Ain Shams University
Faculty of Science
Chemistry Department

Synthesis, characterization and applications of some nanometal oxides

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy (Ph.D.) in Science "Chemistry"

Presented by

Mostafa Abdellah Sayed Ahmed

M.Sc. in chemistry (2013), Chemistry Department, Faculty of Science, Ain Shams University

Supervised by

Prof. Dr. Mohamed M.M. Abo Aly
Prof. of inorganic chemistry, Faculty of science, Ain Shams University

Dr. Ayman Ahmed Abdel Aziz
Assist. prof. of inorganic chemistry, Faculty of science, Ain Shams University

Dr. Abdelnaby Mohamed Salem
Lecturer of inorganic chemistry, Faculty of science, Ain Shams University

Dr. Amr Ali Mohamed Hassan
Lecturer of inorganic chemistry, Faculty of science, Ain Shams University

2017

Ain Shams University
Faculty of Science
Chemistry Department

Synthesis, characterization and applications of some nanometal oxides

A Thesis Submitted by

Mostafa Abdellah Sayed Ahmed

For the Degree of Ph.D. in Chemistry

(Inorganic Chemistry)

To

Department of Chemistry

Faculty of Science

Ain Shams University

2017

Ain Shams University
Faculty of Science
Chemistry Department

Synthesis, characterization and applications of some nanometal oxides

Thesis Advisors **Thesis Approval**

Prof. Dr. Mohamed M.M. Abo Aly ……
Prof. of inorganic chemistry, Faculty of science,
Ain Shams University

Dr. Ayman Ahmed Abdel Aziz ……
Assistant prof. of inorganic chemistry,
Faculty of science, Ain Shams University

Dr. Abdelnaby Mohamed Salem ……
Lecturer of inorganic chemistry, Faculty of science,
Ain Shams University

Dr. Amr Ali Mohamed ……
Lecturer of inorganic chemistry, Faculty of science,
Ain Shams University

Head of Chemistry department

Prof. Dr. Ibrahim Husseiny Ali Badr

Ain Shams University
Faculty of Science
Chemistry Department

Synthesis, characterization and applications of some nanometal oxides

Referee Committee	**Thesis Approval**
Prof. Dr. Mohamed M.M. Abo Aly Prof. of inorganic chemistry, Faculty of science, Ain Shams University	……
Dr. Ayman Ahmed Abdel Aziz Assistant prof. of inorganic chemistry, Faculty of science, Ain Shams University	……
Prof. Dr. Badr Eldein Awad Elsayed Prof. of inorganic and analytical chemistry, Faculty of science, El-Azhar University	……
Prof. Dr. Ahmed Mahmoud Elsayed Daher Prof. of inorganic chemistry, Authority of nuclear materials	……

Head of Chemistry department

Prof. Dr. Ibrahim Al-Husseiny Badr

ACKNOWLEDGEMENT

First and foremost, thanks to ***Allah*** *for giving me the opportunity and well-power to accomplish this work*

I would like to express my sincere gratitude and indebted to ***Prof. Dr. Mohamed Abo Aly****, Prof. of Inorganic Chemistry, Chemistry Department, Faculty of Science, Ain Shams University. He was always kind enough to suggest the topics of research and to follow up the progress of the work with keen interest, guidance and valuable criticism and whose efforts made this humble work as possible.*

Also, I wish to express my sincere gratitude to ***Dr. Ayman Abdel Aziz, Dr. Abdelnaby Salem and Dr. Amr Ali****, Lecturers of inorganic Chemistry, Chemistry Department, Faculty of Science, Ain Shams University, for their valuable advices and encouragement during this research work.*

Finally, deep thanks and gratitude to my family, my friends, my colleagues and all peoples who help me to finish this work.

Mostafa Abdellah Sayed

Contents

Abbreviations

Å	Angstrom
b	blank sample (dye + catalyst in absence of light)
BET	Brunauer-Emmett-Teller
^{o}C	Centigrade Degree
CB	Conduction Band
CR	Congo Red
DMSO	Dimethyl Sulfoxide
e^-	electron
ev	electron volt
FTIR	Fourier Transformed InfraRed
GHz	Gigahertz
G^+	Gram positive
G^-	Gram negative
h	hour(s)
h^+	hole
HPC	Hydroxy Propyl Cellulose
H1	CeO_2 nanoparticles prepared in the presence of 10% Tween 20 by hydrothermal technique

H2	CeO_2 nanoparticles prepared in the presence of 5% Tween 20 by hydrothermal technique
H3	CeO_2 nanoparticles prepared in the presence of 2.5% Tween 20 by hydrothermal technique
H4	CeO_2 nanoparticles prepared in the presence of 10% Tween 80 by hydrothermal technique
H5	CeO_2 nanoparticles prepared in the presence of 5% Tween 80 by hydrothermal technique
H6	CeO_2 nanoparticles prepared in the presence of 2.5% Tween 80 by hydrothermal technique
KV	Kilovolt
M	Molarity
Mb	Methylene blue
min.	Minutes
mm	millimeter
mmol	millimoles
MOs	Metal Oxides
NCs	Nanocrystals
nm	Nanometer
No.	Number
NPs	Nanoparticles
ppt	Precipitate

SEM	Scanning Electron Microscopy
TEM	Transmission Electron Microscopy
T1	CeO_2 nanoparticles prepared in the presence of 10% Tween 20 by wet chemical method
T2	CeO_2 nanoparticles prepared in the presence of 5% Tween 20 by wet chemical method
T3	CeO_2 nanoparticles prepared in the presence of 2.5% Tween 20 by wet chemical method
T4	CeO_2 nanoparticles prepared in the presence of 10% Tween 80 by wet chemical method
T5	CeO_2 nanoparticles prepared in the presence of 5% Tween 80 by wet chemical method
T6	CeO_2 nanoparticles prepared in the presence of 2.5% Tween 80 by wet chemical method
UV	Ultraviolet
VB	Valence Band
Vis	Visible
W	Watt
Wt/v	Weight per volume
XRD	X-Ray Diffraction

List of Figures