Ain Shams University
Women's College for Arts,
Science and Education

Spectroscopic Study for Some Polymers Doped by Some Nanometric Materials.

Thesis Presented by

Shaymaa Sherif Hassan El Shafey

For

The PHD of Physics Degree in Science
A Dissertation

Submitted For

Physics Department, Women's College for Arts, Science and Education,
Ain Shams University, Egypt

Supervisors

Prof. Dr. A. B. El Bialy
Prof. of spectroscopy
Women's College
Ain Shams University

Ass. Prof. Dr. S. S. Hamed
Ass. Prof. of spectroscopy
Women's College
Ain Shams University

Ass. Prof. W. M. Mousa
Ass. Prof. of spectroscopy Women's College Ain Shams University

Dr. R.K.Abd El Hamid
Lecturer of spectroscopy Women's Collage Ain Shams University

2016

Ain Shams University
Women's College for Arts,
Science and Education

Approval Sheet
PH.D Thesis

NAME OF STUDENT: ***Shaymaa Sherif Hassan El Shafey***
Title of Thesis: Spectroscopic study for some polymers doped by some nanometric materials.

SUPERVISOR COMMITTEE

Prof. Dr. A. B. El Bialy ( )
Prof. of spectroscopy Women's College
Ain Shams University

Ass. Prof. Dr. S. S. Hamed ( )
Ass. Prof. of spectroscopy Women's College
Ain Shams University

Ass. Prof. Dr. W. M. Mousa ( )
Ass. Prof. of spectroscopy Women's College
Ain Shams University

Dr. R.K.Abd El Hamid ( )
Lecturer of spectroscopy Women's College
Ain Shams University

Date of Research: / /

Approval Stamp:

Approval of Faculty Council: / /

Approval of University Council: / /

Ain Shams University
Women's College for Arts,
Science and Education

Student name	**:*Shaymaa Sherif Hassan El Shafey***
Scientific degree	**:** PH.D
Department	**:** Physics Department
Faculty	**:**Women's College for Arts, Science and Education
University	**:**Ain Shams University
Date of graduate	**:**2004

ACKNOWLEDGEMENT

I would like to thank the family of Physics Department Ain Shams University for their sincere help.

I would like to express my deepest thanks to **Prof. Dr. Aida El Bialy**, Department of physic, College of Women, University of Ain Shams, Cairo, Egypt, for her support.

I am especially thankful to Assistant Prof. **Dr. S. S. Hamed** Department of physic, College of Women, University of Ain Shams.

I am also thankful to **Dr. W. M. Mousa** Assistant Prof. of physics, College of Women, University of Ain Shams.

I am also thankful to **Dr. R. K. Abd El Hamed** Lecture of physics, College of Women, University of Ain Shams.

Finally, I am grateful to my family for their patience and support.

ABSTRACT

In this work polystyrene solution doped with zinc oxide and iron oxide nanoparticles which were synthesis by different methods to prepare different films of nano. ZnO/PS and nano. Fe_2O_3/PS with different weights (0.5,1 and 2 wt%) of nano. ZnO and nano. Fe_2O_3. The morphology of the samples were studied by using Transmission Electron Microscopy (TEM). The crystal structures were studied using X-Ray Diffraction (XRD), the particle sizes were calculated from (XRD) and conformed by (TEM). Fourier Transform Infrared Spectrometer (FTIR) was used to investigate the functional groups of samples. Also electronic transition were studied by using Ultraviolet-Visible spectrometer (UV-Vis). The electrical conductivity, the real and imagine part of dielectric constant were studied.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

The purpose of the present work is to prepare and characterize pure and doped polystyrene with zinc oxide and iron oxide nanoparticles at different concentration (0.5,1,2wt%). Both precipitation and sol gel method were used for samples preparation. The particle size and the morphology of samples were studied by X-Ray Diffraction (XRD) and Transmission Electron Microscope (TEM). The functional groups of samples were investigated by using FTIR Spectrometer ranged from (4000-200) cm^{-1}. Ultraviolet and Visible regions (UV-Vis) were studied in the range between (200 and 800) nm. The dielectrical parameters of these samples were studied at temperature ranging from (30 C^o to 130 C^o).

The thesis is divided into five chapters.

- **The First Chapter**: the introduction which discusses, in general review of nanotechnology, nanostructure material, method for synthesis and polystyrene
- **The Second Chapter:** gives a general review on the most important physical methods used for nanoparticles and characterization by different methods.

The Third Chapter: is devoted to review briefly the fundamental theories related to X-Ray Diffraction, infrared and Electrical Conductivity.

The Fourth Chapter: is devoted to the description of the instrumental set up used in the present work and methods for preparation.

The Fifth Chapter: includes the results and discussion.

The TEM images showed that doped polystyrene with ZnO nanoparticles has spherical structure with diameters size ranging from (22 to 25) nm, nanoparticles appeared in micrograph more homogenous and more distributed in polymer by increasing the concentration of ZnO nanoparticle from (0.5 to 1 wt%). Fe_2O_3 appeared as nanorod with length 80 nm and has particle size from (20.5 to 23.3) nm by increasing Fe_2O_3 concentration nanoparticle from (0.5 to 1 wt%).

The X-Ray Diffraction Pattern of ZnO/PS and Fe_2O_3/PS indicated that it has amorphous structure, and its particle size increase with increasing ZnO and Fe_2O_3nanoparticles concentration.

By comparing the FTIR spectrum of pure polystyrene and the FTIR spectrum of doped polystyrene it was observed that, appearance of a new band appeared at 469 cm^{-1} in spectrum of ZnO/PS but in the spectrum of Fe_2O_3/PS band appeared at 461 cm^{-1}, Also a new band in the region from (400-200 cm^{-1}) could be assigned as an M-oxide band in the spectrum of Fe_2O_3/PS.

From UV-Visible results we can see that, the absorption band appeared at (264 nm) in pure polystyrene for π-π^* transition and this band shifted to higher wavelength in spectrum of ZnO/PS and Fe_2O_3/PS this shift due to the extent of conjugation of the work structure since increasing in conjugation can decrease the energy required to these transition.

AC electrical conductivity has been measured at temperature ranged from (30 C^o to 130 C^o) as a function of frequency ranged from (42Hz to 5MHz), it was found that it increased by increasing temperature. This is due to the presence of free charge carriers which is connected with the polymer chain and increase its mobility and chare carries generation. The activation energy was calculated; also it found to decrease with increasing the concentration of ZnO and Fe_2O_3 nanoparticles.

The dielectric constant $\varepsilon^{\backslash}$ was measured over frequency range (42Hz to 5MHz), it observed that, the curve have two maximum peaks one at lower frequency at (280) KHz and the other at higher frequency at (500) KHz. The dielectric constant increase by increasing temperature. The dielectric loss $\varepsilon^{\backslash\backslash}$ was decrease with increasing frequency in the range (200 – 400) KHz, until reached maximum peak at frequency (500) KHz for all samples then it decreases to minimum value at frequency equal (1200) KHz .