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Antibacterial by use SnO_2 Nanoparticle by Hydrothermal Method

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Abstract
This study investigated the effect of different concentration on the preparation of SnO_2 nanoparticles by hydrothermal method. The results showed that a significant impact on the surface morphology and antibacterial activity of the SnO_2nanoparticles. Fesem scanning of the prepared SnO_2 particles, showed that, it has a semi-spherical circumferential shape, and the particles are agglomerated, irregular in shape, with an average particle size of (35 nm), and its crystal size ranges within (24.85-25.12 nm). The findings of the inhibition zone diameters for SnO_2 nanoparticles on isolates of Gram-positive *S.aureus* and Gram-negative *E.Coli*. Their findings showed that the most effective inhibitor of both Gram-negative and Gram-positive bacteria is SnO_2 nanoparticles produced.

Keywords: Nanoparticle, Sno_2 Nanoparticles, Surface Morphology, Antibacterial Activity

Introduction

The interest in nanotechnology has increased due to the special properties that allow it to be used in various fields and applications. These fields include the chemical, mechanical, and technological industries, as well as the medical field and pharmaceutical industry. Nanotechnology has become popular due to its unique characteristics, such as high strength, lightweight, excellent chemical reactivity, small size, high surface area, and high stability. These properties have made nanotechnology a promising area of research and development, leading to its widespread use across multiple disciplines [1]. The field of nanotechnology is one of the most popular areas of research and development in basically all disciplines [2]. This is due to its high strength, lightweight, excellent chemical reactivity, very small size, high surface area, and high stability [3]. Tin oxide powders come in both synthetic and mineralogical forms. The compound is commercially viable in several oxidation states but is of particular interest to the electronics industry as tin dioxide (SnO_2). Also known as stannic oxide, SnO_2 is the primary ore derived from raw tin and is synthetically produced at scale by flowing hot air over the molten material. The resultant oxide powder can be used in industrial polishes, glass and ceramic coatings, a broad range of construction materials, antibacterial and gas sensor devices [4], Such as high electrochemical coefficient of correlation and high photochemical stability [5]. there are several methods for preparing SnO_2nanoparticles, including both physical and chemical methods. Some of the physical methods include thermal evaporation and physical vapor deposition. Some of the chemical methods include chemical vapor deposition (CVD), sol-gel deposition, hydrothermal and electrochemical deposition. These different methods offer different advantages and disadvantages, and the choice of method depends on the specific requirements and goals of the application [6-9]. This paper describes antibacterial by use SnO_2 nanoparticle by hydrothermal method.

Experiment Setup

Figure (1 a, b, c and d). Shown. Samples of tin dioxide (SnO_2) were prepared in the laboratory from tin(II) chloride, also known as stannous chloride. It is a white solid compound with the chemical formula $SnCl_2$, and its molecular weight is 189.62 g/mol. It is soluble in water, ethanol, and ether, ethyl acetate, and methyl ethyl ketone. Tin II chloride exists in two forms, one of which is anhydrous and has the formula $SnCl_2$ and its density is 3.95 g/cm^3 and its melting point is 247 C and its boiling point is 652C, while the second form is dihydrate and its formula is $SnCl_2.2H_2O$ and its density is 2.71 g/cm^3 and its melting point is 37.7 C. For samples, we used 0.4 g,0.5 g,0.6 g,0.75 g of $SnCl_2.2H_2O$ and dissolved it by adding 60 ml of ethanol and 40 ml of deionized distilled water, then mixed the substance for 20 minutes, then added 15 ml of ammonia solution and mixed the resulting solution for an hour, then put the solution in The autoclave is inside a thermal oven at a temperature of 140 C for a period of five hours, then after cooling, we take the solution and carry out washing and separation operations on it for several stages to produce the nanomaterial (SnO_2). Diagnostic bacterial isolates were received from the biology department at the University of Kufa and isolated from several infection cases including isolates of *Staphylococcus aurous* and isolates of *Escherichia coli*.

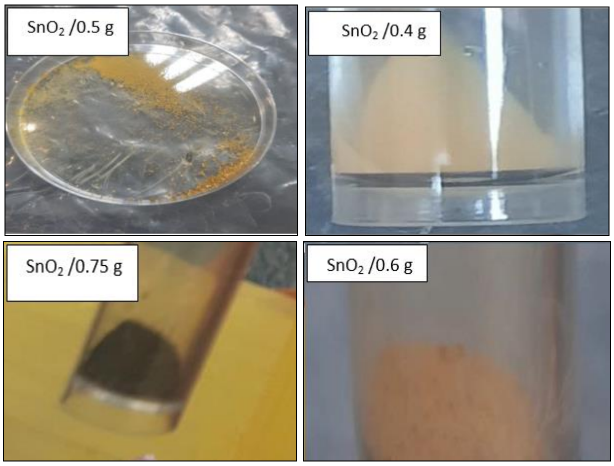

Fig 1: (SnO_2) Four different concentrations

Results and Discussion

Morphological Investigation

A field emission scanning electron microscope is used to study the crystal structure, surface structure, shape and size of particles, and the distribution of crystals. The scanning electron microscope technique was used to take an image of the surfaces of the crystals of the material, as it showed a clear difference in the crystal structures and surface homogeneity. The scanning electron microscope technique was adopted at a cross-sectional distance of 200 nm. And the power of magnification K X Mag = 50.00, as the properties of the surface morphology were studied for each of the different concentrations of the material, as the properties and effectiveness of the material depend greatly on the nature and shape of its surface.

The fesem scanning of the prepared SnO_2 particles as shown in figures (2 a,b,c and d), showed that, It has a semi-spherical circumferential shape, and the particles are agglomerated, irregular in shape, with an average particle size of (35 nm), and its crystal size ranges within (24.85-25.12 nm).

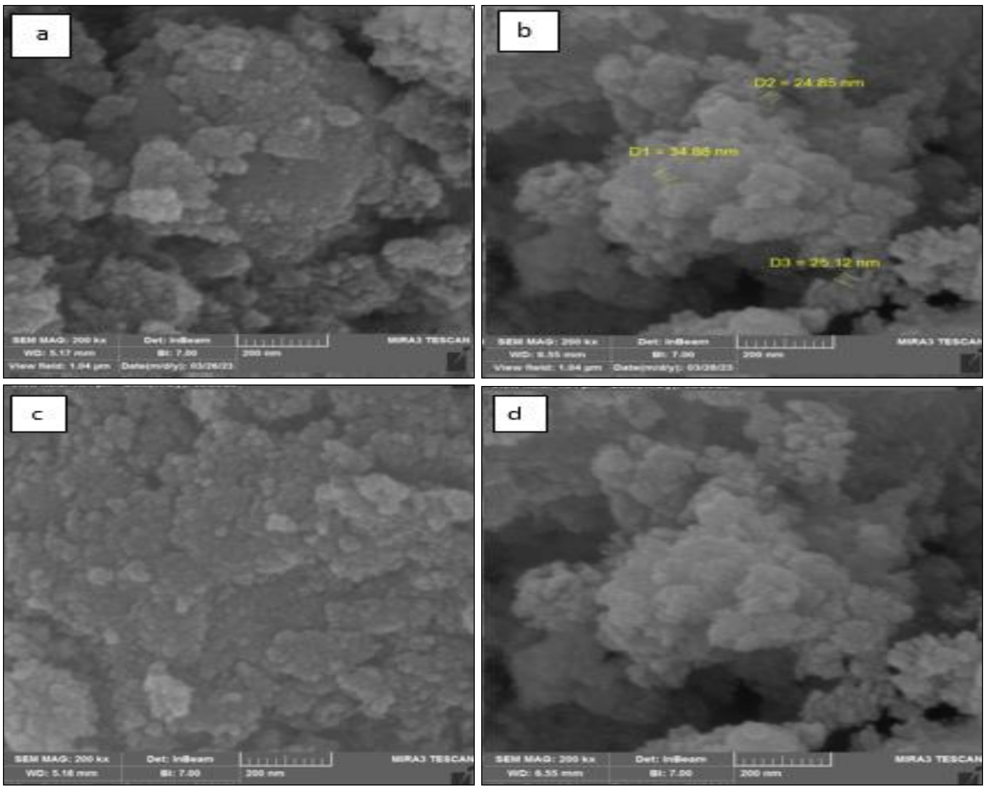

Fig 2: The FESEM of SnO_2 nano particle Four different concentrations

Antibacterial Activity Experiment:

was investigated against Gram-negative *Escherichia coli* (*E.Coli*) and Gram-positive *Staphylococcus aureus* (*S.aureus*). The findings of the inhibition zone diameters for SnO_2 nanoparticles on isolates of Gram-positive *S.aureus* and Gram-negative *E.Coli* are shown in Figure (3a, b, c, d, e, f, g and h) and table 1. Their findings showed that the most effective inhibitor of both Gram-negative and Gram-positive bacteria is SnO_2 nanoparticles produced. The difference in the efficiency of tin oxide to kill or stop the growth of both the bacteria's are due to difference in the cell structure of G. positive and G. negative bacteria or chemical composition of cell of a bacteria or the chemical composition of tinoxide.

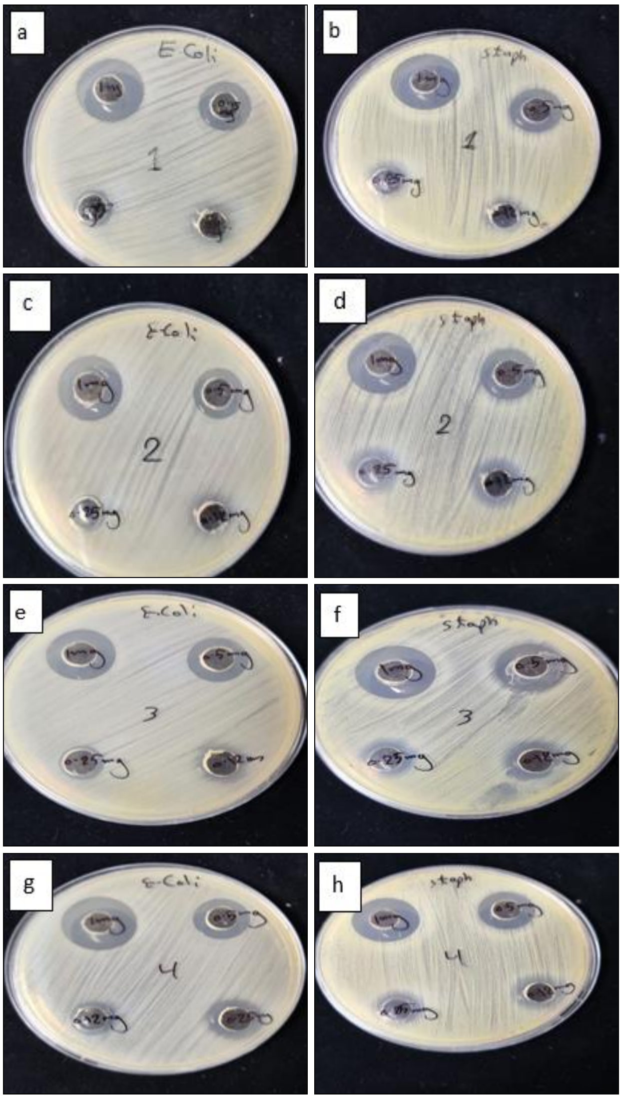

Fig 3: (a, b, c, d, e, f, g and h) inhibitor of both Gram-negative and Gram-positive bacteria is SnO_2 nanoparticles

Table 1: Inhibitor of both Gram-negative and Gram-positive bacteria is SnO_2 nanoparticles

concentrations(g)	concentrations(mg)	E. coli	S. aureus
0.4 g of SnO_2	1 mg of SnO_2	22 mm	23 mm
	0.5mgof SnO_2	16 mm	17 mm
	0.25mgof SnO_2	11 mm	12 mm
	0.12mg of SnO_2	9 mm	10 mm
0.5 g of SnO_2	1 mg of SnO_2	20 mm	22 mm
	0.5mgof SnO_2	15 mm	18 mm
	0.25mgof SnO_2	9mm	13 mm
	0.12mg of SnO_2	0mm	11mm
0.6 g of SnO_2	1 mg of SnO_2	20 mm	22 mm
	0.5mgof SnO_2	17 mm	20mm
	0.25mgof SnO_2	12mm	13mm
	0.12mg of SnO_2	0mm	10mm
0.75 g of SnO_2	1 mg of SnO_2	22 mm	20 mm
	0.5mgof SnO_2	17 mm	18 mm
	0.25mgof SnO_2	14mm	13 mm
	0.12mg of SnO_2	2mm	11mm

Conclusions

The information provided describes the successful synthesis of SnO_2 nanoparticles using the hydrothermal method. This method is fast, clean, and cost-effective, making it an attractive approach for producing metallic oxide nanoparticles. The fesem scanning of the prepared SnO_2 particles, showed that, it has a semi-spherical circumferential shape, and the particles are agglomerated, irregular in shape, with an average particle size of (35 nm), and its crystal size ranges within (24.85-25.12 nm)**.**The synthesized nanoparticles exhibit significant inhibitory activity against both Gram-negative E.Coli and Gram-positive S.Aureus bacteria, with inhibition diameters ranging from 9-23 mm. The largest inhibition diameters were observed for nanoparticles prepared in 1mg, followed by those prepared in 0.5mg and 0.25 mg and 0.12mg. This suggests that SnO_2 nanoparticles used in the synthesis process may impact the antimicrobial properties of the nanoparticles. Overall, the successful synthesis of SnO_2 nanoparticles using the hydrothermal method, and their strong antimicrobial activity, highlights the potential of these nanoparticles for use in various applications, including biomedical and environmental fields. Further studies could investigate the impact of different synthesis parameters and surface modifications on the properties of these nanoparticles.

References

1. Selma MH. Preparation and Characterization of Tin Oxide Thin Films by Using Spray Pyrolysis Technique, 2014.
2. Paul DR, Robeson LM. Polymer nanotechnology: Nanocomposites, 2008.
3. Seyedeh Matin Amininezhad,Alireza Rezvani, Mehdi Amouheidari, Sayed Mohamad Amininejad, Sajjad Rakhshani. The Antibacterial Activity of SnO2 Nanoparticles against Escherichia coli and Staphylococcus aureus, 2015.
4. Mwathe P, *et al*. Effect of surface passivation on electrical properties of Pd-F: SnO2 thin films prepared by spray pyrolysis technique. Coatings. 2014; 4(4):747-755.
5. Vidhya S, *et al*. Structural and optical investigations of gallium doped tin oxide thin films prepared by spray pyrolysis. Journal of Saudi Chemical Society. 2016; 20(6):703-710.
6. Park MS, Kang YM, Wang GX, Dou SX, Liu HK. The effect of morphological modification on the electrochemical properties of SnO2 nanomaterials. Adv Funct Mater 2008; 18(3):455-461.
7. Kim K, Instead TGF, Chu WK. Anneling effect of SnO2 Thin Films Prepared by chemical vapor deposition solar cell, 2007.
8. Bilal Ahmad Thoker, Asif Ahmad Bhat, Atif Khurshid wani, Masood Ayoub Kaloo and Gulzar Ahmad Shergojri. Preparation and Characterization of SnO_2 Nanoparticles for Antibacterial Properties, 2020.
9. Patil GE, Kajale DD, Gaikwad VB, Jain GH. Preparation and characterization of sno2 nanoparticles by hydrothermal route, 2012.