شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

HANAA ALY

CHEMISTRY DEPARTMENT-FACULTY OF SCIENCE

Sol-Gel and Sonochemical Synthesis of Some Nanostructured Transition Metal Oxides and Evaluation of Their Photocatalytic Activity

Thesis Submitted by

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B.Sc. Chemistry, 2011

For the Requirement of Master Degree in Chemistry

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To

Department of Chemistry

Faculty of Science, Ain Shams University

2021

CHEMISTRY DEPARTMENT-FACULTY OF SCIENCE

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Thesis Supervisors **Approved**

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Prof. Dr. Hala Kamal El-Sayed Farag ……
Inorganic Chemistry Department, National Research Centre

Head of Chemistry Department

Prof. Dr. Ayman Ayoub Abdel-Shafi

To My Parents

To My Mother in-Low

To My Husband Eng. Emad

To My Brother and Sisters

To My Beautiful Kids Ans&Toty

To My Teachers

To Every knowledge seeker:

Al-Khatib al-Baghdadi stated in his book "The History of the City of Peace: The History of Baghdad" that:

Imam Al-Shafi'i wrote a:

أخي لن تنال العلم إلا بستة سأنبئك عن تفصيلها ببيان

ذكاء وحرص وافتقار وغربة وتلقين أستاذ وطول زمان

"Oh my brother you will never become a scholar until you complete the six pillars of THE REQUISITES OF KNOWLEDGE:

A QUICK MIND, ZEAL FOR LEARNING, POVERTY, FOREIGN LAND, A PROFESSOR'S INSPIRATION, AND OF LIFE A LONG SPAN."

End of Quote!

Acknowledgment

*I am very grateful to **Allah almighty**, the Most Merciful Who blessed my efforts, showed me the way and provided me with power to present this work in an acceptable form.*

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Alaa Asem Abd El-Hameed

ABSTRACT

Name: Alaa Asem Abd El-Hameed sery

Title of Thesis: "Sol-Gel and Sonochemical Synthesis of Some Nanostructured Transition Metal Oxides and Evaluation of Their Photocatalytic Activity."

All experiments and the work of the study have been carried out at Inorganic chemistry department, National research centre.

Tailoring the shape, size and composition of semiconducting nanoparticles is an intelligent key in electronics and environmental remediation. This thesis presents a comparative experimental study between sol-gel and sonochemical approaches for the synthesis of SnO_2 and NiO nanoparticles. In addition, the doping effect on the structural, optical properties and the photocatalytic activity of the synthesized oxides was studied. The XRD results revealed the high purity of the prepared oxides and the well incorporation of the dopant elements into the host structure. Morphological characterization by HR-TEM showed ultrafine nanoparticles with an average size < 10 nm for the oxides calcined at 250^{o}C. The particle size increased upon calcination reaching about 30-40 nm for the samples calcined at 750^{o}C. The EDX results of the doped samples ensured the existence of the dopant elements without any impurities. Diffuse reflectance spectroscopy UV-DR results of the doubly doped tin oxide $Sn_{0.094}Ti_{0.03}Ni_{0.03}O_2$ and nickel oxide $Ni_{0.094}Ti_{0.03}Sn_{0.03}O$ exhibited lower band gap energies 3.24 eV and 3.27 eV, respectively, than

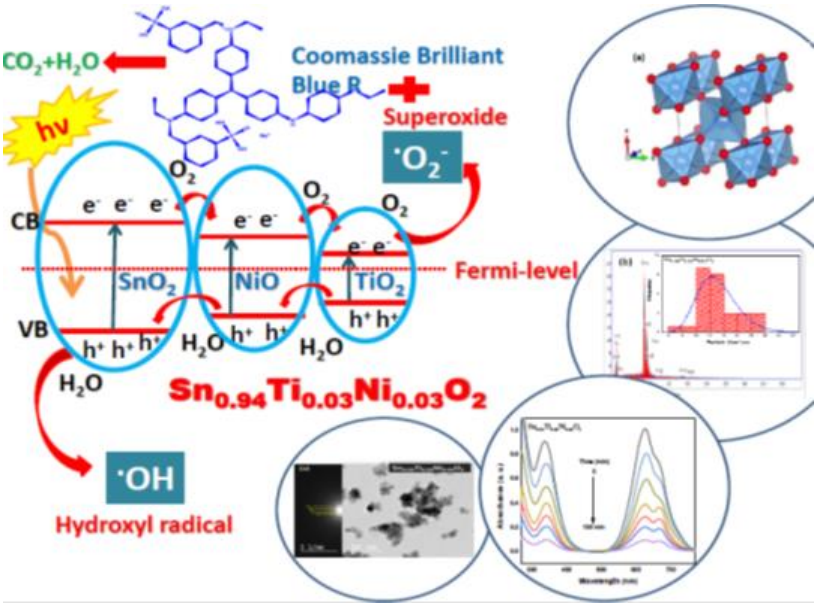
ABSTRACT

that of their corresponding pure oxides. The fluorescence probe method showed a higher rate for the prepared oxides by sonochemical than the sol-gel routes. Also, photodegradation of Coomassie Brilliant Blue dye R (CBBR) showed a higher reaction rate for the tin oxide than nickel oxides samples. The photocatalytic activity process using five real industrial wastewater samples, was explored and the COD values were found to be within the allowed range. Based on COD measurements, the synthesized oxides could be feasible candidates for the photodegradation of organic pollutants.

Keywords

Sonochemistry; Sol-Gel; Semiconductors; Metal Oxides; photodegradation; Advanced oxidation process

Graphical Abstract



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List of Abbreviations

Abbr.	Definition
XRD	: X-ray diffraction
FT-IR	: Fourier transform infrared spectroscopy
HR-TEM	: High Resolution Transmission electron microscope
EDX	: Energy Dispersive X-ray Analysis
BET	: Brunauer–Emmett–Teller
UV -DR	: Diffuse Reflectance Spectroscopy
VB	: Visible light
COD	: Chemical oxygen Demand
CBBR	: Coomassie Brilliant Blue dye R
Eg	: Band Gap
D	: Crystallite Size
P	: Particle Size
K_f	: Fluorescence Rate Constant
K_{deg}	: Photodegradation Rate constant
η	: Removal Efficiency