

شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلو

# بسم الله الرحمن الرحيم





MONA MAGHRABY



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلو



شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



MONA MAGHRABY



شبكة المعلومات الجامعية التوثيق الإلكترونى والميكروفيلم

## جامعة عين شمس التوثيق الإلكتروني والميكروفيلم 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



MONA MAGHRABY

# Physics Department Faculty of Science Ain Shams University



# Synthesis and characterization of some diluted magnetic semiconductors

Thesis

Submitted to Faculty of Science- Ain Shams University in partial fulfillment for Degree of Master of Science in

**Physics** 

By

#### Noha Ali Atta Hassan

B.Sc. (Physics), 2007 Ain Shams University Egypt

#### **Supervisors**

**Prof. Dr. Adel Abd El –Sattar**Professor of Solid State Physics
Physics Department, Ain Shams University

**Prof. Dr. Hesham Mohamed El-said**Professor of Solid State Physics
Physics Department, Ain Shams University



**Degree**: Master's Degree in Physics

Title: Synthesis and characterization of some

diluted magnetic semiconductors

Name: Noha Ali Atta Hassan

**Thesis Supervisors:** 

Prof. Dr. Adel Abd El-Sattar

Professor of Solid State Physics

Physics Department, Faculty of science

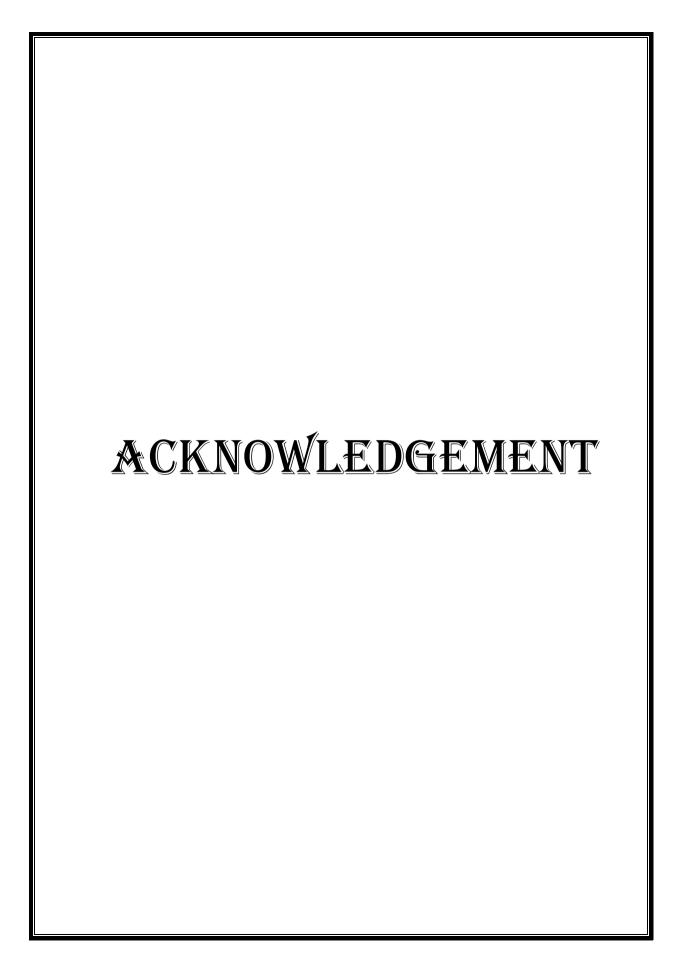
Ain Shams University

#### Prof. Dr. Hesham Mohamed El-said

Professor of Solid State Physics

Physics Department, Faculty of science

Ain Shams University



### **ACKNOWLEDGMENT**

First, I want to thank **GOD** for helping me to finish this study this way.

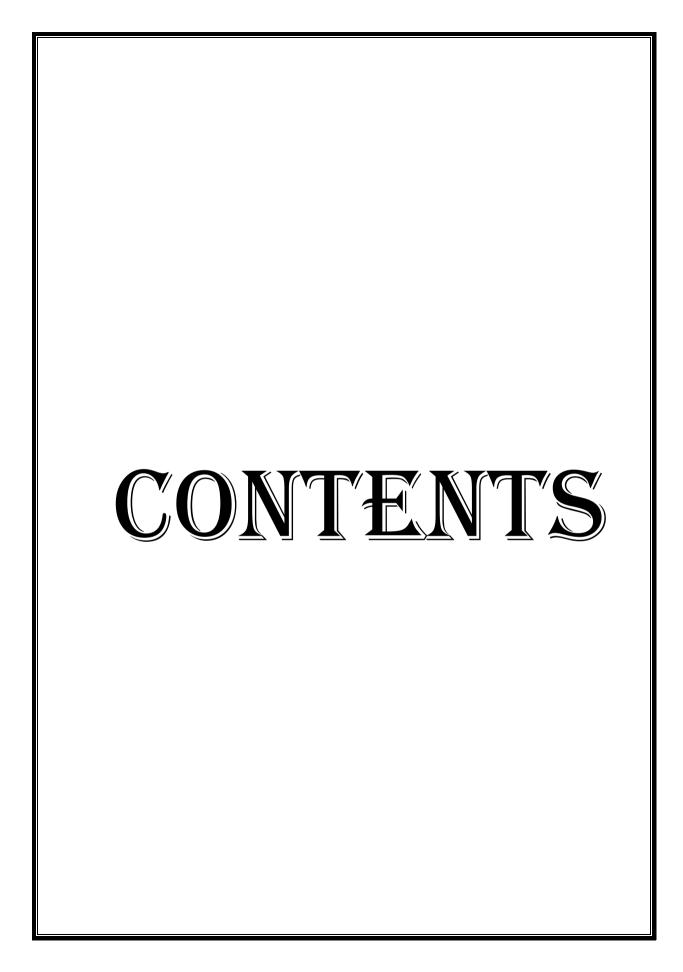
I would like to give great thanks to my **Mother** and all my **family** for their support and encouragement.

It was honor for me that I could be one of the students of **Prof. Dr. Adel Abd Elsattar**, Physics Department, Faculty of Science, Ain Shams University and **Prof. Dr. Hesham Mohamed Elsayed**, Physics Department, Faculty of Science, Ain Shams University.

Dear professors, it gives me great pleasure to introduce my humble effort to you wishing that it would be appreciated by your Excellency.

No words can express how I am grateful for Prof. Dr. Hesham Mohamed Elsayed for his great efforts with me. Actually, he was so helpful and patient with me and he is worth of lots of thanks and gratitude.

Finally, I would like to thank all my **friends** and **coworkers** and everyone prayed for me or wished me good luck. Really, your words were so meaningful to me and gave me a push. Thank you all.



## **Contents**

AcknowledgementI
ContentsII
List of FiguresV
List of TablesVIII
AbstractIX
English SummaryXII
IntroductionXV
Inti oduction
Chapter 1: Theoretical background
1.1 Semiconductor nanomaterials2
1.1.1 Electrical transport and conduction mechanism2
1.1.2 Types of transport and macroscopic models for ac
Conduction3
1.1.2.1 Quantum-mechanical tunneling (QMT) models5
a) Quantum mechanical tunneling (QMT)5
b) Small Polaron Tunneling (SPT)6
c) Overlapping large polaron tunneling (OLPT)8
1.1.2.2 Classical Hopping models9
a) Atomic Hopping over barrier (nearest neighbor
hopping (NNH))9
b) Correlated barrier hopping (CBH) model10
1.2 Dielectric properties12
1.2.1 The Macroscopic concept of polarization
1.2.2 The Microscopic concept of polarization15
1.2.3 Frequency dispersion of complex dielectric
Permittivity16
1.3 Zinc-oxide semiconductor18
1.3.1 Crystal structure 19

## **Contents**

1.3	3.2 Electrical properties	20
1.4	Magnetic materials	21
	4.1 Materials classification based on their	
	behaviors	
1.4	4.2 Heisenberg and Dirac theory	
	1.3 The exchange mechanisms which enable the ali	
	magnetic moments	_
1	.4.3.1 Heisenberg model (the direct spin	
	interaction)	
1	.4.3.2 Indirect exchange interaction	
	.4.3.3 RKKY –interaction	
1.5	Origin of ferromagnetism in DMSs	30
	5.1 Zener -Model	
	5.2 Spin –split impurity band model	
	5.3 ZnO based DMS	
Cha	pter 2: Literature Survey	37
	-	
~		
Cha	pter 3: Experimental Technique	
2 1	Duananation of Camples	52
3.1	. r	
3.2		
3.2.1	X-ray diffraction measurements	55
3.2.2	Fourier transform infra-red spectroscopy	56
3.2.3	Transmission electron microscopy	57
3.2.4	Dielectric Measurements	58
3.2.5	Magnetization measurements	60