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RESEARCH PAPER

Antimicrobial Activity of Ag:ZnO/MWCNT Against cinetobacter Baumannii

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ABSTRACT

ZnO absorbs certain amount of light which represent by VU region and this behavior is responsible to decide the activities in different applications light. The main objective was to study ZnO after and before modifying with AgN and MWCNTs in binary and ternary composites with and without UV-A light irradiation. The work include synthesized ZnO/MWCNT, Ag:ZnO and Ag:ZnO/MWCNT with characterization by x-ray diffraction and photo-luminance . the synthesized binary and ternary ZnO composites were tested in inhibition Acinetobacter baumannii which shown higher activities for Ag:ZnO/MWCNT as compere with ether synthesized nano composites.

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INTRODUCTION

ZnO is a semiconductor crystallizes material with two main forms, hexagonal wurtzite and cubic zinc characterized by wide band gap energy reach to about 3.37 eV and exciton binding energy equal to 60 meV at room temperature [1]. The nature of forming ZnO make it amazing material for biocompatible and biodegradable, with biosafe for used in medical applications [2].May be ZnO nanoparticles are extensively used in alter the surface properties of the objects to hydrophilic state when adsorbed on that surface but , it is still needed for more parameters that could be create more activities as antibacterial agent.

The large band gap represent the critical parameter decided the behaviour of ZnO , thus many attempts were done to remove or at least reduce this influence. The most common ways to modifying absorbance light properties include hybrid with Ag Nano participle and and carbon nanotubes (CNTs)[3-4] .

Ag Nano participle shows distinctive properties in biological such the evolution of antibacterial activity additionally, chemical properties such conductivity which could be ideal hyberdization with ZnO [3]. Carbon nanotubes CNTs knows as two types single SWCNTs and multi walled carbon nanotubes MWCNT with varieties in properties such unique internal structure ,electronic conductivity , high surface area, and specific chemical stability make it one of the best carbon materials to enhance the properties of ZnO[4] . The two materials AgNP and CNTs enhance the behaviour of ZnO due to prevent the agglomerations and the abilities for prevents the recombination of electrons and holes and that provided many active site for ZnO.

In the present work, MWCNTs were impregnated with Ag by photo-precipitation technique in aqueous solution of ZnO to forming

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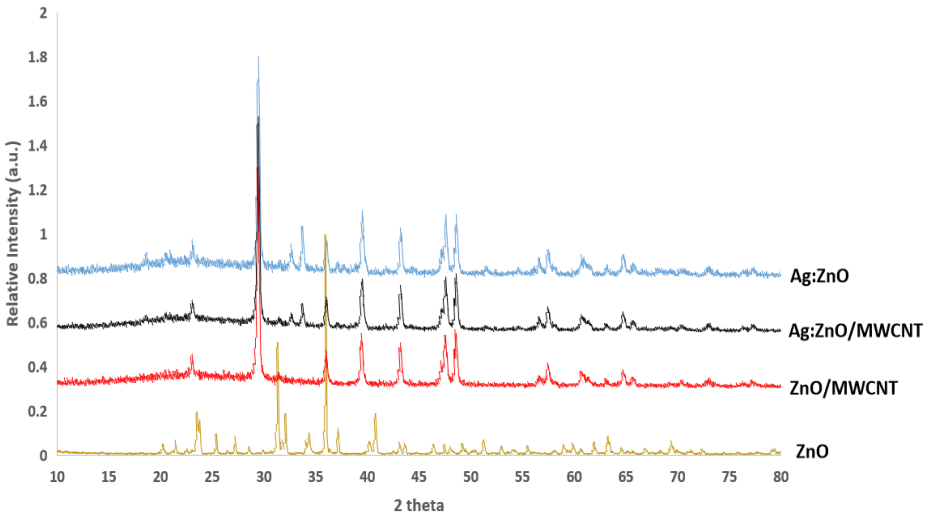

Fig. 1. XRD patterns for ZnO, ZnO/MWCNT, Ag:ZnO and Ag:ZnO/MWCNT

ternary composites Ag:ZnO/MWCNT . In the same time binary composites were synthesized Ag:ZnO and ZnO/MWCNT and compared with Ag:ZnO/MWNT in the inhibition bacteriology of with and without UV-A irradiation.

MATERIALS AND METHODS

Zinc oxide ZnO was supplied from Jinda Nano Tech. (Xiamen) Co.,Ltd.China with more than 98% in purity. silver nitrate ($AgNO_3$) salt was supplied by Sigma-Aldrich and Hydrogen peroxide (30%) from Barcelona-Spain. Ammonium hydroxide. 37% was supplied from Sigma Aldrich. Multi walled carbon nanotubes MWCNTs were supplied from cheap-tube com. USA which synthesized by chemical vapor deposition with purity reach to 80 % and average diameter and length 0.9 nm and 2 micro meter respectively.

Synthesis of binary and ternary composites

MWCNTs was oxidation by piranha reagent [5]. 100 mg of MWCNT was dispersed and stirred with 30 ml of H_2O_2/NH_4OH (1:1) for 3 hours at 10 °C then condensation reaction for 3 h at 70°C before filtering drying at 80 °C for 4 h. The first binary composites Ag:ZnO was prepared by an irradiation equivalent weight (10%) of $AgNO_3$ with UV-A light (1.3 m W) in aqueous solution of ZnO for 4 hour at 40°C, using a 200-W mercury lamp , ZnO/MWCNT was prepared by mixing required amounts from MWCNTs (10%) to the aqueous solution of ZnO with using ultrasonic water bath to achieve homogenize distribution.and Ag: the ternary composites Ag:ZnO/MWCNT was prepared by Adding Ag source and MWCNTs to ZnO with using the same condition for photo-deposition in the second section of reparation (Ag:ZnO).All the synthesized materials were washing and thermal treatments at 100°C for 3 h.

RESULTS AND DISCUSSION

Characterization

The characteristic XRD patterns of nanomaterials are shown in Fig. 1. The diffraction peaks at scattering angles (2θ) around 30°(100), 32°(002), 35°(101), 36°(102), 50°(110), 60° (103) and 63°(112) respectively suggesting wurtzite structure of ZnO [6] . carbon nanotubes MWCNT was characterized by two peaks at 24°(002) and 43°(211) which unclear in ternary and binary composites due to lower intensities for two peaks make it over lap with ZnO peaks [4]. the peaks at 28° (002), 42° (200) , 69° (220) refers to AgNs and 39° (002), 48° (211) for AgO and 65° (311) for Ag2O respectively [7-8].

Fig. 2, shows the emission spectra of pristine ZnO and impregnated with 10% of MWCNTs and Ag in binary and ternary composite. The emission spectrum of pristine ZnO has at band 546 nm, and that typically related to oxygen vacancy for defects in ZnO [9].after modifying under binary and ternary composites ZnO witnessed red shift which increase as the arrangement:
Ag:ZnO/MWCNT > Ag:ZnO > ZnO/MWCNT

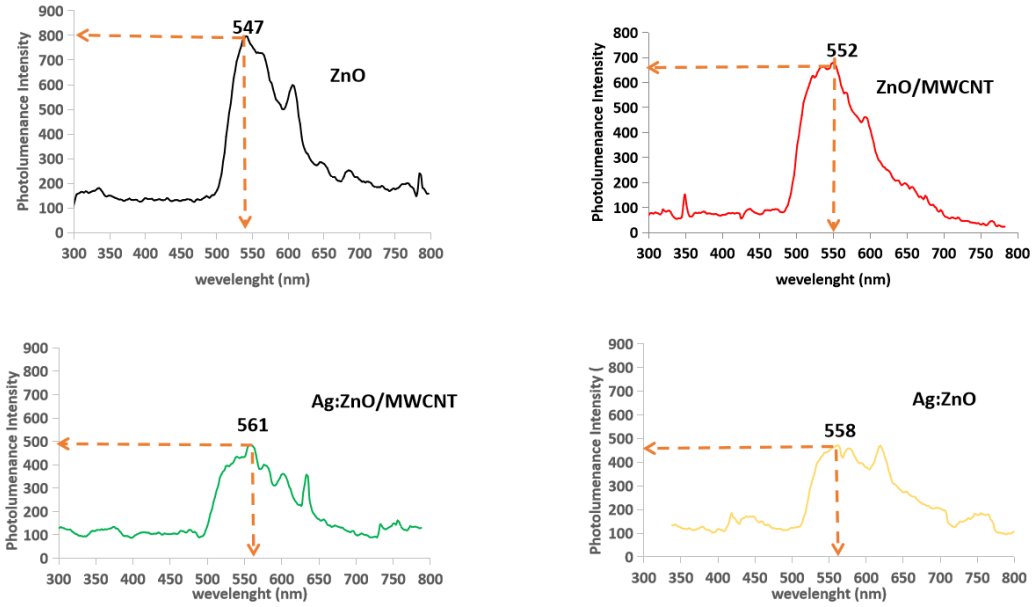

Fig. 2. Photo-luminescence (PL) spectra of ZnO, ZnO/MWCNT, Ag:ZnO and Ag:ZnO/MWCNT

And that agreement with many works [10-11] . Compared to the undoped ZnO, the emission spectrum of ZnO:Ag nanopowder shows a red-shift of the green emission band. Also, the emission bands around 750 nm and 900 nm have been observed.

The PL measurements were done for pristine ZnO, ZnO/MWCNT, Ag:ZnO and for ternary composites Ag:ZnO/MWCNT as shown in Fig. 2. A maximum peak around 547 nm is observed, which is due to the band gap transition of pristine ZnO. The ether small peaks from 570–750 nm are assigned to photo-luminance accrued from surface defects/vacancies.the photo-luminescence for ZnO after modifying with MWCNT and Ag were witnessed reduce in intensity with red shift in wavelength which variance according to the additions materials [10,4] . The larger reduction in binary composites in intensity and red shift was detected in the presence of Ag on the ZnO surface more then MWCNTs effects.the enhancement effects which shown the best red shift and intensity was represent in ternary composites Ag:ZnO/MWCNT when the shifted reach to 561 nm while ZnO/MWCNT and Ag:ZnO was 552 and 558 nm respectively[11].

Antibacterial activity

The disc of agar diffusion procedure was used to assess the inhibition of Acinetobacter baumannii by ZnO and modifying Nano particles which include ZnO/MWCNT, Ag:ZnO and Ag:ZnO/MWCNT by measure Inhibition zone diameter.the inhibition process were done in two conditions the first without irradiation of UV-A light while the second with irradiation UV-A light.firstly MWCNTs individually do not have an antimicrobial activity against bacteria. The minimum inhibition concentration MIC was 0.75 mg/ml loaded with 100µl at 35ºC for 20 hours.

The inhibition zone were reported in Fig. 3, which measured with micro meter unite which include the activity with and without irradiation when measured to MIC 0.75 mg/ml for 20 hours with circulars system to kept the temperature at 35ºC. in the first case without irradiation by UV-A the value of zone area was 2.79 , 2.95, 3.23, 3.75 micrometer for ZnO, ZnO/MWCNT, Ag:ZnO and Ag:ZnO/MWCNT respectively as shown in Fig. 3a which wittiness increase the area after modified ZnO. The activities can arrange :

ZnO < ZnO/MWCNT < Ag:ZnO < Ag:ZnO/MWCNT

The second case was refer to the inhibition after irradiation with UV-A light as represent in Fig. 3b and that shows increase in the zone inhibition for Acinetobacter baumannii with the same arrangement for the first case.

The enhance in inhibition due to impersonated ZnO with AgN and MWCNTs were estimated by using equation[Zone area after modifying - Zone

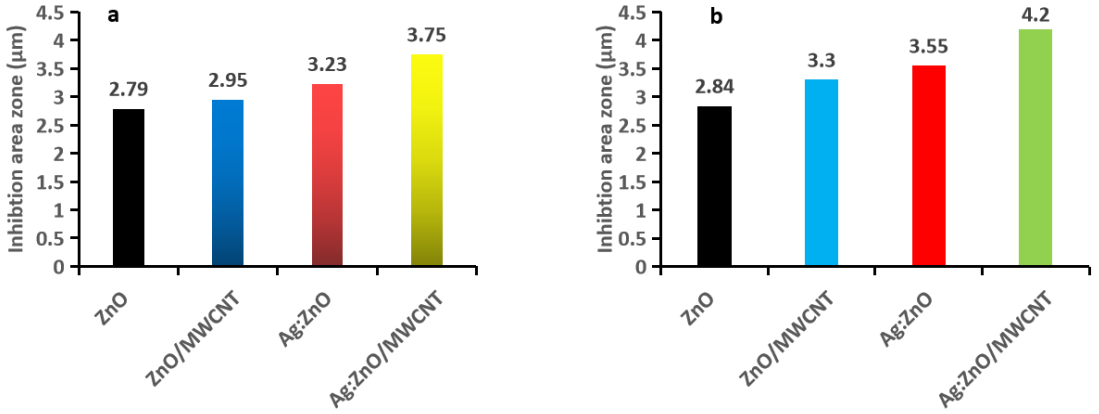

Fig. 3. the inhibition area zone of Acinetobacter baumannii by ZnO, ZnO/MWCNT, Ag:ZnO and Ag:ZnO/MWCNT (a) without irradiation , and (b) with irradiation with UV-A light (0.7 m W)

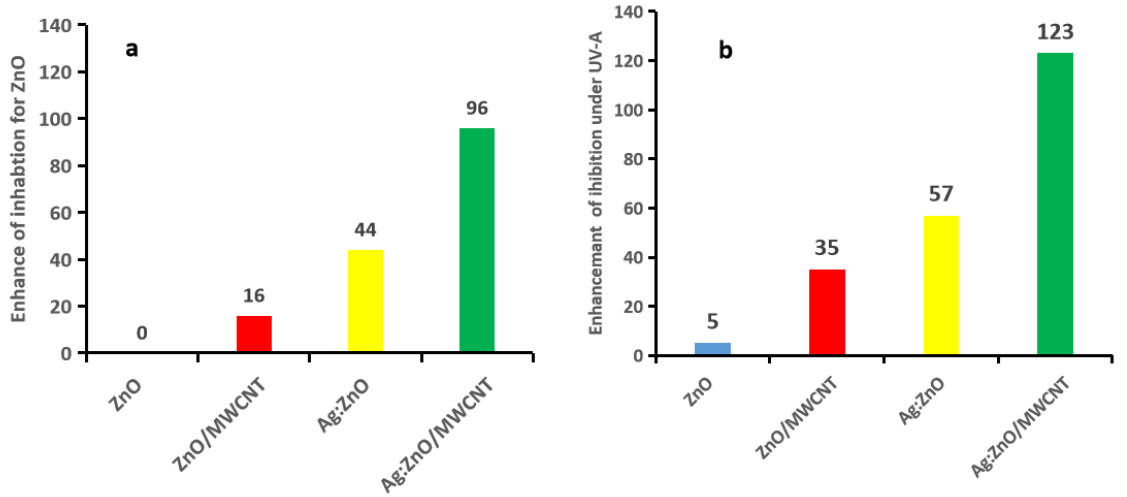

Fig. 4. Enchantment percentage of inhibition for (a) ZnO after modifying with Ag and MWCNTs in ternary and binary composites while (b) refers to inhibition under UV-A light

area before modifying] which reported in Fig. 4a. the influence of impregnated two species with ZnO was shown higher increasing with AgN as compare with MWCNTs indicated that Ag had a greater antimicrobial effect against bacteria compared to MWCNTs. This behaviour could be related to forming real bonded between ZnO and AgN (photo-deposition method) while weak bridge with MWCNTs (physio or chemo adsorption method) thus 44% enhancement with AgN against 16% with MWCNTs.the combination effect for two species AgNs and MWCNTs were succeed to rices the enchantment of inhibition to 96% for Ag:ZnO/MWCNT as compare with pristine ZnO. the increase for the higher value [12] can be related to co-enhancement between bridge of higher electron density and conductivity with higher surface area for MWCNTs and specific p-concordance with small size of AgNs [13-14] and reported in Fig. 4b. the influence of irradiation towards inhibition of Acinetobacter baumannii by ZnO in pristine and impregnate phase were witness larger inhibition due to play the addition species AgN and MWCNTs important roles when prevent or at least reduce the recombination for e-/h+ pairs and that absolutely increase the zone area for inhibition with kept the ternary composites Ag:ZnO/MWCNT the first level in activities as compare with the

ether composites [15]

ZnO is recognized as a colorless, (absorb UV-light) however, convert to color material after impregnated with AgN and MWCNTs and that enhance ZnO to absorb the light in visible region which causing increase the activities as inhibition for bacteria. The mechanism that could be explain the behaviour of additive Nano materials which causing increase the activities of ZnO were include to view : the first can be related to abilities of AgN and /or MWCNTs for dispersion on the Nano particles surface and generation of reactive species due to reduce the recombination e^-/h^+ on the surface of Nano particles [16].

The second view can be related to reduce the particle size of ZnO in binary and ternary composites which reduce the agglomeration and that increasing the dispersion of composites and create more active sited on the surface of bacteria which damage it [17-18]. Therefore, the two views agree that Ag:ZnO/MWCNT had behave the lower recombination between e- and h+ compared with ZnO/MWCNT and Ag:ZnO . And give more evidence for better attachment of (ZnO/MWCNT < Ag:ZnO<Ag:ZnO/MWCNT)with the surface of bacteria produced more inhibitor activities.

CONCLUSION

In this regard, ZnO Nano particles were combined in composites matrix with more antimicrobial activity at nanoscale and that yield a fordable and safe strategies to inhibition many types of bacteria. The results from the present study demonstrate that the presence of AgN and MWCNTs were succeed to enhance the activities of ZnO towards inhibitor the Acinetobacter baumannii at the level of concentrations. The enhancement represent by increase the zone area of inhibition and that shows higher activates under an irradiation by UV-A light. The activates of ternary composites Ag:ZnO/MWCNT was more active with two concoctions due to accumulation effect for Ag and MWCNTs which achieve higher surface area and conductivity with specific ratios of electron density and amazing distribution with less agglutination for particles . all of theses parameters crate more active site for more inhibition center against the Acinetobacter baumannii .

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this manuscript.

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