Plant Archives Volume 20 No. 1, 2020 pp. 2747-2750 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

ANALYTICAL STUDY OF ZNO:NIO NANOCOMPOSITE OF ANTIBACTERIALACTIVITIES

Itab fadhil Hussein*, Asmaa Deiaa Nusseif and Aseel Mustafa Abdul Majeed

Physics Department, College of Science, Mustansiriyah University, Baghdad, Iraq.

Abstract

NiO:ZnO nanocomposite is examined using a cost-effective gel method. X-ray pattern synthesis demonstrates that the prepared NiO:ZnO nanocomposites have a high crystallization with an average size of a 50 nm crystalline bead. SEM images reveal the morphology and particle size distribution of the NiO:ZnO Nano compound, and the average nanoparticle size was about 70 nm. The results showed that antibacterial studies against positive germs (G + Ve) for *S. aureus* and negative Gram (G-Ve) bacteria from E-Coli for concentration (50, 75 and 100 g / ml). The results showed that the antibacterial activity of NiO:ZnO nanocomposite against *S. aureus* bacteria was higher than that of *E. coli*.

Key words : NiO:ZnO nanocomposite, XRD pattern, SEM of ZnO/NiO, antibacterial efficacy.

Introduction

In the last years, the interest in the fabrication ZnO:NiO Nano composite for advanced application such as gas sensors, solar cells and antibacterial because of their have large surface area (Karthikl, *et al.*, 2018) (Karthikeyan, *et al.*, 2017) (S_ahin, *et al.*, 2017). Nanomaterial's have significant electronic, thermal, catalytic properties, and optical properties compared to their bulk counterparts, and have many wide-ranging concerns (Yeabyo & Gebrekidan, 2018) (Diallo, *et al.*, 2018) (Sirelkhatim, *et al.,* 2015). Recently, the formation of nanoparticles sized crystalline metal oxides has been a growing interest due to a large surface areas, their unique properties, surface defects, and speed of propagation.In addition, nickel oxide semiconductors can be considered as distinct topics and are selected in future studies and research due to of low-cost materials such as ion storage. NiO nanoparticles is the p-type and ZnO is the n-type semiconductor that chosen because of its high chemical stability and good counductivity at low temperature (Talebian, *et al.*, 2015). Their good characterization of NiO and ZnO nanoparticles related to both the size particles and the morphology of nanomaterial (Doudi & Talebian, 2016) (El-Kemary, *et al.*, 2013). Also, the antibacterial characterizations of some nanocomposite have been recognized for thousands of years and using this characterization the old Greeks cooked. Presently, the studied has acquired importance result to the increase of bacterial resistance to antibiotics. *E. coli* inhabit the intestines of peoples and other animals. Although most strains of *E. coli* are not pathogenic. There are many methods of preparing ZnO:NiO Nano composite. Chemical method is one of the better methods and it is cheap and appears to be most suitable for fabrication antibacterial (Mustafa, *et al.*, 2018) (Mohamed *et al.*, 2018). Recent years it has been well prepared of two different semiconductors with different energy levels of antibacterial for enhanced their functional characteristic due to their interfacial activity (Doudi & Talebian, 2016). On the other hand the antibacterial characterizations. In this report, The ZnO:NiO Nanocomposite materials have been produced by simple sol-gel method and studied as antibacterial applications.

Materials and Methods

ZnO: NiO nanocomposite is prepare by sol-gel method at 0.1M both of nickel and zinc nitrate and Urea $CO(NH_2)_2$ solution with 100 mL in ethanol/water, solution were mixed under magnetic stirring for 20 min were added to the 0.4 NaOH. After washing by distilled water and

***Author for correspondence :** E-mail: itabfadhil@uomustansiriyah.edu.iq

methanol, the precipitate dried at 80°C. Finally the calcinations were carried out at 500°C for 4 hr. The antibacterial activity synthesis of ZnO:NiO Nanocomposite was completed versus *Escherichia Coli* (E-Coli) a gram negative and ZnO:NiO Nanocomposite versus *Staphlococcus aureus* (*S. aureus*) a gram positive. Next 22 h of incubation, the (ZOI) was measured

Results and Discussion

The structural property about the crystallinity of ZnO:NiO Nanocomposite is obtained from the X-ray diffraction is shown in Fig. 1. The diffraction peaks are related to 31.85°, 34.55°, 36.35°, 47.6°, 56.65°, 67.95°, 68.12°, 75.1° and 79.05° hexagonal structure of the ZnO nanoparticles with (JCPDS No. 36-1451) while, diffraction peaks at 37.25°, 43.2° and 62.7° of the NiO nanoparticles with (JCPDS No. 04-850). The observed X-Ray pattern of ZnO:NiO nanocomposite shows that the nanoparticles are good crystalline (Sushmitha, *et al.*, 2018) (Abdul Rahman, *et al.*, 2014). The calculated lattice constant, crystallite size, strain and dislocation density of ZnO:NiO nanocomposite is reported in the Table 1. Crystallite size of ZnO:NiO nanocomposite estimated by the Scherer equation (Nalumaga, 2017).

$$G.S = \frac{0.89\,\lambda}{\beta\cos\theta} \quad (1)$$

G.S is the crystallite size of nanocomposite, β= reveals the FWHM, θ= is the angle, and λ=1.54A°. The micro-strain magnitude and dislocation density can be calculated by using equation (Kanjwal, 2015) (Sakeek, 2012).

$$\delta = \frac{1}{G.s^2} \quad (2)$$

$$\eta = \frac{\beta\cos\theta}{4} \quad (3)$$

The FESEM image of ZnO:NiO nanocomposite is shown in Fig. 2-a. The show of some large nanoparticles and the non-uniform morphology has the tendency to agglomerated result to their high surface energy and high surface tension of ZnO:NiO nanoparticles and forms irregular shaped nanoparticles. Fig. 2-b It reveals the particles size distribution of ZnO:NiO Nano composite. The average nanoparticles size was around 70 nm (Dnyaneshwar, *et al.*, 2017).

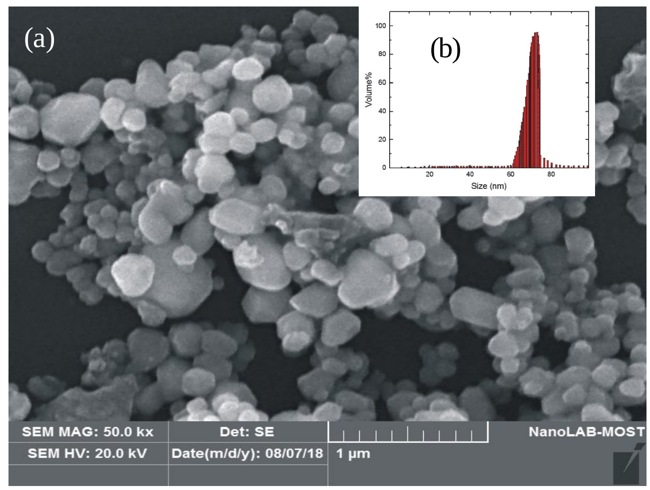


Fig. 2: a) Show The FESEM image of ZnO:NiO Nanocomposite, b) show particles size distribution

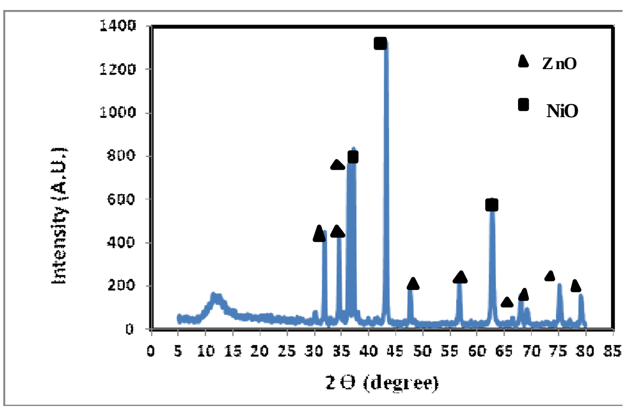


Fig. 1: X- Ray Pattern on ZnO:NiO Nanocomposite.

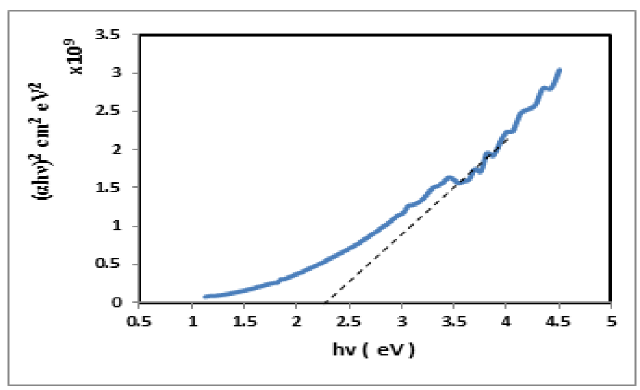


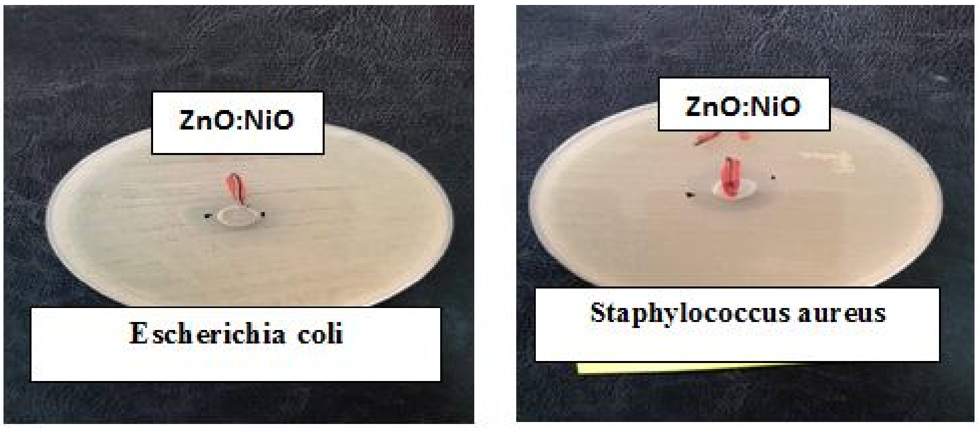
Fig (3): Optical energy band gap of ZnO:NiO nanocomposite

Table 1 Structural property of ZnO:NiO Nanostructures

Sample	Phase	Lattice Constant a (A)	Lattice Constant c (A)	Crystallite Size D (nm)	Strain (ε) × 10−3	Dislocation density (δ) × 10^{14} (lines/ m^2)
ZnO:NiO Nanostructures	ZnO	3.31	5.2	45	22.3	3.12
	NiO	4.2	-	50	24.5	4.32

Table 2. Antimicrobial activity of ZnO:NiO nanocomposite at concentration (50, 75 and 100 µg/mL).

Sample	Bacteria	Zone of inhibition (mm in diameter)		
		50µl	75µl	100µl
ZnO/NiO nanocomposite	Staphylococcus aureus	23	28	30
	Escherichia coli	15	16	18



Fig(4) Antibacterial activity of ZnO:NiO nanocomposite against Gram-positive and Gram-negative bacterium *Staphylococcus aureus* and *E.coli*

Displays the ultra violet –visible absorption Energy gap spectrum of ZnO:NiO Nanocomposite is determined by the following equation ((Dnyaneshwar, *et al.*, 2017).

$(\alpha h\nu)^r = A(h\nu - Eg)$ Where α is the absorption coefficient, $h\upsilon$ is the photon energy, r =2 E_g is energy gap of ZnO:NiO Nanocomposite. Optical energy gap is estimated by linear extrapolation to the $h\nu$-axis. The optical energy gap (Eg) of ZnO:NiO Nanocomposite is found as 3 eV.

The antibacterial activity of ZnO:NiO nanocomposite was tested using agar good diffusion method against both of the gram positive and the gram negative bacteria. Clinical isolates of *Staphylococcus aureus and E. coli*. The most significant effect of nanocomposite is found for the concentration (100 µg/mL). Fig. 4 is clear the zone of inhibition around the bacterial strain for ZnO / NiO nanocomposite. The diameters of the zones of inhibition obtained from the test are listed in table 2. The results show that, the antibacterial efficacy of the ZnO / NiO nanocomposite against *S. aureus* bacteria is higher than that of *E. coli*. The reason for the decrease in the antibacterial efficacy of the prepared ZnO /NiO nanocomposite against *E. coli* may be due its gram negative nature. It is well known that gram negative bacteria consist of multiple cell walls compared to gram positive bacteria (*S. aureus*). It is noted that when compared with the standard antibacterial agent (Ciprofloxacin)

Conclusion

ZnO: NiO nanocomposite was prepared by sol-gel method. It is clear that the prepared ZnO:NiO nanocomposite have high crystalline quality with an average crystallite grain size of 50nm. The antibacterial studies show that ZnO:NiO nanocomposite exhibits good sensitivity against *S. aureus* bacteria is higher than that of *E. coli*.

References

Abdul Rahman, I., M. Ayob and S. Radiman (2014). Enhanced Photocatalytic Performance of NiO-Decorated ZnO Nanowhiskers for Methylene Blue Degradation. *Journal of Nanotechnology*, p. 8.

Diallo, A., K. Kaviyarasu, S. Ndiaye and B. Mothudi (2018). Structural, optical and photocatalytic applications of biosynthesized NiO nanocrystals. *Green Chemistry Letters and Reviews*, **11(2):** 166-175.

Dnyaneshwar, R. *et al.*, (2017). Photocatalytic degradation of dyes in water by analytical reagent grades ZnO, TiO2 and SnO2: a comparative study. *Drink.Water Eng. Sci.*, **10:** 109-117.

Doudi, M. and N. Talebian (2016). The study of antibacterial properties of NiO thin film using Sol-gel synthesis. *Biological Forum-An International Journal*, **8(1):** 127-131.

El-Kemary, M., N. Nagy and I. El-Meha (2013). Nickel oxide nanoparticles: Synthesis and spectral studies of interactions with glucose. *Materials Science in Semiconductor Processing,* **16:** 1747-1752.

Kanjwal, M. (2015). Electrospun NiO, ZnO and composite NiO-ZnO nanofibers: Photocatalytic degradation of dairy effluent. *J. Material Sci. Eng.,* p. 4.

Karthikeyan, V., A. Padmanaban and T. Dhanasekaran (2017). Synthesis and Characterization of ZnO:NiO and Its Photocatalytic Activity. *Mechanics, Materials Science and Engineering Journal,* **9**.

Karthikl, K., S.S. Dhanuskodil and C. Gobinath (2018). Multifunctional properties of microwave assisted CdO–NiO–ZnO mixed metal oxide nanocomposite: enhanced photocatalytic and antibacterial activities. *Journal of Materials Science: Materials in Electronics,* **29:** 5459–5471.

Mohamed, M., A. Sabah and M. Ibrahim (2018). A systematic review on antibacterial activity of zinc against *Streptococcus mutans*. *Saudi Dental Journal,* **30:** 283-291.

Mustafa, A., I. Fadhil and A. Fadhil (2018). Producing High Purity of Metal Oxide Nano Structural Using Simple Chemical Method. *Journal of physics,* **1032**.

Nalumaga, H. (2017). *A Study on the Properties of ZnO/TiO2 Nanocomposite Prepared via the Sol-gel Technique,* s.l.: Kangwon National University.

S_ahin, E., S. Javad and A. Aslani (2017). Antibacterial activity against *Escherichia coli* and characterization of ZnO and ZnO–Al2O3 mixed oxide nanoparticles. *Arabian Journal of Chemistry,* **10**.

Sakeek, H. (2012). Macro–meso-porous TiO2, ZnO and ZnO–TiO2-composite thick films Properties and application to photocatalysis. *Catalysis Science and Technology,* **2:** 379-385.

Sirelkhatim, A., S. Mahmud and A. Seeni (2015). Review on Zinc Oxide Nanoparticles: Antibacterial Activity and Toxicity Mechanism. *Nano-Micro Lett.,* **7(3):** 219-242.

Sushmitha, V., V. Maragatham, P. Deepak and M. Sridharan (2018). Structural, electrical, optical and magnetic properties of NiO/ZnO thin films. *Materials Science and Engineering,* **310**.

Talebian, N., M. Doudi and H. Mogoei (2015). Antibacterial activities of sol–gel derived ZnO-multilayered thin films: p-NiO heterojunction layer effect. *J. Sol-Gel Sci. Technol.,* **74:** 650-660.

Yeabyo, G. and M. Gebrekidan (2018). Antibacterial Activity of Ag-Doped TiO2 and Ag-Doped ZnO Nanoparticles. *International Journal of Photoenrgy,* p. 7.