Sudan University of Science & Technology
College of Postgraduate Studies

Determination of the Energy Gap of Gum Arabic Doped with Zinc Oxide Using the UV-VIS Technique

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A dissertation Submitted in a partial fulfillment of the Requirements of M.Sc. degree in Physics

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Aug- 2018

الآيـة

قال تعالى:

(ظَلَّلْنَا عَلَيْكُمُ الْغَمَامَ وَأَنزَلْنَا عَلَيْكُمُ الْمَنَّ وَالسَّلْوَىٰ ۖكُلُوامِنطَيِّبَاتِ مَا رَزَقْنَاكُمْ ۖوَمَاظَلَمُونَاوَلَٰكِنكَانُواأَنفُسَهُمْ يَظْلِمُونَ)

صدق الله العظيم

سورة البقرة الآية (57)

Dedications

To the one who gave Paradise Life?

To the person who gave me happiness

My mothers

To the one who radiates his light and taught me how to deal with the hardships

To the person who gave me his happiness against his pleasure.

My father

To those who have come out of the same womb.

I love you and the Mighty, You are the joy

Brothers and Sisters

Acknowledgment

Praise is to Allah, the Lord of the Worlds and the Cherkals of God, and I am honored for the work of this research, and thanks to my supervisor **Dr. Mahmoud Hamid Mahmoud Hilo** gave me most of his time so that the research would come out with this beautiful picture also thanks **Dr. Issa Ismail and Dr. Elfatih** who provide me with his information and educational experience.

And also **Teacher Abdul Hameed** of the research laboratory, and thanks also to the **teachers Ismail and Amir** in the lab chemistry to stand with me in the practical part, and also thanks **Dr. Abdulsakhi Ibrahim.**

I thank all the friends and their support and everyone who gave me his knowledge, and thanks to the University of Sudan College of Graduate Studies Department of Physics.

Abstract

In this work ,Zinc Oxide nano particle (ZnO) were successfully synthesized by a sol-gel method, then the solution of the gum Arabic was also prepared and powred by the mortar method.

The samples were characterized by UV-VIS spectroscopy technique. Then the wave length (λ) nm was plotted vrs the absorption and calculation were done to evaluate the energy gap (Eg) using the formula

$$(\alpha h\nu)^2 = C(h\nu - Eg)$$

It shows that the energy gap of gum Arabic is found to be, Eg = (2.760) eV, for both samples. Which prove that it is a real semiconductor and its conductivity increases with the increasing of the dopants Zinc Oxide (ZnO).

المستخلص

في هذا البحث تم تحضير أكسيد الزنك النانوي بطريقة المحلول الجلاتيني بنجاح. كما تم تحضير محلول الصمغ العربي بطريقة الحرق الكيميائي، بعد تم تشويب محلول الصمغ العربي بأكسيد الزنك النانوي في وجود حمض الستريك. حيث تم تحضير عينتين مختلفتين من المحلول المشوب بنسب تشويب مختلفة. تمَ حساب قيمة فجوة الطاقة للعينات عن طريق قياس امتصاص الأشعة فوق البنفسجية في درجة حرارة الغرفة . ووجد ان فجوة الطاقة توضح ان الصمغ العربي المشوب بأكسيد الزنك يقع ضمن فئة أشباه الموصلات وموصليته تزداد بزيادة نسبة التشويب.

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List of abbreviations

Abbreviation	Meaning
DPP	Polymers dike Pyrrole
CPs	Conducting polymers
UV	Ultra violet
SPEs	Solid polymers electrolytes
Eg	Energy gap

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

The conducting polymer electrolytes have been intensely interesting to physicists, chemists and engineers because of their fundamental physical properties and potential application in various electrochemical devices such as fuel cells super capacitor sensors and display devices [1].

The development of polymer electrolytes has gone through three stages which are dry solid-state polymers, gel plasticizer polymer electrolytes systems and composite polymer electrolytes system. The first category of solid polymer electrolytes e.g. based electrolyte system, shows very low ambient temperature conductivities of the order of 10 The second category of polymer electrolytes is known as gel polymer electrolytes or plasticized polymer electrolytes which consists of both the properties of liquid and solid,; phases in the same electrolytes system. Combination of both properties i.e. the cohesive properties of solid and the diffusive properties of liquids give unique characteristics of the gel to find various important applications including polymer electrolytes.

Polymers containing Ions have been proposed as electrolytes for many solid state electrochemical devices. Over the past few decades important applications have been found in lithium batteries, super capacitors, electro chromic windows and chemical sensors. The research and development of solid polymer electrolytes (SPEs) has received a great deal of attention due to the usefulness of these materials in a variety of applications Polymer electrolytes are commonly doped with an alkaline salt in order to achieve high ion conductivity, They are of major interest for a range of applications, for example in battery In recent years thermoplastic polymers are more and more replacing conventional materials, either in structural high performances or in very qualified specialty applications, behaving as multifunctional materials. The lightness, the chemical resistance, the easiness to be thermally processed and oriented, the ability to assume a variety of shapes and sizes, the relatively slow aging and weathering, the possibility to tailor the chemical structure for specific applications, etc. make these materials very advantageous and therefore worth of a thorough study. Indeed, polymeric/ materials, more than others, show a complex frame of interwoven relationships among microstructure, process sing procedures and physical properties.

As an example, the orientation of the crystal line phase and the amount of the amorphous one are highly relevant for the mechanical performance of a polymeric material in structural applications. Furthermore, cold drawing of polymeric films, performed to optimize their orientation, clearly shows that different initial structures can affect the final properties of the fibers Instead, limited investigation has been barely developed so far for other physical properties, as barrier, electrical or optical properties, in spite of their increasing importance for high-value specialized applications. Concerning the electrical properties, polymers generally behave as insulating systems, although in the last decades the exciting discover of conductive polymers has opened new theoretical developments as well as important applications. In electrical insulation technology materials with higher

Reliability are required for severe operating conditions to display a good performance, an insulating material should have a very low electrical [2].

Conducting polymers were “practically” predicted in 1962 by John Pople and S.H. Walmsley before their experimental discovery. In this classical

Paper Pople and Walmsley introduced the concept of “solutions’” in poly acetylene. The authors suggested that such a defect could be mobile and, if charged, could be responsible of

1.2.1 Research Problem

Many polymers have to be classifying as a bad or semi conductors of electric current, so researches would be stabilized to try to make them more efficient in conducting electricity as they are.

1.3 Objective of study

The aim of this work was focused on the followings

1. Determination and studying the energy gap of Gum Arabic doped with zinc oxide.

2. Preparation of the gum Arabic solution by a chosen chemical method.

3. Study the effect of doping of the gum Arabic by ZnO to increase the efficiency of the electric conductivity of the gum Arabic polymer.

1.4 The importance of the research

An extra ordinarily large range of conductivity can be obtained upon doping of conducting polymers (CPs), the conductivity increases as the doping level rises. Both n and p type dopants, as well as protonic acid doping, have been used to induce an insulator–metal transition in CPs. Charges introduced into the polymers and oligomers through doping are stored in different states called solutions, polarons, and bipolarons. The nature of the charge carriers is dependent on material and doping level. When a charge moves through a dielectric crystal, it will be permanently surrounded by a region of lattice polarization. Moving through the crystal, the charge carries the lattice distortion with it. The moving charge together with the accompanying self-consistent polarization field can be treated as a quasi particle called a "polaron" with its own particular characteristics, such as effective mass, total momentum, energy, etc. In an organic polymer chain, it is energetically possible to localize the charge that appears soon the chain and to have, around the charge, a local distortion (relaxation) of the lattice [7].

1.5 Method

This research will use the practical applied method to prepare the samples, and, the solution of both Gum Arabic and zinc oxide, and analyzes them by using the ultra violet (UV) device to determine and characterizes the electrical properties of the Gum Arabic doped with zinc oxide.

1.6 Layout of the Research

This research contains four chapters which are arranged as follows:

* Chapter one contains the introduction

* Chapter two includes the theoretical background and literature survey

* Chapter three the experimental part of the research which due to Material and Methods.

* Chapter four contains the results and discussion Conclusion References.

CHAPTER TWO

THEORETICAL BACKGROUND AND LITERRTURE REVIEW

2. Introduction

2.1 Zinc oxide (ZnO)

Metal to be represented in all six enzyme classes vizoxido reeducates, transferees, hydrolyses, lyses, isomerizes, and ligases [8].Zinc is one of the essential nutrients required for plant growth. It's important role can be adjudged as it controls the synthesis of iodole acetic acid which dramatically regulates the plant growth. It is also necessary for the chlorophyll synthesis and carbohydrate formation [9]

2.2 metal oxide nano particles

Metal oxides play a very important role in many areas of chemistry, physics and materials science [10-15]. The metal elements are able to form a large diversity of oxide compounds [16] these can adopt a vast number of structural geometries with an electronic structure that can exhibit metallic, semiconductor or insulator character. In technological applications, oxides are used in the fabrication of microelectronic circuits, sensors, piezoelectric devices, fuel cells, coatings for the pass ovation of surfaces against corrosion, and as catalysts. In the emerging field of nanotechnology, a goal is to make nanostructures or nano- arrays with special properties with respect to those of bulk or single particle species [17-21]. Oxide nano-particles can exhibit unique physical and chemical properties due to their limited size and a high density of corner or edge surface sites. Particle size is expected to influence three important groups of basic properties in any material. [22].

2.3 CRYSTAL STRUCTURE OF ZnO

General, Zinc oxide crystallizes in two main forms, hexagonal wurtziteand cubic zinc blende but the (B4 type) wurtzite structure is obtained only at optimum and is characterized by two interconnecting sublattices of zn2+and o2-where each anion is surrounded by four cations at the corners of a tetrahedron with a typical sp3 covalent bonding. Among different phases of ZnO,based on the first principle periodic Hartree-Fock linear combination of atomic orbital's theory the wurtzite is found to be the most thermodynamically stable phase[23].

Tetrahedral symmetry plays a vital role for the polarity of ZnO that arises along the hexagonal axis. Piezoelectricity and spontaneous polarization are the direct consequence of polar symmetry of ZnO along the hexagonal axis [23].

The second important effect of size is related to the electronic properties of the oxide. In any material, the nano structure produces the so-called quantum size or confinement effects which essentially arise from the presence of discrete, Structural and electronic properties obviously drive the physical and chemical properties of the solid, the third group of properties influenced by size in a simple classification. In their bulk state, many oxides have wide band gaps and a low reactivity.[24] Metal-oxide particles such as TiO_2 and ZnO, serve many functions in the various polymeric materials. Traditionally, they have been used as pigments to enhance the appearance and improve the durability of polymeric products, and usually they have been considered to be inert. As nano sized particles, these materials exhibit broad band UV absorption, toughness, and service life of polymeric materials, for example, in applications in which mar resistance is important. Optimizing the material properties of metal-oxide nano particle/polymer composites, the microstructure and dispersion (sizes and spatial distribution) of nano particles must be characterized as a function of different process conditions [25].

2.4 Gum Arabic

2.4.1 CRYSTAL STRUCTURE OF GUM

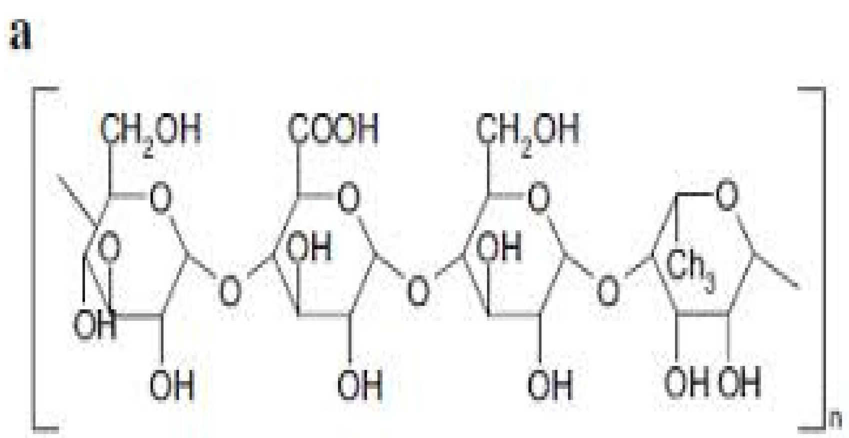

Fig (2.1) Structure of gum

Fig (2.2) Photo for gum Arabic

2.4.2 Chemical Structure of Gum Arabic

Gum Arabic consists mainly of high-molecular weight acid contents than gum from acacia Senegal. Acacia seyal gum contains a lower proportion of nitrogen and the specific rotations are very different.The amino acid compositions are similar with hydroxyl propylene and serine the major constituents [26].

2.4.3. Physical Properties of Gum Arabic

Solubility: Yield a solution up to 55% concentration. Gum Arabic is truly soluble in cold water. Other gums are either insoluble in cold water or form colloidal suspensions, solutions not true.

Viscosity: A 20% aqueous solution will give less than100 cps, i.e. Gum Arabic is not very viscous at such concentrations. High viscosity obtained only at concentrations of 40% - 50%.

Color: Colorless (top quality) to pale straw color (average quality).

Taste: Has no off-taste.

Toxicology and Status: AD not specified by (JEFCA + EEC), general status as (GRAS).

Fiber: Can be regarded as 95% soluble fiber according to some of the available test methods.

Film forming: Super film-forming properties make it ideal for some confectionery coatings and lithographic plate solutions.

viii. Emulsifier: Produced highly stable emulsions making it very useful in the preparation of oil-in-water food flavors emulsions, particularly for citrus oils.

2.4.4 Products of Acacia Tree

Acacia Senegal Gum (Hashab) is a pale white to orange-brown solid, which breaks with a glassy fracture [27].

2.4.5 Economic Methodology of Production Gum Arabic

Agricultural operations, including Gum Arabic harvesting, are primarily financed by village traders using the" Sheila "system. Typically, the traders provided cash, seeds, tools and basic commodities (water, sugar, tea...) for the households to get by during the “hunger gap". Farmers pay back in kind at prices determined early in the season and usually integrating important credit charges [28].

2.5 Uses of Gum Arabic

Raise human immune level especially for pregnant women. Help digestion as a fiber. Have supernatural power to drive away evil spirits and white witches. Treatment of kidney failure, added to house paints.

2.6 Gum Arabic tapping

Axe used in tapping had been replaced by one, which utilizes a specially designed tool, "Sunki" .This has a metal head fixed to a long wooden handle; the pointed end of the head is pushed tangentially into the stem or branch to penetrate just below the bark, and then pulled up to strip a small length of bark longitudinally from the wood [28].

2.7 Gum Arabic Grades

The grading of Gum Arabic based upon its physical parameters such as color, shape, size and purity, which made it rather simple, can be done by the producers themselves [28].

2.8 Literature Review

2.8.1 Introduction

The properties ifzinc oxide makes the material eligible exists in various shapes in the form of nanostructures exhibiting a varieties of properties like piezoelectricity, optical transparency, conductivity, solar cell, UV and visible photoluminescence.

2.8.2 Synthesis of ZnO nano particles

As we all know any material in its nano form is more demandable than in its bulk form because in nano level the material undergoes a drastic change in its property and has versatile application. Thus zinc oxide which is a multifunctional material with a large direct band gap created anxiousness in the scientific minds to enhance the research on one dimensional nanostructure especially oxide materials, optical nonlinearity and much variety of experimental techniques such as optical absorption, transmission, reflection, spectroscopic [29].

2.8.3 Optical properties

ZnO is a direct band semiconductor and a transparent conductive material. ZnO films are transparent in the wavelength range of 0.3 and 2.5 µm, and plasma edge lies between 2 and 4 µm depending on the carrier concentration. It is well known that a shift in the band gap edge appears with an increase in the carrier concentration. This shift is known as Burstein-Moss shift [29]. Different groups of people use the term Gum Arabic with varying degrees of precision. In the context of its use as a food additive the most recent, defined Gum Arabic as the dried exudation obtained from the stems and closely related species (and closely related species) satisfies the specification. Which compiles? With the definition and specifications that have been tested and shown to be safe to consume. In Sudan, the term Gum

Arabic is used in a wider context to include two types of gum which are produced and marketed, but which are, nevertheless, clearly separated in both national statistics and trade: "Hashab" In a still wider sense. Gum Arabic taken to mean the gum from any Acacia species (and is sometimes referred to as acacia gum) [28].

2.9 Extraction of Gum Arabic

Gum Arabic is the dried, gummy exudation obtained from various species of acacia trees of the leguminous family [30], fined Gum Arabic as dried exudates from the trunk and branches of acacia Senegal or acacia seyal of the family Leguminous [27]. Acacia trees belong to the botanical family of Leguminous, predominantly species of the groups Fables and Gum misfire. The only species producing sap eligible for the name acacia gum or Gum Arabic are Acacia Senegal and Acacia Seyal [31]. Acacia is a small to medium sized thorny tree, with a stem, which is irregular in form and often highly branched. In leaf, like many other Acacias, it has a dense, spreading crown, in common with other members of the A. Senegal complex, it has characteristic sets of prickles on the branches, usually in threes with the middle one hooked downward and the lateral ones curved upward. The bark is not papery or peeling [28]. The tree is deciduous, droops its leaves in November in the Sudan [32]. Acacia Seyal has a single straight stem with a characteristic, pronounced color, usually orange-red, to the powdery bark, and straight thorns rather than the curved prickles of A. Senegal [28].

2.10 Nanotechnology

High electrical conductivity, in a series of papers in1963, Weiss and coworkers reported high conductivity in iodine oxidized polypyrrole. In the first part of this series the authors described a chemical examination of polypyrrole and they suggested that it may be regarded as a three-dimensional network of pyrrole rings interconnected by direct carbon to carbon linkages. In the second part the authors suggested that the molecular iodine is present as a charge-transfer complex. In the latter paper (part III) they described further experiments that show the influence of charge-transfer complexes of polypyrrole on its electronic properties. These papers also describe the effect of iodine doping on conductivity, the conductivity type (n or p), and electron spin resonance studies on polypyrrole. In1968 the properties of organic semiconductors, especially the polyanilines, were reviewed by R. De Servile [26].

Another type of acceptor that has been often incorporated in conjugated polymers is the dike to pyrrole opyrrole (DPP) unit. DPP has its origin as a strongly colored dye, where the most famous one is or more commonly.

2.11 Properties of polymers

Polymers possess different type of properties some of these polymers are soft, flexible while some others are may be hard, right, tough, etc. Physical properties polymers are directly depends upon the nature of primary and secondary bond forces and size of the molecules .the nature of the bond which hold the atom consisting of small atom nucleus containing positive charge and mass surrounded by the electron relatively for away, the chemical reaction and primary bond formation generates by losing or sharing of that valance electrons.

Physics properties of polymers include the degree of polymerization, molar mass distribution, crystallites, as well as thermal phase transitions: i.e., Tg and Tm where Tg (glass transition temperature) and melting point (for thermal plastics) [33].

2.12 Processing methods

The synthesis of nonmaterial can be well accomplished by two app-roaches; -.firstly, by "Bottom Up" method where small building blocks are produced and assembled into larger structures. Where the main controlling parameters are morphology crystalline particle size and chemical composition. Examples: chemical synthesis, laser trapping, self-assembly, colloidal aggregation, etc and secondly, by "Top Down" method where large objects are modified to give smaller features.
For Example: film deposition and growth, nano imprint /lithography, etching technology, mechanical polishing etc. the main reason of alteration in different mechanical, thermal and other property is due to increase in surface to volume ratio. Synthesis of nonmaterial is most commonly done based on three strategies i.e. under liquid phase synthesis the techniques used for synthesis are:

2.13 Sol-gel Process.

2.13.1 Methods using solid precursors

Low-Temperature Reactive Synthesis nanostructure materials can have significantly different properties, depending on the chosen fabrication route. Each method offers some advantages over other techniques while suffering limitation from the others.

2.13.2 Applications

The two concepts necessary for nanotechnology are self-replication and positional control. These could both come from something called a universal assembler. By following the basic principles of nanotechnology versatile number of devices can be fabricated.

A nano technological computer can be built which would have the computational power of computers a few years back, and would be smaller than anything we can see with a microscope. In all, this assembler would weigh about 1.66e-15 grams, which would make it smaller than a common bacterium. Nanotechnology, like every other field, has both a good and bad side One side of nanotechnology, is that anything that can be precisely defined can be built [8-11].

If someone is hungry, they have but to go to their replication unit, (something that would probably resemble today's microwave in design) and order whatever it is they want. With nanotechnology, there is the possibility of what is called a 'morph' material, a substance made up of tiny little machines that can take on any shape [9]. A table becomes a chair when unexpected company shows up, stairs that turn into ramps for the disabled, but then again, the disabled could have artificial 'nano limbs', that morph into useful tools when necessary. Nanotechnology could help in creating tomorrow's computers.

A computer can be designed which have the size of small 6 organisms and have the computational power of today's personal computers. This would make it possible to fit a full computer into something the shape and size of a piece of paper, including display, voice recognition, and new features that are not available, due to lack of speed and power of today’s computers. Clothes that could change colors, toys that changes shape, self-adapting surgical implants, and many other things, that would drastically improve and diversify our abs.

CHAPTER THREE

Experimental

3.1 Introduction

In this chapter we will deal with the practical experiments that were done, and the results obtained in addition to the amount of these results, besides the materials used in practical.

3.2 Materials and Tools

- The Natural gum Arabic was used after processing.

- Zinc sulphate heptahydrate $ZnSO4.7H2O$ (purity = 99%, molecular weight = 50g, (QUALIKEMS FINE CHEMICALS PVT. Ltd), Sodium hydroxide NaOH (purity = 96%, molecular weight = 50.00 g, (NICE LABORATORY REAGENT), demonized water with sodium hydroxide NaOH 25 ml and, Zinc sulphate hepta; hydrate ZnSO4.7H2O 40ml were used. to prepare ZnO, we brought chemicals, such as zinc sulphate, sodium hydroxide, demonized ions, Arabic gum, citric acid, distilled water.

3.3 Method

3.3.1 Synthesis of ZnO nano particles

Zinc oxide nano-powder was synthesized by sol gel process. Zinc Sulphate Heptahydrate (ZnSO4.7H2O) and sodium hydroxide (NaOH) was used as precursor materials and sodium hydroxide solution was used as a solvent as well. Zinc Sulphate was dissolved in NaOH by Molar ratio (1:2). The sodium hydroxide solution was added drop wise to the solution of Zinc sulphate heptahydrate under vigorous stirring and left for 12hrs then the precipitate was filtered and washed with de ionized water 600ml and dried in an oven at 100oC. The dried material was ground to a fine powder using agate mortar and finally fernis annealed at 700oC for an hour.

Whole synthesis can be summarized as:

3.3.2 Gum Arabic:

We brought the sample of dry gum Arabic and the gum was poured by the mortar until the sample became small granules and weighed by the delicate balance.

Adjustment:

We brought 4 cups and zinc oxide was mixed after adding distilled water to the HOMOGENIZES using an intermediate test tube for the simple and large sample of the sample, B.

3.3.4 Preparation of ZnO/gum Arabic nano composites solution

Preparation of gum Nan composite Films.6 g/L xanthan aqueous solution was mixed with gum at different concentration gradients in the presence of citric acid at 300 mg/L. This concentration of citric acid was chosen because it worked well for xanthan cross linking [24]. The homogenous solution was well prepared after being thoroughly stirred overnight and blended by ultrasonic homogenizer at 50% power for 10minutes. The solution was then poured onto Teflon-coated plates and treated in a hot air oven at 50 C until the films (0.2 mm) were casted. The casted films were directly peeled from the plates and put into the hot air oven again at 165 C for 7 minutes. As soon as the oven cooled down, all samples were collected and then stored in a sealed plastic bag at room temperature for further research [49].

3.4 Results

Sample 1

SOLVENT	WIGHT	DISTELWATER
ZnO	0.5g	10ml
Gum	5g	10ml
Citric acid	0.3g/l	5ml

Sample 2

SOLVENT	WIGHT	DISTELWATER
ZnO	1.5g	30ml
Gum	14g	20ml
Citric acid	0.9g/l	15ml

Cause zinc oxide over time is not considered a nano-particle so it is homogeneous to reflect the nature.

Second, add the distilled water to the gum in each cup on its own and the gum was moved until it became semi-liquid. The solution was added to the acid gum Arabic gum with continuous stirring. Also, the zinc oxide solutions was added to the gum with stirring also for 5-7 minutes, and were shut down in their headquarters Falcon for 24 hours until the deposition dissolved solution and became water at the top.

The two samples were placed on the oven at 50 ° C to dry out the growth, followed by a temperature of 165 degrees so that the cohesion and distortion between the glue and the zinc oxide, The two samples were formed in white and gray, while in white, the smell of burnt sugar was similar to the smell of burnt sugar, while the other did not have any smell, we tried to pull the sample of the Petri after the nose, but the crumbs were broken and after it were added drops of distilled water and returned in shape before the nose Glad it in this bitter It did not enter the oven, and was left to dry naturally in the form of the examination slice (for blood tests) was removed before it dried out and left the Petri.

The UV test:

In order to test the ultraviolet light, the sample must be in liquid form. The aromatic gasoline and chloroform were selected to determine the melting of the sample in one of them. After the gasoline test, the sample was not melted in all ways after it was moved and pressed. Also chloroform did not dissolve the sample with the same characteristics of gasoline. Put the sample in the distilled water to dissolve in water easily and distilled water becomes the solution for this sample and the UV device to know the absorption, and the wavelength was set from 190 to 800 nm, and was read in the form of a graph did not record the first reading because it is not fixed and then diluted the solution and also did not record this reading because it is not accurate, and then eased again and this time recorded readings It was saved in the computer and was copied in the cylinder, came out in the form of a table with a number of columns and rows, the most important columns column A, which represents the wavelength, and column B, which represents the energy gap, and then use the application Origin to draw the curves a graph Curve for each table was found.

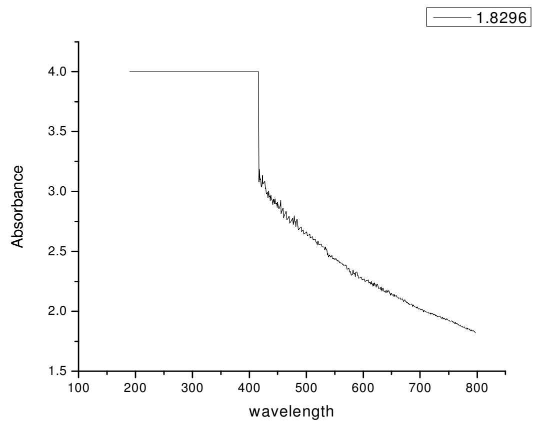

Fig (3.1) plots the relation of wavelength vrs absorbance of gum Arabic doped zinc oxide (ZnO) for sample 1.

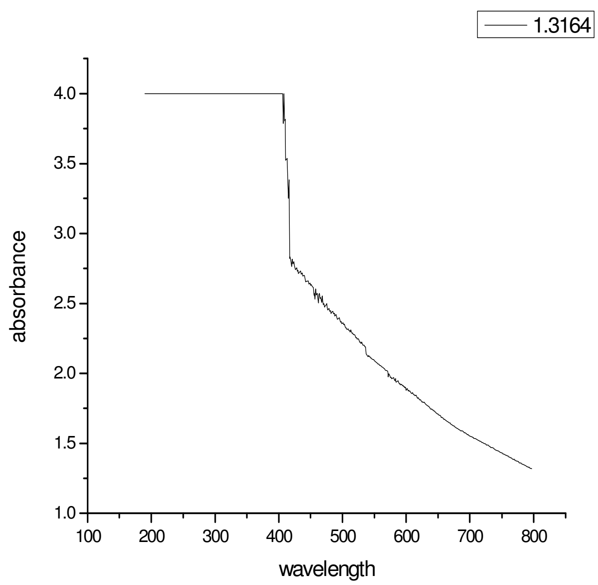

Fig (3.1) plots the relation of wavelength vrs absorbance of gum Arabic doped zinc oxide (ZnO) for sample 2.

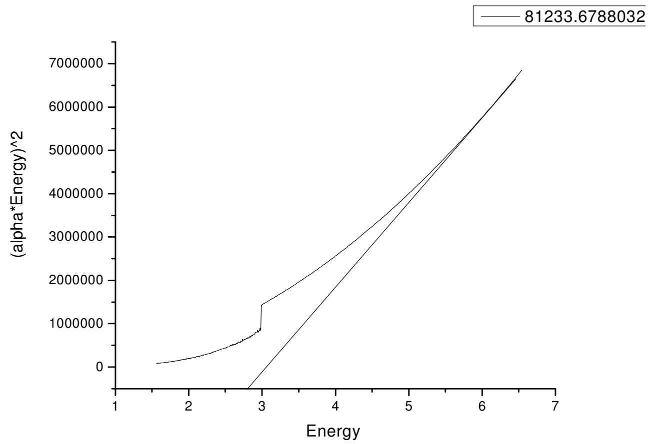

Fig (3.3) plots the relation of Energy vrs $(\alpha h v)^2$ of gum Arabic doped zinc oxide (ZnO) for sample 1.

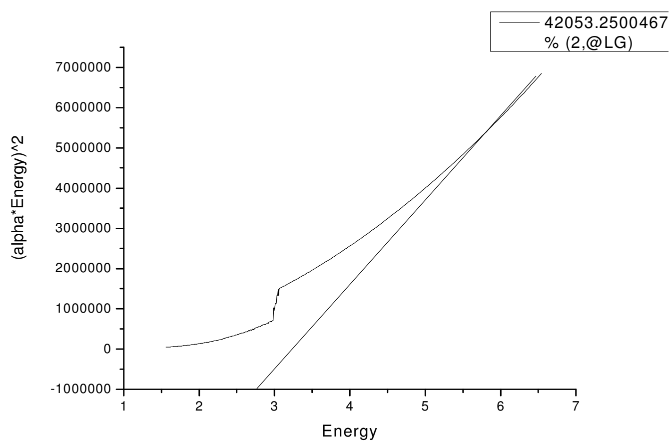

Fig (3.4) plots the relation of Energy vrs $(\alpha h v)^2$ of gum Arabic doped zinc oxide (ZnO) for sample 2.

CHAPTER FOUR

DISCUSSION

4.1 Discussion

Fig (3.3) plots the relation of the optical energy (hυ) vrs $(\alpha h\upsilon)^2$ of Gum Arabic doped zinc oxide (ZnO) sample 1 with different wavelengths (190 - 800) nm; the optical energy gap (Eg) has been calculated by the relation:

$$(\alpha h\nu)^2 = C(h\nu - Eg)$$

Where C is constant, by plotting $(\alpha h\nu)^2$ vrs photon energy (hυ) for all sample treated of Gum Arabic doped zinc oxide (ZnO) with different wavelengths (190 - 800) nm, and by extrapolating the straight thin portion of the curve to intercept the energy axis, the value of the energy gap has been calculated, the value of (Eg) of the samples treated of Gum Arabic doped zinc oxide (ZnO) obtained to be (2. 760) eV, which is less than the approach the value of (3.630) eV, and the value of (Eg) lies at the same range for the two sample prepared (2. 760) eV. The decreasing of (Eg) related to decrease in the wavelength of samples. It was observed that the different wavelength of the samples confirmed the reason for the band gap shifts.

Fig (3.2) plots the relation of the optical energy (hυ) vrs $(\alpha h\upsilon)^2$ of Gum Arabic doped zinc oxide (ZnO) sample 2 with different wavelengths (190 - 800) nm; the optical energy gap (Eg) has been calculated by the relation:

$$(\alpha h\nu)^2 = C(h\nu - Eg)$$

Where C is constant, by plotting $(\alpha h\nu)^2$ vrs photon energy (hυ) for all sample treated of Gum Arabic doped zinc oxide (ZnO) with different wavelengths

(190 - 800) nm, and by extrapolating the straight thin portion of the curve to intercept the energy axis, the value of the energy gap has been calculated, the value of (Eg) of the samples treated of Gum Arabic doped zinc oxide (ZnO) obtained to be (3.673) eV, which is approach the value of (3.630) eV, and the value of (Eg) was decreased from (3.673) eV for sample 368 nm to (3.630) eV for the sample 400 nm. The decreasing of (Eg) related to decrease in the wavelength of the samples. It was observed that the different wavelength of the samples confirmed the reason for the band gap shifts.

4.2 contributions

On one hand, the discussion above shows that the different value of the solvent weights used in both samples does not change the property of the energy gaps behavior of the solution of Gum Arabic doped zinc oxide (ZnO) prepared, and the graphs ensure that the sample are in the range of the semiconductors region, on the other hand, the rest of optical and electrical characteristics and properties of both samples can be tested by using other different techniques rather than UV visible device.

4.3 Conclusion

The defrosting of citric acid on the zinc-oxide polymer led to reducing the energy gap, the polymerization of the acid with a citric acid did not affect the nature of the electronic transitions, but negatively affected the values of the energy gap, which makes this, affect in many the field of visual and electronic applications.

The band gap of the zinc oxide nano particles was estimated from the UV-VIS absorption. It was observed that the band gap of the samples remains almost the same.

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