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SYNTHESIS AND CHARACTERIZATION OF (PVA-PVP-C.B) NANO COMPOSITES

Ali A. Abid[1], Sameer H. Al-nesrawy[2], Ali R. Abdulridha[3]

[1]University of Babylon, Faculty of Education for Pure Science, Department of Physics, Iraq.
E-mail: aliareabe@yahoo.com
[2]University of Babylon, Faculty of Education for Pure Science, Department of Physics, Iraq.
E-mail: samiralnesrawy289@gmail.com
[3]University of Babylon, Faculty of Education for Pure Science, Department of Physics, Iraq.
E-mail: ali_rzzq@yahoo.com

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ABSTRACT: In this present study, polymer blend (PVA-PVP)-Carbon black (C.B N375) nanocomposites have been investigated. The (PVA-PVP-C.B) nanocomposites are organized by via casting procedure. The optical microscope, FTIR and optical properties have been studied. The absorbance of nanocomposites (PVA-PVP-C.B) increased for experimental consequences with the growing of carbon black (C.B) nanomaterial concentrations. Also with the increasing of carbon black (C.B) concentrations the energy gap of (PVA-PVP-C.B) nanocomposites decreased. The coefficient of absorption, refractive index, coefficient of extinction, imaginary and real constants of dielectric of (PVA-PVP-C.B) nanocomposites increased with the increasing of carbon black (C.B) concentrations.

KEYWORDS: Carbon black nanoparticle, Optical constants, Energy gap, Polyvinyl alcohol, Polyvinyl Pyrrolidone.

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I. INTRODUCTION

Nano composites are ingredients with high enactment show unusual stuff combinations. With fastest request to be in elastomers and engineering plastics, their possibilities are so outstanding that they are beneficial in many ranging areas from packaging to biomedical applications. Nanotechnology includes the manufacturing and Nano composites application proposal new technics and chances of trade for several subdivisions of the automotive, aerospace, electronics, physical, chemical and systems at rulers reaching from singular atoms or molecules to submicron dimensions. It is broadly felt that nanotechnology is the next manufacturing revolt [1].

Nano composites polymers containing polymers organic and nanoparticles inorganic in a nano-scale regions signify a novel types of resources that have interested significant interest in last years. This composites materials differ from the unpolluted polymers in respects to some of the chemical and physical properties [2].

The introduction of impurities to polymers influences many of their properties, making them more applicable to various fields. It allows us to influence and tune certain characteristics, thus making them more advantageous to use an enhancement of desirable properties was observed with the introduction of impurities in polymers, the combination of nanoparticles in polymers matrix offer the possibilities of substantial's improvement to the optical possessions of the material with individual minor amounts on nanoparticle. Since they can effect strongly the physical, one advantage of nanoparticles, as polymer additive appears comparing to old-style additive, loadings requirement are fairly low. [2]. The polymers optical properties institute significant aspects in study of electronics transitions and the possibilities of their applications as opticals filter. The information's about the electronics structures of amorphous and crystalline semiconductors typically accrued from the study of opticals property in extensive frequency ranges [3]. Polyvinyl pyrrolidone (PVP) and polyvinyl alcohol (PVA) are comprise in the lists of synthetics polymer used in medicines. PVP has a decent repute owing to its unresolved absorptions and complex ability, while PVA used as composites with other material to improve its property, offerings significant structures, recognized good process ability on films formations. Moreover, these synthetics polymer are solubles in water which a amazing characteristics for films formations is. Nevertheless, this characteristic is a difficulty because the materials would dissolves in contacts with fluid into the man body [4]. Dissimilar carbon black grade shaped by chemical decomposition of hydro-carbons at raised temperature. The most wanted inforcing fillers where

ISSN- 2394-5125 VOL 7, ISSUE 15, 2020

resistances to abrasions, cuting, and aged must be at a extreme. The four chief process of the formations of four types carbon black are,1. Lamp-black, Channel-black, Furnace-black (e.g N110 to N762), and thermal-black (e.g N990,N991)[5,6].

The optical property deliberate in this research such as:

Coefficient of Absorption (α) is calculating by following equation: [7]

$$\alpha=2.303A/t \quad (1)$$

Where A: is the absorbance and t: is the thickness.

The in-direct transitions models of nanocomposite gives: [8,9]

$$\alpha h\upsilon = B (h\upsilon - E_g^{opt.} \pm E_{ph.})^r \quad (2)$$

Where B is a continuous, hυ is the energy of photons, Eg is the band gap optical energy and r = 2 for allowed-indirect transitions and r = 3 for forbidden-indirect transitions. at (-) absorption of phonons, and (+) when emission phonons.

The nanocomposites refractive index (n) had been determined by following equation:[10]

$$n=\sqrt{\left(4R - {}^{k}/_{R-1}\right) - \left({}^{R+1}/_{R-1}\right)} \quad (3)$$

Where R is the nanocomposite reflectances.

The coefficient of extinctions (k) is given by using the following equation: [11]

$$K=\alpha\lambda/4\pi \quad (4)$$

The dielectric constant (real and imaginary) parts of (ε1 and ε2) for (PVA-PVP-C.B) nanocomposites are calculate by using equations:[12]

$$\varepsilon_r = n^2-k^2 \text{ (real part)} \quad (5)$$

$$\varepsilon_i = 2nk \text{ (imaginary part)} \quad (6)$$

II. EXPERIMENTAL WORK

2.1 The Material used

(PVA) polymer is the largest synthesis and water-solubles polymers shaped in the world founded on volumes. The melting point of PVA is 230 0C and it's molecular weight (18000g/mol).Provenance of PVA is Spain Industrial development, PVP is a white and hygroscopics powders with a weak characteristics order Provenance of PVP is Anhui Leaf chem Co., Ltd, China (mainland)and high purity (99.8%) .The melting point of PVP is (150-180) 0C. Carbon black (C.B) (N375 -32nm) abounding by Doudah, Iran.

It is inspected in agreement with DBP absorption (ASTM D 136) and Iodine absorptions (ASTM D 135) and preparations of (PVA-PVP-C.B) nanocomposites and study the optical and structural possessions. The matrix polymer has been prepared by using PVA (90 wt.%), and polyvinyl pyrrolidone (10 wt.%)) as a matrix.

The polymers are liquefied in water distill with magnetic stirrers in mixing procedure to get uniform solutions. The C.B nanoparticles added with different weight percentage to the solution were (0,5, 1, 1.5 and 2) wt.% . in order to prepare the (PVA- PVP- C.B) nanocomposites using the casting method.

III.RESULTS AND DISCUSSIONS

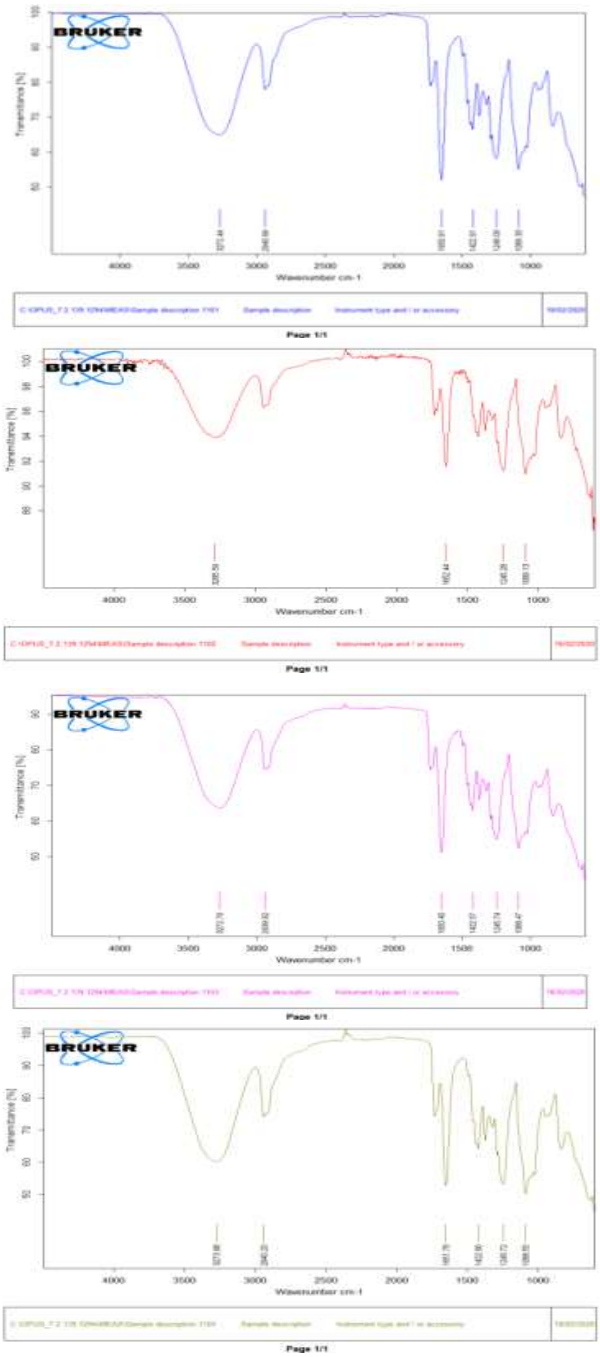
FTIR spectra noted by FTIR (Bruker company, German origin type vertex-70). The FTIR spectra of nancomposites (PVA-PVP-C.B) are listed at room temperature with wavelength (500-4000) cm-1, Fig 1. (A, B, C, D and E) explained (PVA-PVP-C.B) nanocomposites FTIR spectra, its exhibited distinctive band of stretched and bended vibration of the function group formed in nanocomposite.

From the spectrum demonstrated, the broad bands at about 3272 cm-1 is gave to the stretch vibrations of groups (C-H) of polymers, which may be due to the intermolecular or intramoleculars types of the polymers of hydrogen bonds and the nanoparticle.

The band absorption of the – CH2 a symmetrical stretch vibration at about 2940 cm-1, The group in 1650 cm-1 can be assigned to the (C=C) stretching aromatic.

ISSN- 2394-5125 VOL 7, ISSUE 15, 2020

The peak at about 1422 cm-1 attributed to the (CH2) bending or bending (O-H),and 1245cm-1 assigned to (CH2) wagging twisting (out-of-plane) bending vibrations , whereas the group (C- O) single band at about 1088 cm-1 [13].



ISSN- 2394-5125 VOL 7, ISSUE 15, 2020

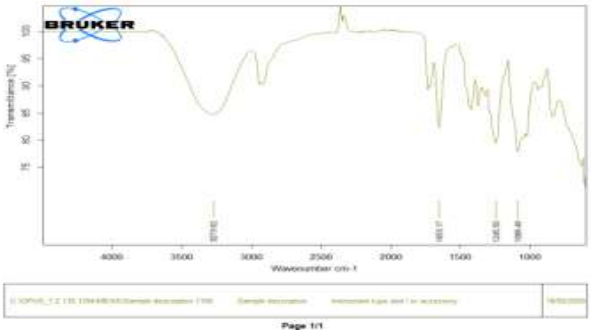


Figure 1: Spectrum FTIR for (PVA-PVP-C.B) Nano-Composites.(A) Pure Blend, (B) 0.005 wt.% C.B Nanoparticles, (C) 0.01wt.% C.B Nanoparticles, (D)0.015wt.% C.B Nanoparticles, (E) 0.02 wt.% C.B Nanoparticles

Fig 2 show the absorbance via a wavelength in the ultraviolet regions of the electromagnetic spectrum (About 300 nm in wavelength), All Nano composites show low absorbance's at visible regions, which explained as incident photons have not sufficient energy of interaction with atoms at long wavelengths, so a transition of photons will occurs. While the decreasing in wavelength, the interaction between material and incident photon will happen, and then the absorbance's will increases [14]. In others words absorbs the incidents light by the frees electrons. Consequently, by the increases of the weights percentages of the carbons black, that showed an importants roles to influences on the absorptions. this behaviors attributes to carbon black nanoparticles absorbs the incidents lights. These results are similars to the results reached by the researchers [15] .

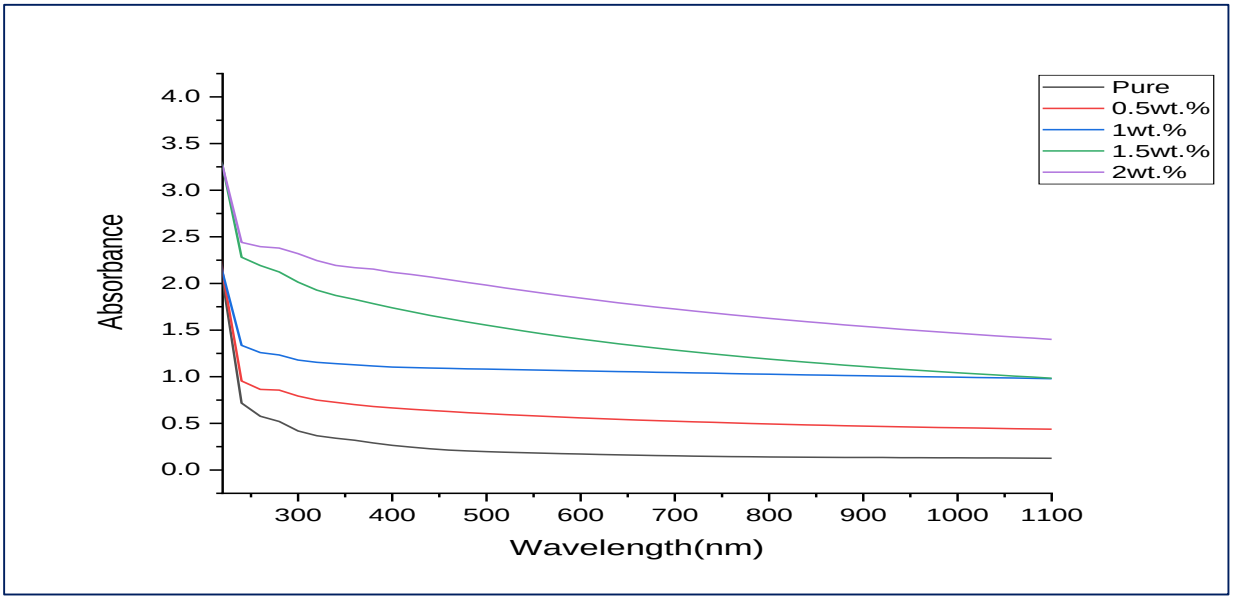


Figure 2: The Variation of Optical Absorbance for (PVA-PVP-C.B) Nano Composite with Wavelength

Fig 3 shows the spectrals transmittances as a functions of wavelengths by addings a differents ratios of carbons black ,from this figures shows that the decreased of transmittances with increasings C.B concentrations, This is caused by the addeds carbon black and these molecules fill the vacancies between (PVA-PVP) blends [16].

ISSN- 2394-5125 VOL 7, ISSUE 15, 2020

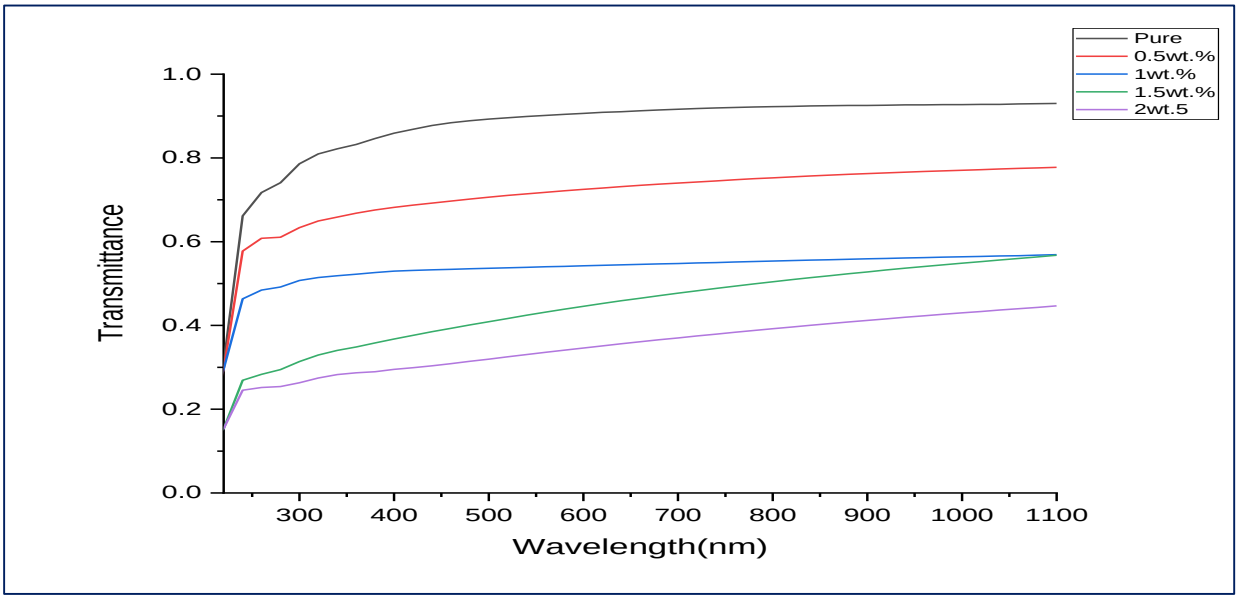


Figure 3: The Variation of Optical Transmittance for (PVA-PVP-C.B) Nano Composites with Wavelength

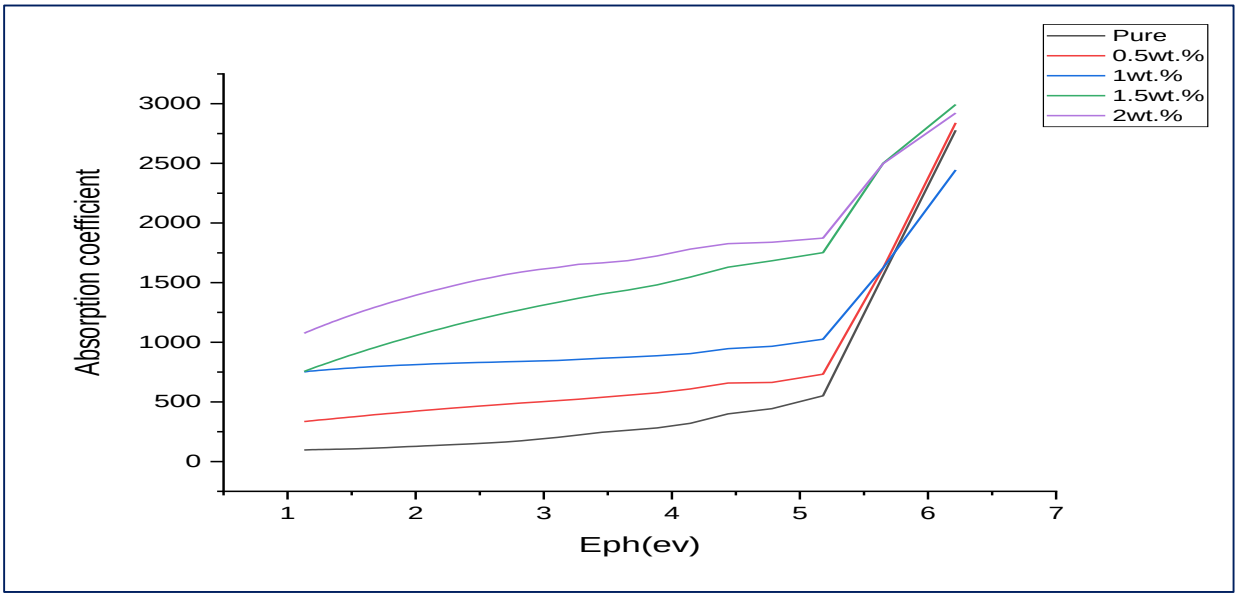


Figure 4: The Absorption Coefficient for (PVA-PVP-C.B) Nano Composite with Various Photon Energy

The results of absorptions coefficients α cm-1 versus photons energies for (PVA-PVP-C.B) nanocomposites films were presenting in Fig. (4). It is observed to sees that α was the smallest at lows energies, which means that the little possibilities of electrons transitions. Because of the energies of the incidents photons were not sufficients to transfers the electrons from the valences bands to the conductions bands, while at high energies the absorptions of the electrons is stellars. The results of the absorptions coefficients were less than (104 cm-1) which means there was a large probability's of the indirects transitions. The obtaining values of the opticals energy gaps decreasing with the increasing of the additives particles as shown in Table 1. It can be notes that significants of a reductions in the energy gaps values. This due to increasing of the localized levels in energy bands gaps [17,18,19,20]. Figures (5) and (6) show the allowed and for biddens indirect opticals energy gaps respectively for (PVA-PVP-C.B) nanocomposites films were calculating roughly from the intercepts of the extrapolating linears parts of the curves against the photons energy's (hυ) at $(\alpha h\nu)n = 0$.

ISSN- 2394-5125 VOL 7, ISSUE 15, 2020

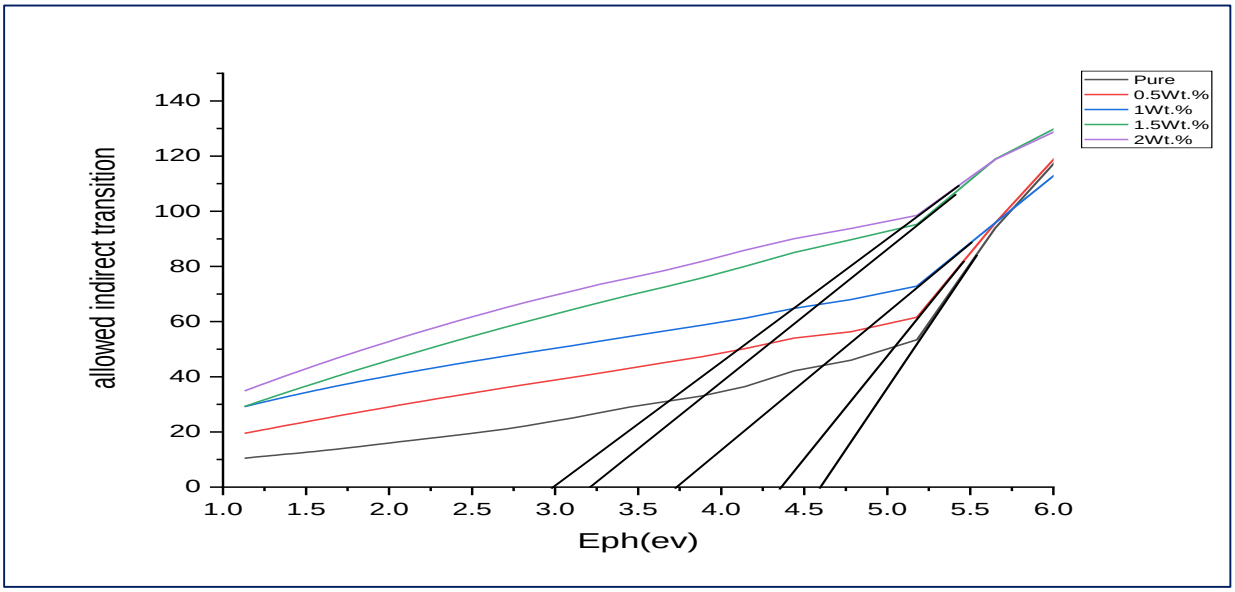


Figure 5: The Energy Gap for the Allowed Indirect Transition (αhν)1/2 (cm-1.eV) 1/2 versus Photon Energy of (PVA-PVP-C.B) Nanocomposites with Different Concentration

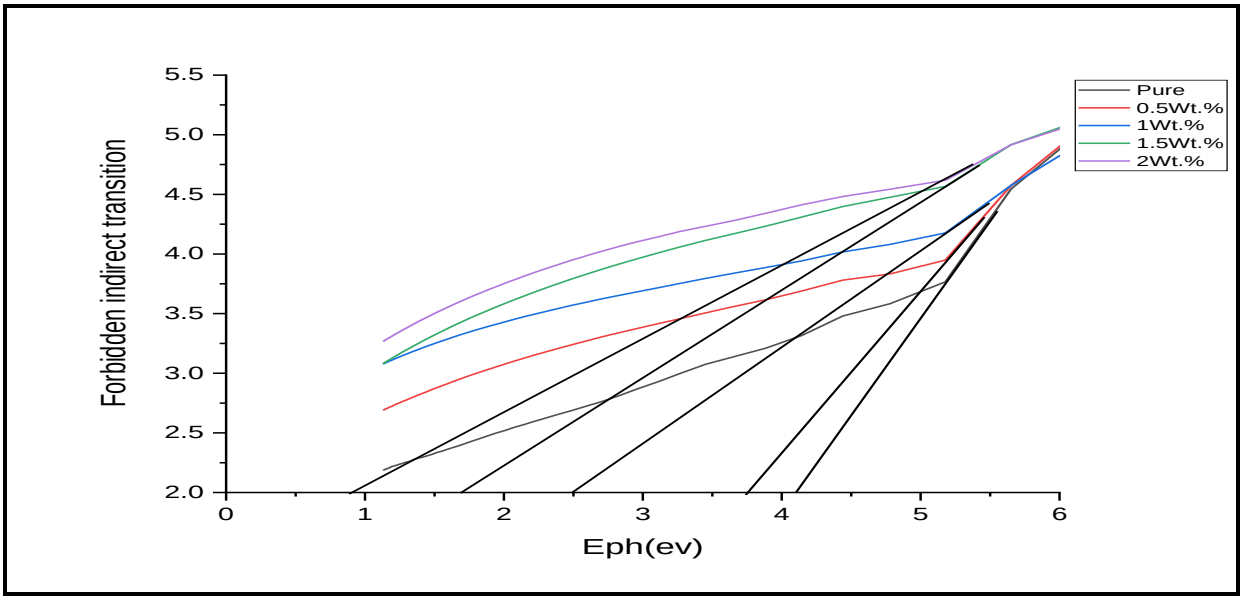


Figure 6: The Energy Gap for the Forbidden Indirect Transition (αhν)1/3 (cm-1.eV) 1/3 versus Photon Energy of (PVA-PVP-C.B) Nanocomposites with Different Concentration

Table 1: Optical Energy Gap Values for the Allowed and Forbidden Indirect Transition for (PVA-PVP-C.B) Nano composite Films

C.Bwt%	Allowed Indirect Transition(ev)	Forbidden Indirect Transition(ev)
0	4.75	4.12
0.5	4.375	3.625
1	3.75	2.5
1.5	3.25	1.624
2	3	0.8

Extinctions coefficients (k) can be calculateds by using equations (4). The behaviors of this coefficients as a functions of the wavelengths is shown in Fig.7 for (PVA-PVP-C.B) nanocomposites .It is observeds that (k) is the lowest values of lows particles and approximately constants at visibles and nears infrared regions. Meanwhiles, the extinctions coefficients increases with the increasings of the wavelengths accordings to equations (4). This is

ISSN- 2394-5125 VOL 7, ISSUE 15, 2020

attributed to increasing of absorptions coefficients with the increases of weights percentages of carbon black [21]. Absorptions coefficients has a direct relations with (K) as in the equations (4).

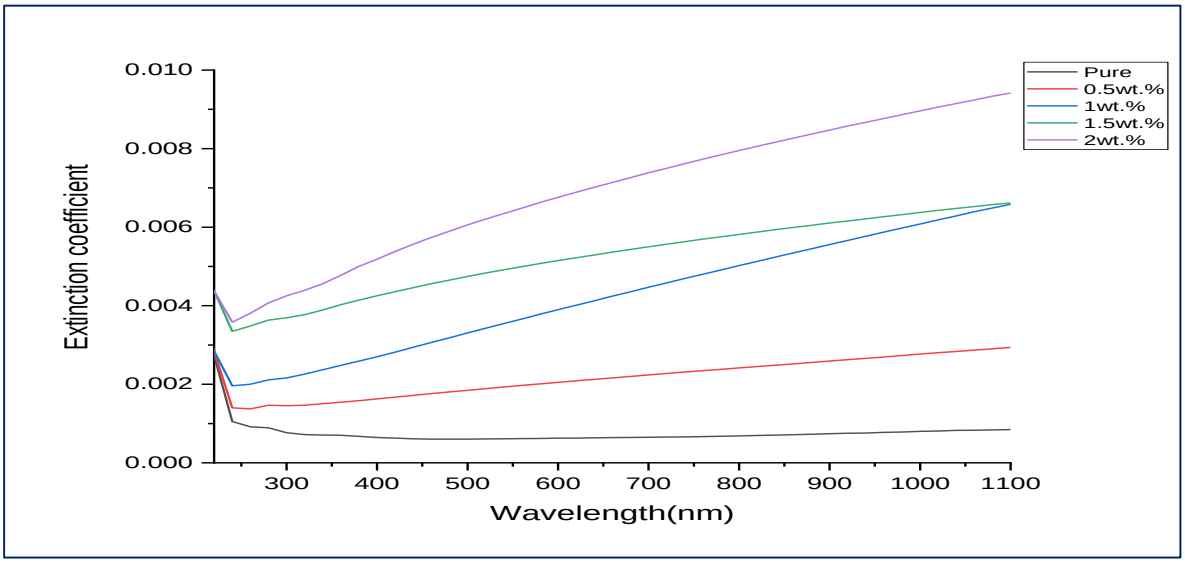


Figure 7: The Extinction Coefficient for (PVA-PVP-C.B) Nanocomposites with Various Wavelength

The dispersions curves of the refractives index n(λ) in the normal dispersions regions (λ =220 - 1100 nm) for the studied systems can be represents in Fig, 8. It is found that the values of (n) decreasing with increasing's of wavelength and reach to constants values at the very longs wavelengths. Also, it is founds that (n) increases with increasing's carbons black content . This increases in refractives index of (PVA/PVP) blends. after embedding's carbons black may be due to the structural modifications in polymeric matrix [22] . where the refractives index is calculated from equations (3).

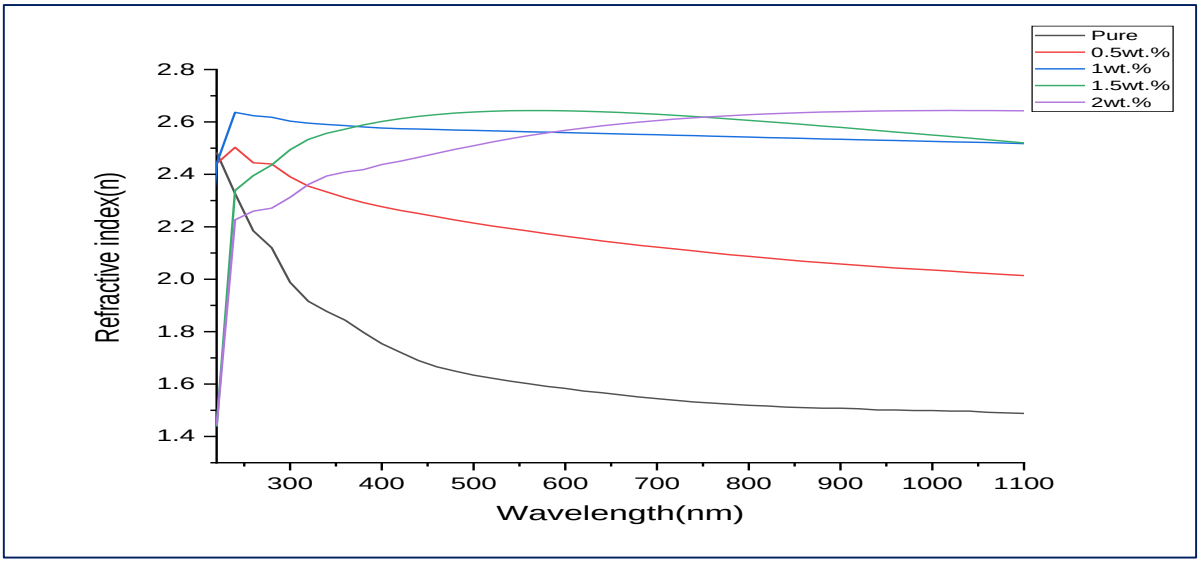


Figure 8: The Relationship between Refractive Index for (PVA-PVP-C.B) Nanocomposites with Wavelength

The dispersions of real and imaginary parts of dielectrics constants (εr , εi) can be represents as shown in figures (9) and (10). for films of pures (PVA/PVP) blends filled with differents contents of carbons black. From this figures, it is noticed that the behaviors of εr was the same as refractives index due to the smaller values of k2 compares to n2, whereas εi basically relies on the values of k, that is connected to the varieties of absorptions coefficients. Also, it is seen that the maximums values of the εr and εi were reaching in the shorter wavelengths regions (absorption region) and the values of εr is top-level than that of εi. The real and imaginary dielectrics

ISSN- 2394-5125 VOL 7, ISSUE 15, 2020

constants (εr , εi) for (PVA-PVP-C.B) nanocomposites have been calculated from equations (5) and (6) respectively [22].

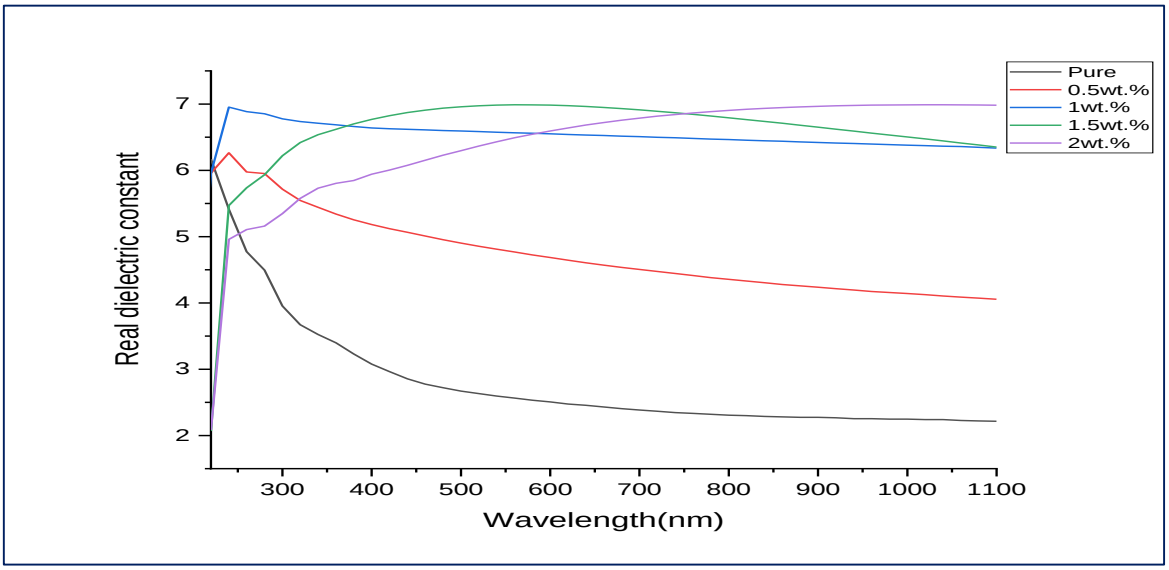


Figure 9: The Variation of Real Part of Dielectric Constant of(PVA-PVP-C.B) Nanocomposites with Wavelength

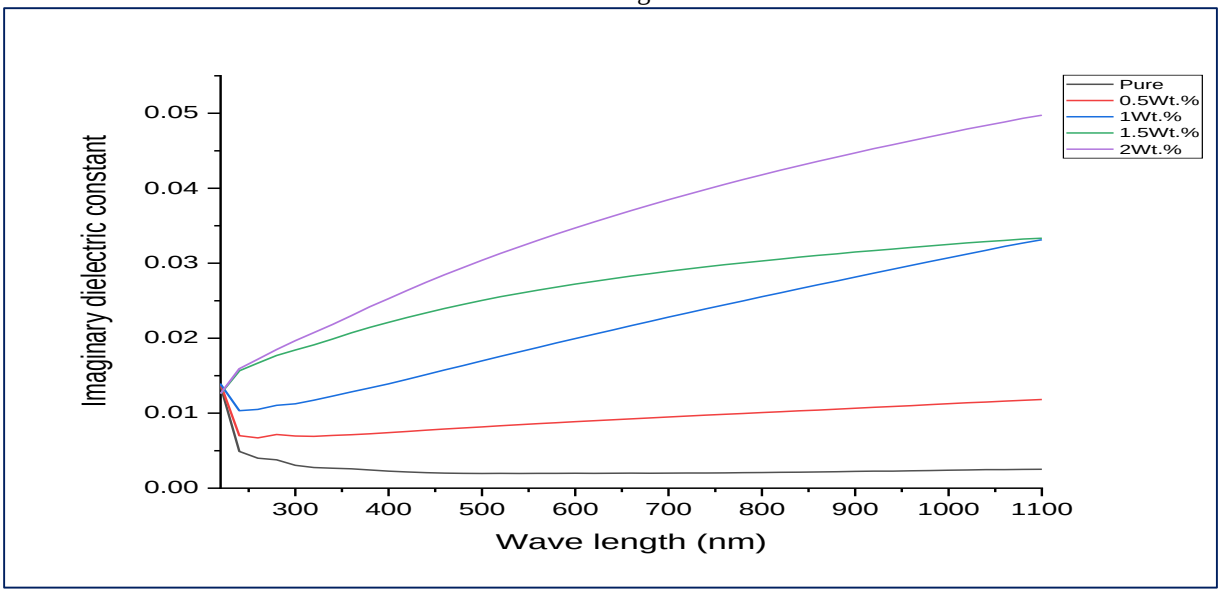


Figure 10: The Variation of Imaginary Part of Dielectric Constant of(PVA-PVP-C.B) Nanocomposites with Wavelength

IV. CONCLUSIONS

1. The absorbance's of polymers blends matrix (PVA- -PVP) increasing with the increasing of carbons black nanoparticles concentrations.
2. The energy bands gaps for (PVA-PVP-C.B) nanocomposites is decreased with the increases of carbon blacks nanoparticles concentrations.
3. The opticals constants (absorptions coefficients (α), extinctions coefficients (k), refractives index (n), reals and imaginary dielectrics constants are increasing with the increasing of carbons black nanoparticles concentrations.

V. ACKNOWLEDGEMENT

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VI. REFERENCES

[1] Z.I. Ali, M.H. Helal, H.H. Saleh, A.F. Zikry, Y.A. Darwish,. Silver-Polymer Blend Nanocomposite, *New York Science Journal*, Vol. 7, 1, 2014.

[2] J.B. Bhaiswar, M.Y. Salunkhe, S.P. Dongre, B.T. Kumbhare,. Comparative Study on Thermal Stability and Optical Properties of PANI/CdS and PANI/PbS nanocomposite, *IOSR Journal of Applied Physics, International Conference on Advances in Engineering & Technology – (ICAET-2014)* Vol. 80, pp. 79-82, 2014.

[3] S Hadi, A. Hashim and A. Jewad, Optical properties of (PVA-LiF) Composites, *Australian Journal of Basic and Applied Sciences*, Vol. 5, 9, 2011.

[4] A. Bernal, I. Kuritka, P. Saha,. Preparation and characterization for a prospective medical application, *Mathematical Methods and Techniques in Engineering and Environmental Science*, ISBN: Vol. 978-1-61804-046-6, pp. 431-434. 2014.

[5] S.H. Al-Nesrawy Effect of some additives on mechanical properties of rubber composites for shock damping, *PH.D. Thesis, University of Baghdad,* 2014.

[6] J. Fauvarque Carbon Black Industry Analyzed, *European Rubber Journal*, Vol.178,No.1,pp.26,1996.

[7] K. Gabur ,Preparation and Study The Electrical and Optical Properties of (PS-Ni)Composites, *M.Sc. thesis, Babylon University, College of Science*, 2010.

[8] Y.N. Al-Jamal, Solid State Physics, Al-Mosel University, 2nd Ed., Arabic Version, 2000.

[9] G.S. Salman, Optical and structural properties of SnO_2 membranes doped (PFCs) and gamma-ray irradiated, *M.Sc. Thesis, Faculty of Science for Girls, Baghdad University, 2005.*

[10] W. Yckoff, Crystal Structures, *Wiley, V. 1, New York*, 1963.

[11] W.Yckoff, Crystal Structures, *Wiley, V. 1, New York*, 1963.

[12] M. Mohammed, Effect of Preparation Conditions on the Structural and Optical Properties of TiO_2 Thin Films Deposited by Pulsed Laser Technique *M.Sc. Thesis, Babylon University, College of science, 2010.*

[13] K. Rajesh, V. Crasta, N. B. Rithin Kumar, Gananatha Shetty & P. D. Rekha, Structural, optical, mechanical and dielectric properties of titanium dioxide doped PVA/PVP Nanocomposite, *Journal of Polymer Research,* Vol 26:99, 2019.

[14] N. Daneshvar, D .Salari, and A. R.Khataee, Photocatalytic degradation of azo dye acid red 14 in water: investigation of the effect of operational parameters. *J..Photochem. Photobiol.A.* Vol 15):111, 2003.

[15] B.G. Streetman, and S. Bonerjee, Solid state electronic devices, 5th Ed., Engle Wood cliffs, Nj Prentice ilall, 2000.

[16] Gh. Abdullah, K. Aziz, and A. Hussen, Optical Characterization of Polyvinyl alcohol – Ammonium Nitrate Polymer Electrolytes Films, *Chemistry and Materials Research,* Vol.3, pp. 84-90,2013.

[17] A. Ghaleb, Preparation and Characterization of (PVA-$Sncl_2$) Composites, *Academic Research International,* Vol. 5,N.(2), 2014.

[18] M. Crane and Y. Hassan, Solar Cells, Collage of Education, *University of Mousl,* 1989.

[19] M. Dahshan, *Introduction to Material Science and Engineering,* 2nd Ed. 2002.

[20] R. G. AL-Morshdy, M. A. Habeeb and H. M. Mansi AL-Asadi, Effect of Nano silver Particles on the Optical and Structural Properties of (PVA-PVP) Films, Adv. *In Phy. Theo. And Appl.,* Vol.34, pp. 30-39, 2014.

[21] B. H. Rabee, Study of Optical and Mechanical Properties for (PVA-$AgCO_3$) Composites, *Eur. J. of Sci.* Res., Vol.57, 4, pp. 583-591, 2011.

[22] H. M. Zidan, M. A. razek, A. M. Abdel, A. E. Tarabiah, Characterization and some physical Studies of PVA ⁄ PVP filled with MWCNTS. *Journal of Materials Research and Technology,* 8, 1, pp. 904-913, 2019.