial activity of ZnONPsNPs against *S. aureus* was found maximum whereas that against *E. coli* was minimum.

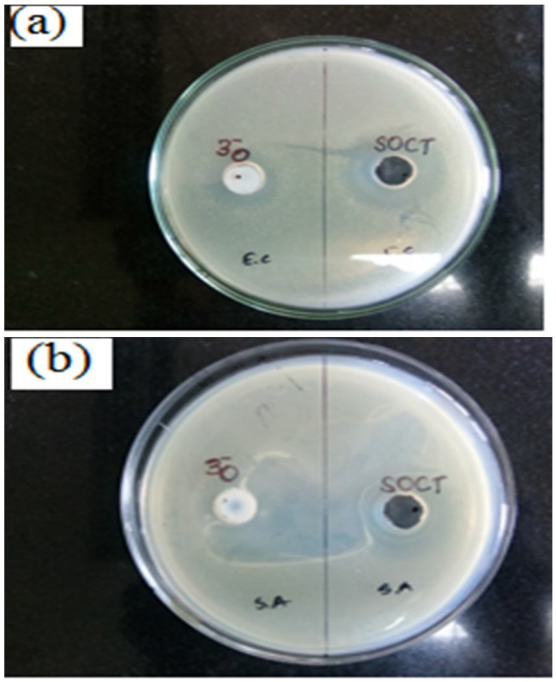

Figure 4: (a) Inhibition ZnONPsNP's against *E. coli* and (b) Inhibition ZnONPsNP's against *S. aureus.*

As shown in fig.(4)(a). Shows the ZnONPsNP's against the *E.coli* with zone of inhibition 07mm & 10mm with different two concentrations (b) shows the ZnONPsNP's against the *S.aureus* 07mm & 12mm with different two concentrations.

CONCLUSION: In this research study, ZnONPs nanoparticles were successfully synthesized via the wet chemical method using zinc acetate**.** Several approaches have been employed to obtain a better synthesis of ZnONPsNPs, such as chemical and biological methods. Development of easy, reliable an ecofriendly methods helps increase interest in the synthesis. In conclusion, a simple method has been developed to prepare nano-ZnONPs and coat the same on cotton fabrics to impart functional properties. The nano-ZnONPs coated cotton fabric is found to have the antimicrobial property. It also clearly demonstrated that the ZnONPs nanoparticles treated fabrics showed increased antibacterial effect than the ZnONPs bulk treated fabrics in comparison with the untreated fabric. The results also demonstrated that higher antibacterial activity was observed against *S.aureus* than *E.coli* both in qualitative and quantitative tests. Nanoparticles showed small amount of agglomeration.

A wet chemical method has been developed to prepare nano-ZnONPs . The nano-ZnONPs found to have the antimicrobial property. It also clearly demonstrated

that the ZnONPs nanoparticles increased antibacterial effect than the ZnONPs bulk. The results also demonstrated that higher antibacterial activity was observed against *S.aureus* than *E.coli* both in qualitative and quantitative test.

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