Effect of (CoO) Nanoparticles on Someoptical Properties of (PVA- Paam) Composite

*Majeed Ali Habeeb, *Hiader Mohammed Mohssen
* University of Babylon,College of Education for pure sciences, Department of Physics.Iraq

**Raheem Gaayid Kadhim
** University of Babylon, College of Sciences, Department of Physics. Iraq

***Abstract*—In the present work, many samples have been prepared by adding different weight percentages of cobalt oxide nanoparticles (3, 6, 9, and 12)wt. %.hese samples were prepared by casting method. The absorptionspectrum has been recorded in the wavelength range (200-1100)nm and calculated energy gap of the indirect allowed and forbidden transitionas well asoptical constant such as(refractive index, extinction coefficient and read and imaginary dielectric constants).**

***Keywords*—(PVA-PAAm) Composites, Cobalt Oxide Nanoparticles, Optical Properties**

I INTRODUCTION

and optical properties of polymers have attracted much attention in view of their application in electronic and optical devices. Electrical conduction in polymers has been studied aiming to understand the nature of the charge transport prevalent in these materials while the optical properties are aimed at achieving better reflection, antireflection, interference and polarization properties[1].Although many people probably do not realize it, everyone is familiar with polymers. They are all around in everyday use, in rubber, plastics, resins , in adhesives and adhesive tapes, their common structural feature is the presence of long covalently bonded chains of atoms. They are an extraordinarily versatile class of materials, with properties of a given type often having enormously different values for different polymers and even sometimes for the same polymer in different physical states[2].Optical properties of polymers constitute an important aspects in study of electronic transition and the possibility of their application as optical filters, a cover in solar collection, selection surfaces and green house. The information about the electronic structure of crystalline and amorphous semiconductors has been mostly accumulated from the studies of optical properties in wide frequency range. The significance of amorphous semiconductors is in its energy gap [3]. Polyvinyl alcohol (PVA) is a potential material having a very high dielectric strengthgood charge storage capacity and dopant-dependent electrical and opticalproperties[3]. So the wide range of applications of PVA can be even more extended byincorporation of dopant into PVA matrix [4].The advantage of poly vinyl alcohol that has the ability to blend into the water which is resistant to do solvents, oils, and has the ability exceptional adhesion materials cellulosic so uses his wide is used in making paper and textile industries in the manufacture of membranes resistance to oxygen in the coating photographic film,[5] also polyvinylalcohol semi-amorphous [6].Polyacrylamide (PAAm) is crystal solid very stable that viscosity in 25C its between(10-5000)*10^{-3} (Poise)by used method sedimentation in the ultracentrifuge .(PAAm) are polymers dissolved in water and these no similar the monomer anther non-baneful. For contain on nitrogen theoretical 19.7% but technological its 15.8% to 16.8% and inform percentage contain on hydrogen 3.6 and this last given him properties many a polarization and have application width of fieldsthe industry,livingand medicine[7] .Further, polymers, on doping with noble metal nanoparticles, show novel and distinctive properties obtained from unique combination of the inherent characteristics of polymers and properties of metal nanoparticles [8].The inorganic or organic nanoparticles doping into the polymer matrix an provide high-performance novel materials that findapplications in many industrial fields[9].The oxides of transition metals, such as copper, iron, nickel, cobalt, and zinc, have received many important applications, including magnetic storage media, solar energy transformation, electronic, semiconductor, varistor, catalysis, and electrical and optical switching devices[10].(CoO) nanoparticles in the 20-30nm rang. Have been prepared by thermal decomposition the particles were characterized to be pyramid shape with hexagonal close-packed structure [11] has cubic rock-salt structure and received considerable attention over last few years due to its importance in technological applications catalytic properties [12].

II MATERIALS AND METHODS

The composite of polymers which consisting of PVA and PAAm were prepare by dissolved the polymers in 30ml of distilled water by using magnetic stirrer used to mixing process to get solution more homogeneous at heat (75C) for (1hour) with ratios (8:2)of PVA and PAAm then the CoO nanoparticles was added slowly to the composite polymers with different concentrations are (3,6,9and12)wt.% The resultsolution was stirred continuously until the solution mixture became a homogeneous viscous appearance at room temperature for times (15-30) minutes. (PVA-PAAm-CoO)nanocomposite membranes are obtained by leaving the mixture solution in a petre dish diameter (5.5cm)at room temperature.

The absorption spectra of (PVA-PAAm-CoO) nanocompositeshave been recording in the length range (200-1100) nm by using (UV-1800) Shimadzu spectrophotometer, theabsorption coefficient (α) was calculated from the following equation:[13]

α=2.303 A\d ………………… (1)

Where A is absorbance and d is the thickness sample.

The optical energy gap has been calculated by using this equation.[15]

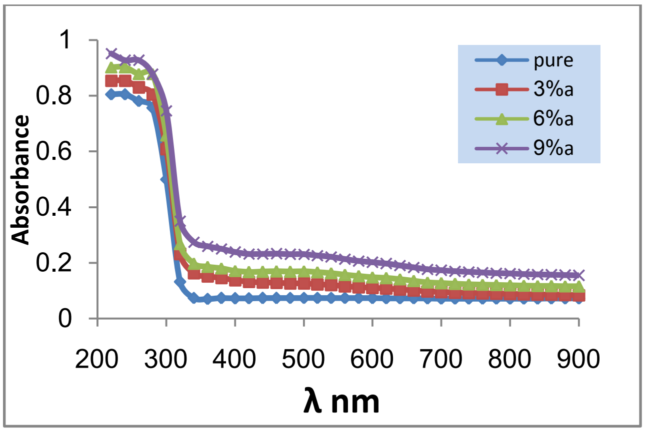
$\alpha h\upsilon = B\,(h\upsilon - Eg)^r$ …………….(2)

Where:hυ is the energy of photon ،B is proportionality constant،Egoptical energy gap and ris an index having the values of (r=2) this indicates an allowed indirect transition. When the value of (r=3), this indicates forbidden indirect transition.
The extinction coefficient (k) is directly proportional to the absorption coefficient (α). [14]
k=αλ/4π.………………(3)
Whereλ is the wavelength of light.
The refractive index has been calculated by using this equation. [16]
$n= [4R/(R-1)^2-k^2]^{1/2}-(R+1/R-1)$ ..……..…. (4)
The parameter ε_1 is the real part ofdielectric constant;ε_2 is theimaginary part of dielectricconstant calculated from these equations. [17]

$\varepsilon_1 = n^2-k^2$.................... (5)
$\varepsilon_2=2nk$ ………………. (6)

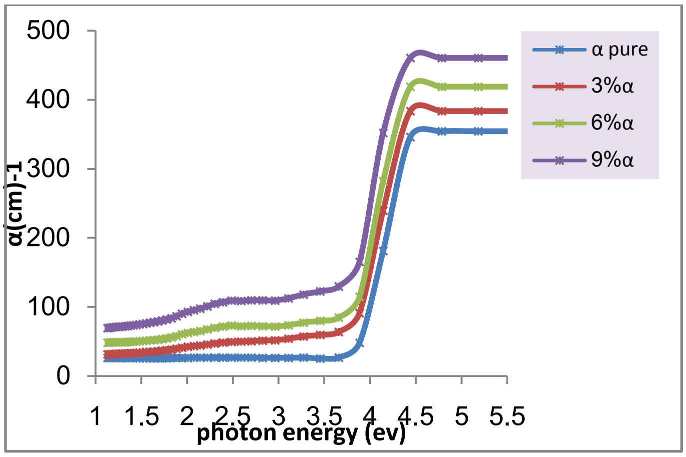
III RESULTS AND DISCUSSION

The relationship between the absorbance and wavelength of the incident light for (PVA-PAAm-CoO)nanocomposites at room temperature shown in Fig(1).From this figure note that intensity of the peak increases as a result of increasing concentration of (CoO) nanoparticles and no shift in the peak position. The increase of absorbance with increase of weight percentage of the (CoO) nanoparticles, is due to absorb the incident light by free electrons [18].



Fig(1): Variation of optical absorbance for (PVA-PAAm-CoO) nanocomposites with wavelength.

Fig(2).shows the relation between the absorption coefficient and photon energy of the (PVA-PAAm-CoO) nanocomposites.We note that the change in the absorption coefficient is small at low energies this indicates the possibility of electronic transitions is a few. At high energy, the change of absorption coefficient is large. The results showed that the values of absorption coefficient of the(PVA-PAAm- CoO)nanocomposites is low($\alpha<10^4 cm^{-1}$) which indicates the indirect electronic transition. [16]



Fig(2): Absorption coefficient for(PVA-PAAm- CoO)nanocomposites with various photon energy.

The relation between $(\alpha h\upsilon)^{1/2}$ (cm .ev)$^{1/2}$and photon energy of nanocomposites shown in Fig (3).From this figure we note that the value of optical energy gap decrease by increasing of weight percentage of (CoO) nanoparticles, also the transition which occurs in the samples is allowed indirect transition.This attributed to the creation of site levels in the forbidden energy gap; the transition in this case is conducted in two stages that involve the transition of electron from the valence band to the local levels to the conduction band as a result of increasing the cobalt oxide nanoparticles weight percentage. Thisbehavior is attributed to the fact that nanocomposites are of heterogeneous type (i.e. the electronic conduction depends on added concentration), the increase of the added rate provides paths in the polymer which facilitate the crossing of electron from the valence band to the conduction band, this explains the decrease of energy gap with increase (CoO) nanoparticles. [19]
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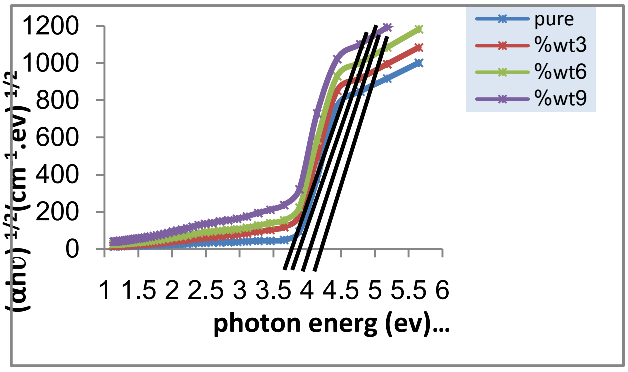
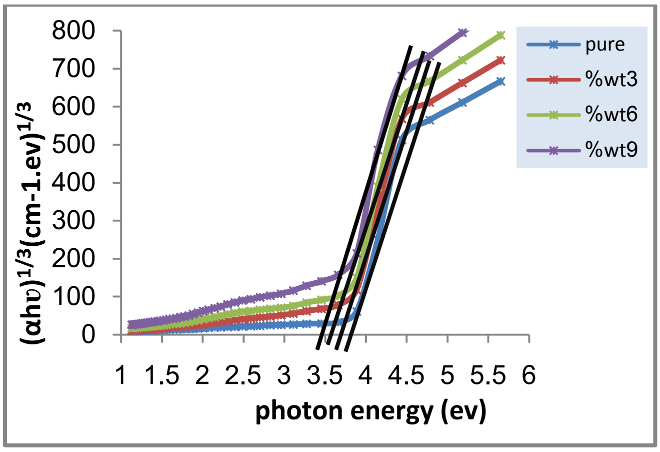


Fig(3): The relationship between $(\alpha h\upsilon)^{1/2}(cm^{-1}.ev)^{1/2}$and photon energyof (PVA-PAAm-CoO)nanocomposites

Fig(4).shows the relationship between $(\alpha h\upsilon)^{1/3}$ $(cm^{-1}.\ ev)^{1/3}$ and photon energy of nanocomposites ,we can see from this figure the value of forbidden energy gap also decreases by increasing weight percentage of (CoO)nanoparticlesas well as this value of forbidden indirect transition is less than the one value which is represent allowed indirect transition.[19]Theforbiddenenergy gab valuesdependence in general on the crystal structure of the nanocomposites and on thearrangement and distribution way of atoms in the crystal lattice, also the decreaseenergy band gap due to decease the distance between the valance band and conduction band withincrease the concentration of (CoO)nanoparticles.[22]



Fig(4): The relationship between $(\alpha h\upsilon)^{1/3}(cm^{-1}ev)^{1/3}$and photon energy of(PVA-PAAm-CoO)nanocomposites

The behavior of refractive index with photon energy of (PVA- PAAm-CoO)nanocompositesshown in Fig(5). This figure shows that the refractive index of (PVA- PAAm-CoO)nanocompositesincrease with increasesconcentration of the(CoO)nanoparticles,The reason of this result is, the increase of the (CoO) concentration leads to increase the density of the nanocomposites.[20]

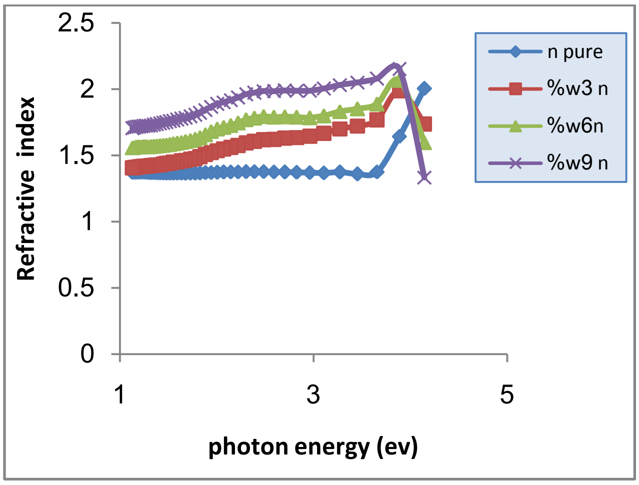


Fig (5): The variation between refractive index and photon energy of(PVA-PAAm-CoO)nanocomposites

The variation between extinction coefficient of (PVA-PAAm-CoO)nanocomposites with photon energy shown in Fig (6). This figure shows that the extinction coefficient has low values at (UV-region) and with little concentration as well as it is increased with increasing additive concentrations of (CoO)nanoparticles because of increasing in absorption coefficient, but at visible region we note that the extinction coefficient is very low because of the low absorption at this region. [21]

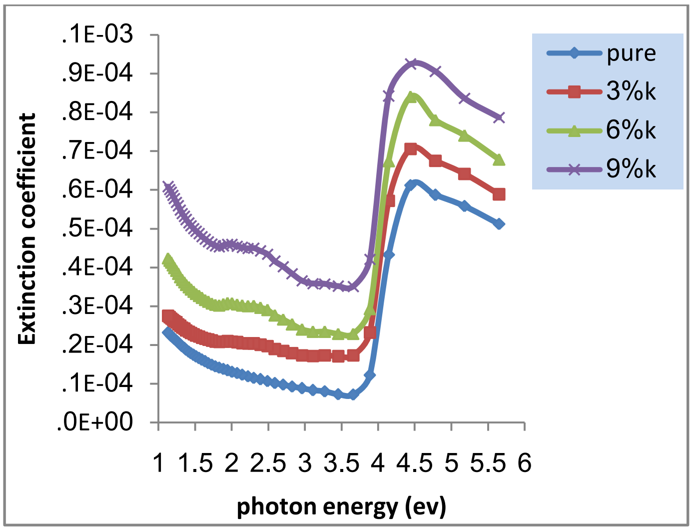


Fig (6): The relationship between extinction coefficient and photon energy of (PVA-PAAm-CoO)nanocomposites.

Figs(7,8).show the variation of real and imaginary parts of dielectric constant of (PVA-PAAm-CoO) nanocomposites.This concluded that the variation of $\varepsilon_1$mainly depends on (n^2) because of small values of the (k^2), while the ε_2 mainly depends on the (k) values which are related to thevariation of absorption coefficient. [17]

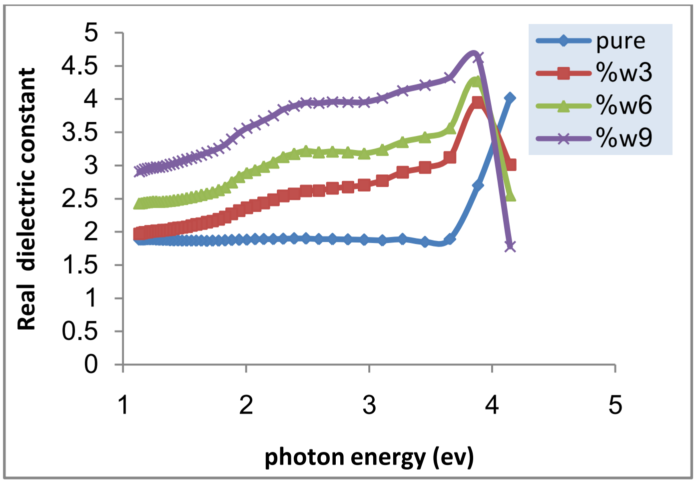


Fig (7): Variation of real part of dielectric constant with photon energy of (PVA-PAAm-CoO)nanocomposites

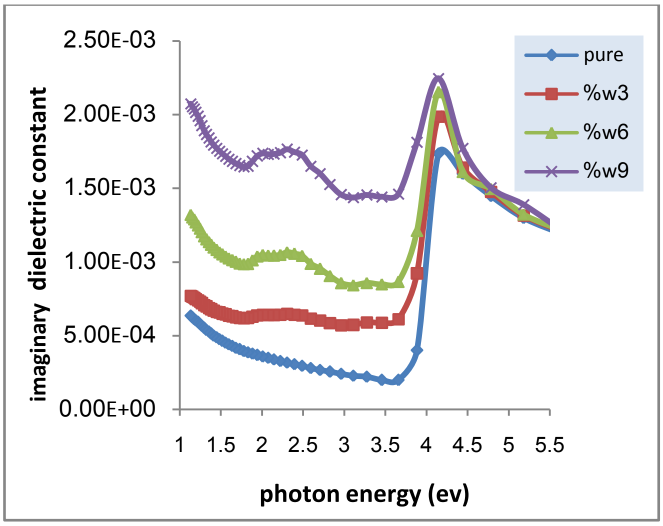


Fig (8): Variation of imaginary part of dielectric constant with photon energy of (PVA-PAAm-CoO)nanocomposites

CONCLUSION

1- The absorption coefficient for all (PVA-PAAm-CoO) nanocomposites increases with increasing of CoO wt. %nanoparticles.
2- The energy gap of indirect transition decreases with increasing of CoO wt. %nanoparticles.
3- Extinction coefficient, refractive index and dielectric constant (real and imaginary) increased with increasing of concentration.

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