

Republic of Sudan
Ministry of Higher Education and Scientific Research
Red Sea University
College of Graduate Studies and Scientific Research

Synthesis, Characterization and Biological Activity(Antibacterial) of Zinc Oxide and Copper Oxide Nanoparticles

A Thesis Submitted in Partial Fulfillment for M.Sc Degree
in Applied Chemistry

By : Remaz Margani Youns Othman
Supervisor : Dr. Abd El Mahmud Saad Ahmed El Amin

February 2019

Abstract

The aim of this study was to synthesize Nano sized Of Zinc Oxide and Copper Oxide powder in an easy and effective method and to investigate the crystallite size, crystallinity, shape, microstructure, composition and interactions between the species of the NP's oxides.

In this study, two Nanoparticles compounds (Zinc Oxide, Copper Oxide) were Synthesized, Characterized, and tested their biological activity, Zinc Oxide Nanoparticles was Synthesized by simple deposition using Zinc Nitrate and Urea in aqueous solution, and Copper Oxide Nanoparticles were Synthesized via its chemical precipitation method using Copper Chloride Dihydrate , Ethanol, and Sodium Hydroxide. Both Synthesized oxides above detected and Characterized XRD, FT-IR and SEM. Biological effectiveness of the NP's oxides was detection by applying them on two types of Bacteria (*Escherichia coli* ,*Staphylococcus*).

The Results show the Characterized by XRD analysis indicated crystalline and hexagonal structure of ZnO-NP's and The crystallite size (22.2 nm), and pattern indicated cryatalline and monoclinic structure of CuO-NP's and the crystallite size (22.4 nm), the SEM analysis shows that their particles morphology was spherical structure. And the FT-IR spectrum shows the existence of O-H,C-O,C-H,C=C,C=O and ZnO,CuO. In their Biological effectiveness Zinc Oxide Nanoparticles was more effective on Bacteria than Copper Oxide Nanoparticles in their concentration (2.5 M). Accumulation of all the experiments confirmed the uniformity of synthesized ZnO-NP's and CuO-NP's.

We Recommended to using Zinc Oxide Nanoparticles in biological effectiveness gives more effective on Bacteria in high concentration and find more simple methods to Synthesized Nano components in laboratory.

المستخلص

الهدف من هذه الدراسة هو تحضير احجام نانوية من مسحوق أكسيد الزنك وأكسيد النحاس بطريقة سهلة وفعالة وللتحقق من حجم البلورات ، الشكل ، البنية المجهرية ، التركيب والتفاعلات بين أنواع الأكاسيد النانوية .

في هذه الدراسة تم تحضير مركبين من الجسيمات النانوية (أكسيد الزنك وأكسيد النحاس) وتوصيفهما واختبار نشاطهما البيولوجي ,تم تحضير أكسيد الزنك النانوي بطريقة ترسيب بسيطة باستخدام نترات الزنك واليوريا في محلول مائي, وتحضير أكسيد النحاس النانوي عبر طريقة الترسيب الكيميائي باستخدام ثنائي هيدرات كلوريد النحاس والايثانول وهيدروكسيد الصوديوم. كل من الاكاسيد أعلاه تم الكشف عن تكونهما باستخدام جهاز FTIR,XRD , SEM ، تم تحديد الفعالية الحيوية لأكاسيد الجسيمات النانوية من خلال تطبيقها على نوعين من البكتريا (*Escherichia coli* ,*Staphylococcus*).

أظهرت النتائج أن التحليل بواسطة XRD يوضح التركيب البلوري والسادسي لأكسيد الزنك النانوي وحجم البلورات (22.2 nm) ، ويشير إلى التركيب البلوري الاحادي لأكسيد النحاس النانوي وحجم البلورية (22.4 nm) ، يوضح تحليل SEM أن جزيئاتهما كانت ذات بنية كروية. ويظهر طيف FT-IR وجود O-H و C-O و C-H و C=O و C=O و ZnO و CuO. في فعاليتها البيولوجية ، كانت الجسيمات النانوية لأكسيد الزنك أكثر فعالية في البكتيريا من الجسيمات النانوية لأكسيد النحاس في تركيزها (2.5 M). أكدت جميع التجارب على تكون ZnO-NP's و CuO-NP's.

نوصي بان استخدام جسيمات أكسيد الزنك النانوية في الفعالية الأحيائية يمنح تأثير اكبر على البكتيريا في التراكيز العالية وإيجاد المزيد من طرق التحضير البسيطة لتكوين المركبات النانوية في المعمل.

Contents	Page number
Aya	I
Dedication	II
Acknowledgment	III
Abstract	IV
المستخلص	V
List of Contents	VI
List of Table	VIII
List of Figure	IX
List of Appendices	X
Chapter One: Introduction	
1-1 Introduction	1
1-2 Problem of this research	3
1-3 Objectives of this research	3
1-4 Importance of this research	3
Chapter Two: Literature and Review	
2 Literature and Review	4
2-1 Nanotechnology ("nanotech")	4
2-2 <u>History of Nanotechnology</u>	5
2-3 Fundamental concepts	7
2-4 Nanomaterials	7
2-5 Applications	8
2-6 <u>Implications of nanotechnology</u>	9
2-7 Zinc oxide	10
2-7-1 Chemical properties	11
2-7-2 Physical properties	12
2-7-3 Structure	12
2-7-4 Mechanical properties	13
2-7-5 Laboratory synthesis	13
2-8 ZnO Nanostructures	14
2-8-1 Applications	15
2-8-2 Safety	15
2-9 Copper(II)Oxide	16
2-9-1 Physical and Chemical Properties	16
2-9-2 Production	16
2-9-3 Reactions	17
2-9-4 Structure and physical properties	17

2-9-5 Uses	18
2-10 Devices Uses for characterization of Nanoparticles	19
2-10-1 X-Ray Diffraction (XRD)	19
2-10-1-1 Applications	19
2-10-2 Scanning Electron Microscope (SEM)	21
2-10-2-1 Principles and capacities	21
2-10-2-2 Sample preparation	22
2-10-2-3 Biological samples	22
2-10-3 FTIR Analysis	23
2-10-3-1 Work of FTIR	23
2-10-3-2 Used of FTIR	23
2-10-3-3 FTIR Spectral Interpretation	24
2-11 Antibacterial Activity	25
2-11-1 The Privileges of NPs as Antibacterial Agents	26
2-11-2 Antibacterial Activity of ZnO Nanoparticles	26
2-11-3 Antibacterial Properties of Copper	27
2-11-4 Copper Bacterial Resistance	28
Chapter Three: Materials and Methods	
3 Materials and Methods	29
3-1Materials	29
3-2 Apparatus	29
3-3 Area of Study	
3-4 Methods	30
3-4-1 Synthesis Of Zinc Oxide Nanoparticles	30
3-4-2 Synthesis Of Copper Oxide Nanoparticles	30
3-5Characterization	31
3-5-1Infrared Spectroscopy (FT-IR)	31
3-5-2 X-ray Diffraction (XRD)	31
3-5-3 Scanning Electron Microscopy (SEM)	32
3-6 Method for Biological Activity	32
Chapter Four: Results and Discussion	
4 Results and Discussion	33
4-1 Physical Properties of the Compounds	33
4-2 The Results of FT-IR	33
4-3 The Results of XRD	36
4-4 The Results of SEM	39

4-5 The Results of Biological Activity	42
<i>Chapter Five: Conclusions and Recommendation</i>	
5 CONCLUTION AND RECOMMENDATION	45
5-1 Conclusions	45
5-2 Recommendation	46
REFERENCES	47
Appendix	49

5-2 Recommendation

-Using Zinc Oxide Nanoparticles in biological effectiveness gives more effective on Bacteria in high concentration.

-Using Zinc Oxide Nanoparticles as antibacterial more than Copper Oxide Nanoparticles, and Copper Oxide Nanoparticles can used in other fields.

-Find more simple methods to Synthesizad Nano components in laboratory.

-Applying Zinc Oxide and Copper Oxide Nanoparticles in other fields.