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Structural, Dielectric and Optical Properties for (Polyvinyl Alcohol–Polyethylene Oxide- Manganese Oxide) Nanocomposites

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Ahmed Hashim[1*], Majeed A. Habeeb[1] and Qayssar M. Jebur[2]
[1]*University of Babylon, College of Education for Pure Sciences, Department of Physics, Iraq.*
[2]*Ministry of Education, Iraq.*

DUE to the scientific, industrial, electrical and medical importance, it was necessary to study the properties of overlapping nanocomposites. So it gained the attention and directed scientists and researchers in the study of its structure and electrical characteristics and other characteristics. So, In the present work, (polyvinyl alcohol- polyethylene oxide- manganese oxide nanoparticles) nanocomposites have been prepared with different concentration of blend and MnO_2 nanoparticles. The manganese oxide nanoparticles were added to (PVA-PEO) blend by weight percentages are (2, 4 and 6) wt.%. The optical microscope images indicate that the manganese oxide nanoparticles additive distribution was homogeneous in the (PVA-PEO) blend. FT-IR indicate that no change on chemical structures between the (PVA-PEO) blend and manganese oxide nanoparticles additives. The dielectric properties of nanocomposites were studied.The results showed that the dielectric constant, dielectric loss and electrical conductivity of (PVA-PEO) blend are increased with the increase in concentrations of manganese oxide nanoparticles. The dielectric constant and dielectric loss decrease while the AC electrical conductivity increases with the increase in frequency of applied electric field. Optical measurements are showed the absorbance of (PVA-PEO-MnO_2) nanocomposites is increased with increase of the concentrations of MnO_2NPs.With increasing of the concentrations of manganese oxide nanoparticles, the indirect energy gap (E_g) of (PVA-PEO) blend will be decreased. And by increasing of the weight percentages of manganese oxide nanoparticles,the optical constants as absorption coefficient, extinction coefficient, refractive index, real and imaginary dielectric constants of nanocomposites are varied.

Keywords : MnO_2NPs, Manganese oxide, Energy Gap, Nanoparticles, Polymer blend.

Introduction

In recent years, materials with suitable and sustainable properties have drawn the worldwide community attention. The purpose of doping variety materials to enhance of their properties. The factors the most influencing of these properties depend on the nature and the method of their synthesis. The developing desired devices required cost guide researchers and coaled applications on the choice of materials and the technology. Nanocomposites and polymer blends are attracting increasing attention from scientists and researchers due to their use in many industrial sectors. Metal oxides like ZnO, TiO_2, SnO_2 and other semiconductors into organic matrices offer more high chemical and physicalstability. Organic polymers as matrices andinorganic nanoparticles as filler are endowed the resulting nanocomposites with excellent optical, electrical and mechanical properties. Perolosites or so-called manganese dioxide nanoparticles MnO_2NPs are an inorganic, compound, brown or black-colored compound. It has wide uses as a catalyst, a wastewater processor,

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batteries and capacities. They are molecular weight 228.81 is found in the form of a solid powder whose melting point is 1564C, insoluble in water [1]. The manganese oxide nanoparticles MnO_2NPs are concentrated due to its differentiated and catalytic adsorption properties. Many of its structural forms have been produced such as β, λ, α, depending on the preparation of MnO_2 nanoparticles. The manganese oxide nanoparticles have been examined through numerous intensive researches that have led to the discovery of their use in many scientific, medical and industrial fields such as antibacterial, biochemical sensors, moisture detection, and dye removal. In addition to : MnO_2 molecules are considered to be potent inhibitors of some bacterial types [2]. The rapidly and suddenly development of nanocomposites has led to interfere in many scientific, industrial, electronic and medical fields. Because they have near-visual and electrical properties which are remarkable, and better in comparison with the physical properties of traditional composites. The addition of very low percentages of nanomaterials, for example, 5% as additives to the polymer leads to improve on the physical properties so they are getting unique physical properties [3].

Nanocomposites exhibit the quality of properties by blendingthe process ability and flexibility of polymers with nano metal oxides [4]. Owing to flexibility, portability and the miniaturization requirements of electronic products, polymer blend materials that have flexibility and low dielectric constant will be getting more attention in integrated circuit devices as interlayer dielectrics. The heating of the integrated circuit can be reduced efficiently, due to reduce the dielectric constant of the dielectric material used in the integrated circuit. Another important problem about the application of polymer-based low dielectric materials are easy to burn. Polymer-based dielectric layers should have flame retardant properties, so they are used in electronic equipment safely. Compared with unfilled polymer blends, nanocomposites exhibit improved physical properties as dielectric properties, fire resistance and mechanical strength [5]. Poly (ethylene oxide) is a semi-crystalline, biocompatible, biodegradable, nonionic and water-soluble polymer of considerable industrial significance, which finds applications in many different branches of industry. PEO is an organic component in organic-anorganic hybrid material applied in advanced technologies in the field of functional coatings with superior barrier properties [6]. Recently, some works have been reported the integration of thin films based on polymeric materials such as Polyvinyl alcohol (PVA) as a gate dielectric for the development of organic thin film transistors, due to the high dielectric constant which enhances the gate capacitance, with the advantages of solution processable material, at low cost, non-toxic, with flexible hydrophilic network and low temperature of deposition. PVA is a poor electrical conductor, water soluble, it has carbon chain backbone with OH groups and it is eco-friendly, and its physical properties may be adapted to a specific requirement in conjunction with inorganic materials [7].

Materials and Methods

Films of (polyvinyl alcohol- polyethylene oxide- manganese oxide) nanocomposites were prepared byusing casting method. The (PVA-PEO) was prepared by dissolving 1 gm of (PVA and PEO) in 20 ml of distilled water by using magnetic stirrer for 1 hr. The manganese oxide nanoparticles were added to (PVA-PEO) blend with concentrations are (2, 4 and 6) wt.%. The dielectric properties of (PVA-PEO-MnO_2) nanocomposites were measured in frequency ranges from 100 Hz to 5×10^6 Hz by using LCR meter type (HIOKI 3532-50 LCR HI TESTER). The UV/1800/ Shimadzu spectrophotometer device is used to measure the optical properties of (PVA-PEO- MnO_2) nanocomposites in the range of wavelength (200-1100) nm

The dielectric constant (ɛ́) of (PVA-PEO-MnO_2) nanocomposites is defined by the following equation [8] :

$$\varepsilon' = \frac{C_p}{C_o} \qquad \text{.....................(1)}$$

Where, C_p is parallel capacitance and C_o is vacuum capacitor

The dielectric loss (ε″) of (PVA-PEO-MnO_2) nanocomposites is given by the equation [9] :

$$\varepsilon'' = \varepsilon' D \qquad \text{.......................(2)}$$

Where, D : is dispersion factor.

The A.C electrical conductivity of (PVA-PEO-MnO_2) nanocomposites is defined by the following equation [10] :

$$\sigma_{A.C} = w \varepsilon'' \varepsilon_o \qquad \text{..................(3)}$$

Where, w is the angular frequency.

Absorption coefficient (α) is computed as the following equation :

$\alpha = 2.303\ (A/t)$ …………………(4)

A : is the absorbance. For amorphous polymers, the indirect transition model can be computed as :

$\alpha h\upsilon = L(h\upsilon - Eg)^x$ ....(5)

Where L is a constant, hυ is the photon energy, E_g is the optical energy band gap, x = 3 for forbidden indirect transition and x = 2 for allowing indirect transition [11]. Refractive index (n) is determined by following equation :

$$n = \frac{1+\sqrt{C}}{1-\sqrt{C}} \quad \text{………………..................(6)}$$

Where C is the reflectance, can be got from :
C =1-A-T …………(7)

The extinction coefficient (k) is calculated by the following equation :

$$k = \frac{\alpha\lambda}{} \quad \text{……………….................(8)}$$

Where is the wavelength of incident light. The dielectric constant is classified into two parts real (ε_r), and imaginary (ε_{im})[12]. It can be computed each of the real and imaginary parts of dielectric constant (r and im) as the following equations:

$\varepsilon_r = n^2 - k^2$ ………………..……..(9)

$\varepsilon_{im} = 2nk$ ………………………(10)

optical conductivity is the movement of the charge carriers due to alternating electric field of the incident electromagnetic waves produced the electrical conductivity. Optical conductivity (σop) can be calculated as [13]:

$$\sigma_{op} = \frac{\alpha nc}{4\pi} \quad \text{.................. . (11)}$$

Results and Discussion

Figure 1 shows the Fourier transform infrared spectra of (PVA-PEO- MnO_2) nanocomposites. For all samples of nanocomposites show broad bands at around 3257.15 cm^{-1} and 2938.87 cm^{-1} are observed because the double bonds of OH groups in the polymer matrix chains. The other bands as (C-O-C) group can be noted in the bands at (1086.30) cm^{-1} were attributed to the PVA film was not so transparent. C-H groups are presenting at Peaks (2888- 2906.1) cm^{-1} and at peaks (1698.57-1698) [14]. Peaks at (1086.30) cm^{-1} were due to the presence of C-O groups. The interaction between MnO_2NPs and polymer blend causes these changes change in spectral of (PVA-PEO) blend involves a shift in some single and double bonds and change in the intensities due to manganese oxide nanoparticles only [12]. From the FTIR studies note that there are no interactions between (PVA-PEO) blend and MnO_2NPs. From these figures we noted the transmittance decreases slightly with the increase of MnO_2NPs concentrations because of the increase in density of nanocomposites [15].

Figures 2 and 3 show the variation of dielectric constant and dielectric loss of (PVA-PEO-MnO_2) nanocomposites films as a function of frequency at different manganese oxide nanoparticles concentrations. The dielectric constant values of (PVA-PEO-MnO_2) nanocomposites films decreases with the increase of frequency. This may be attributed to the tendency of dipoles in polymeric samples to orient themselves in the direction of the applied field. Dielectric loss of (PVA-PEO-MnO_2) nanocomposites drops suddenly with an increase in frequency. This behavior may be due to the fact that at lower frequencies, the dipoles have sufficient time to align with the applied field before it changes its direction. Consequently, the dielectric loss is high [16]. The dielectric constant and dielectric loss decrease with the increase of MnO_2 nanoparticles concentration, this result can be attributed to the increase in conductivity as a result of the increase charge carrier density in polymer matrix [17-25], as shown in Fig. 4. The figure shows that the Fe_2O_3 nanoparticles is aggregated as a clusters at lower concentrations. When increasing the concentrations of Fe_2O_3 nanoparticles, the nanoparticles form a continuous network inside the (PVA-PEO) nanocomposites at concentration 4 wt% for nanocomposites.

Figure 5 shows the variation of A.C electrical conductivity of (PVA-PEO-MnO_2) nanocomposites with frequency for different concentrations of manganese oxide nanoparticles. It is clearly observable from this figure that A.C conductivity increases as the dopant concentration increases. In (PVA-PEO) blend, as the bond rotates with frequency, the existing flexible polar groups with polar bonds cause dielectric α-transition. Thus, there is a change in chemical composition of the polymer repeated unit due to the formation of charge transfer complexes (CTCs) within the

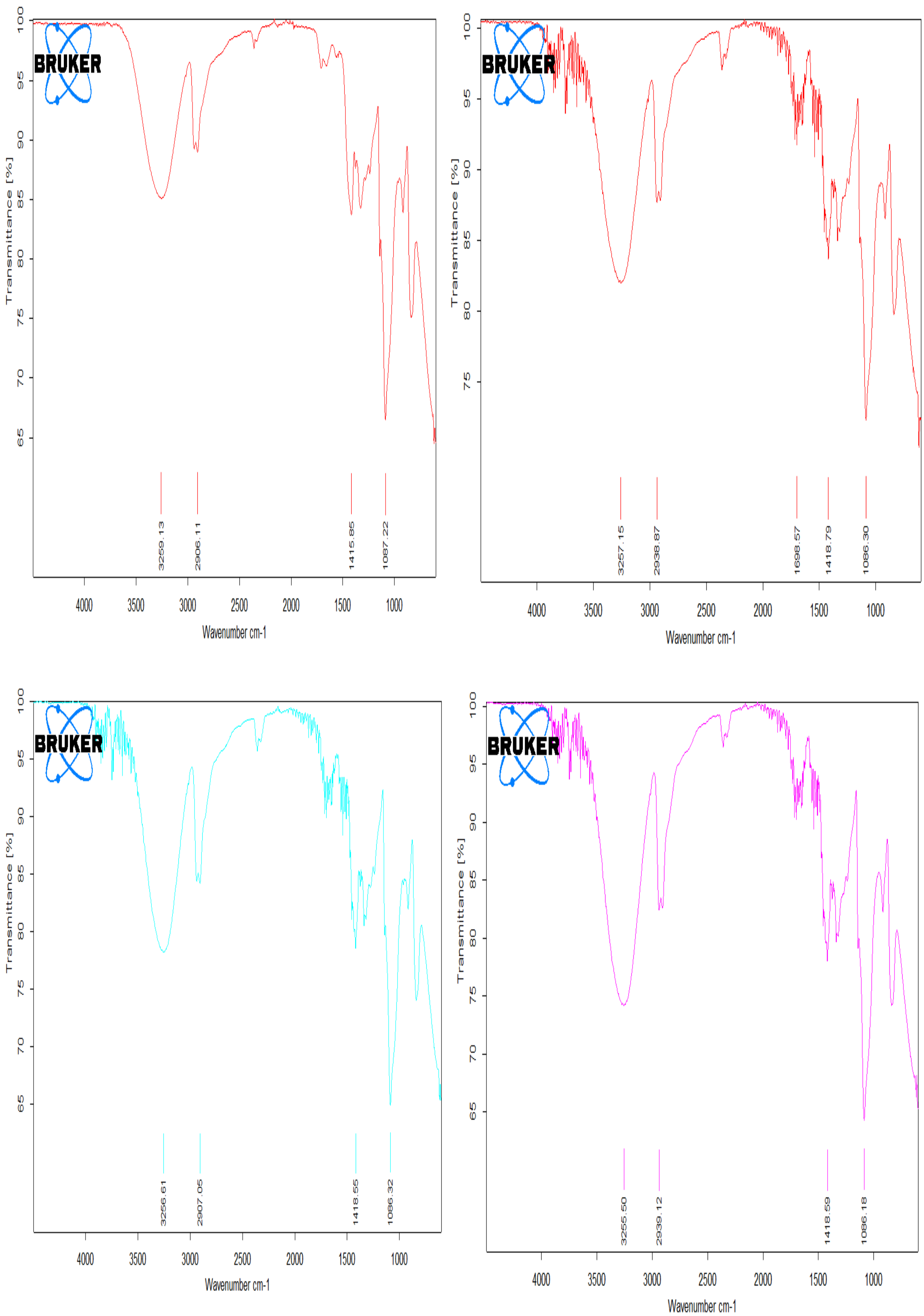

Fig. 1. FTIR spectra for (PVA-PEO-MnO_2) nanocomposites.

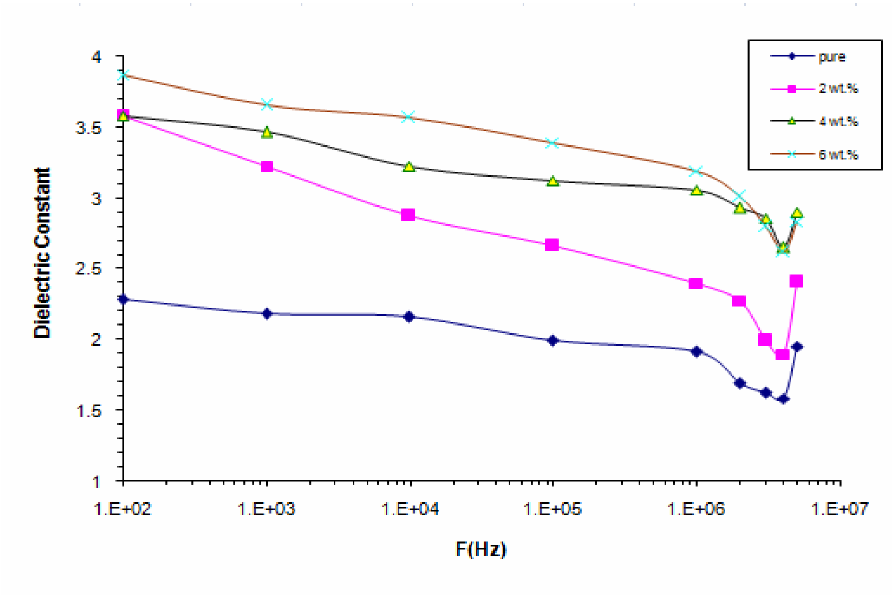

Fig. 2. Variation of dielectric constant for (PVA-PEO-MnO_2) nanocomposites films as a function of frequency at different manganese oxide nanoparticles

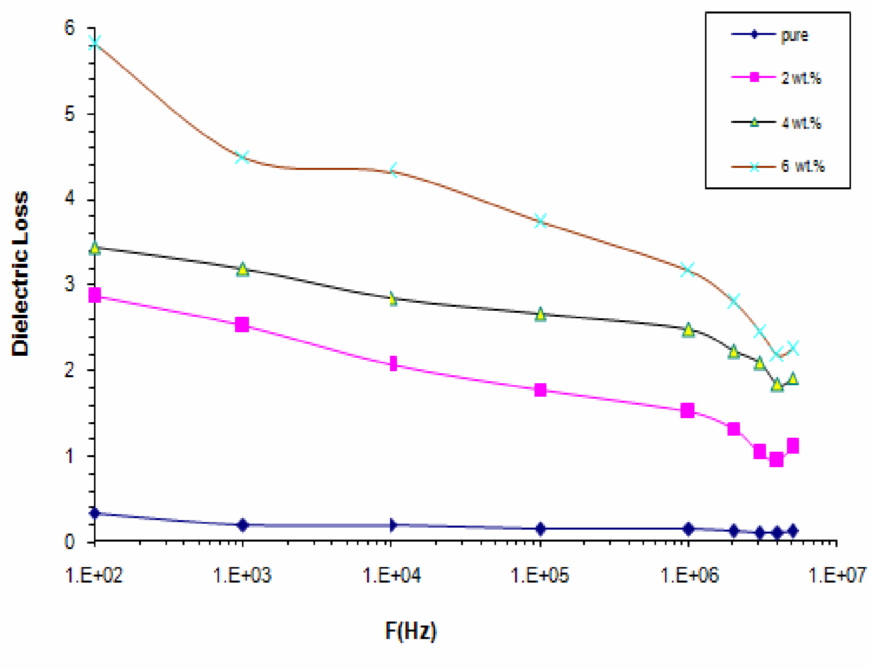

Fig. 3.Variation of dielectric loss for (PVA-PEO-MnO_2) nanocomposites films as a function of frequency at different manganese oxide nanoparticles concentrations.

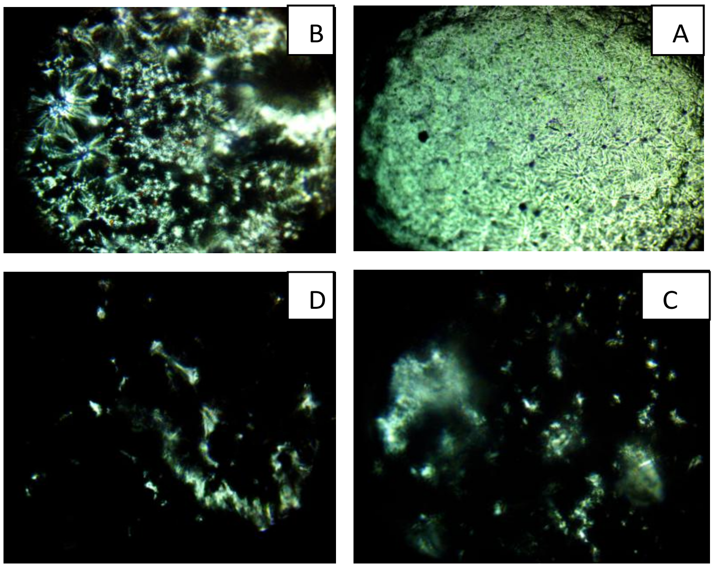

Fig. 4. Photomicrographs (x40) for($PVA-PEO-MnO_2$) nanocomposites:
(A) for pure (B) for 2 wt.% MnO_2 nanoparticles (C) for 4 wt.% MnO_2 nanoparticles

(PVA-PEO) blend chains, which in turn makes the polymer chains more flexible and hence enhances the A.C electrical conductivity [26]. Also, the increase in conductivity with increase the additive concentration may be attributed to increase the charge carriers numbers in polymer blend [27-35].

To know the effects of manganese oxide filler on the optical properties of (PVA-PEO) blend, UV-visible absorption spectra for ($PVA-PEO-MnO_2$) nanocomposites was measured.

Figure 6 shows the absorbance for (PVA-PEO- MnO_2) nanocomposites. It's indicated that intensity of the peak increase by increasing manganese oxide additive [9]. Due to specific weight MnO_2NPs, the absorption band shifts toward the longest wavelength. They are gaving an idea about the formation of intermolecular hydrogen bonding existing between manganese ions with the adjacent OH groups of the (PVA –PEO) blend chain. Due to the distance between valence and conduction band of (PVA-PEO) blendis higher, Its low absorbance. The increase in absorption for (PVA-PEO- MnO_2) nanocomposites, due to increase in manganese oxide nanoparticles which is related to increase the charges carries numbers [7, 36-41].

Figure 7 shows the absorption coefficient against incident photon energy for (PVA-PEO) blend with different percentages of manganese oxide nanoparticles. It shows when energy is low, the absorption low due to the electron transitions are low. But in the high energy, absorption becomes large due to the higher probability for electron transitions. By increasing of MnO_2NPs additive, absorption coefficient for ($PVA-PEO-MnO_2$) nanocomposites is increased [10]. The purpose of the absorption coefficient lies in the transition electrons nature, when the value of absorption coefficient is high in the higher energy expected direct transition of electrons. The energy and momentum conservation can by electrons and photons, when the value of absorption coefficient low expected indirect transition of electrons. The momentum conservation is by phonons only. From the results it's noted indirect energy band gap due the absorption coefficient for ($PVA-PEO-MnO_2$) nanocomposites has values are less than (10^4 cm^{-1}) [11].

Figure 8 shows the variations between absorbance edge $(\alpha h\upsilon)^{1/2}$ for ($PVA-PEO-MnO_2$) nanocomposites vs. photon energy. By plotting a line from the upper side of the curve in direction axis (X) in value ($(\alpha h\upsilon)^{1/2}$ = zero) to get indirect forbidden energy gap transition (allowed) [14]. With increasing manganese oxide nanoparticles concentration, the values of forbidden energy gap (allowed) of (PVA-PEO- MnO_2) nanocomposites are decreased. Because of great localize levels in the forbidden energy gap [42-45]. In addition toattribute to oxygen vacancies of MnO_2NPs which due to form non-stoichiometry [11].

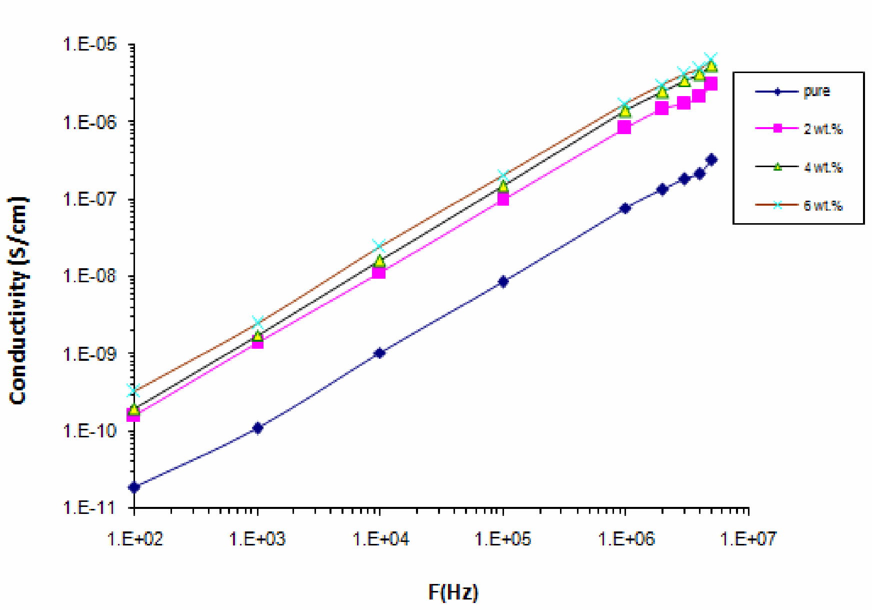

Fig. 5. Variation of A.C electrical conductivity of (PVA-PEO-MnO_2) nanocomposites with frequency for different concentrations of manganese oxide nanoparticles.

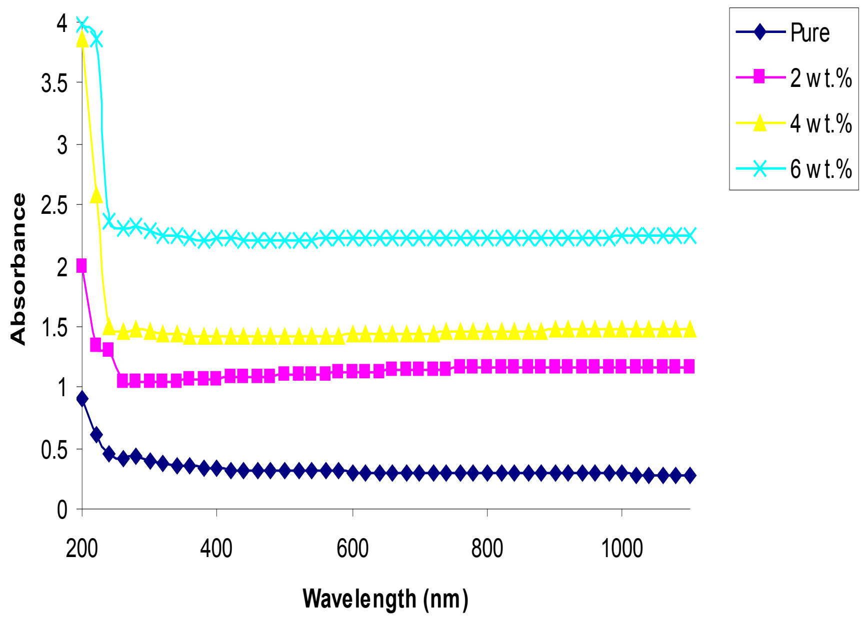

Fig. 6 . Variation of absorbance for (PVA-PEO-MnO_2) nanocomposites with wavelength.

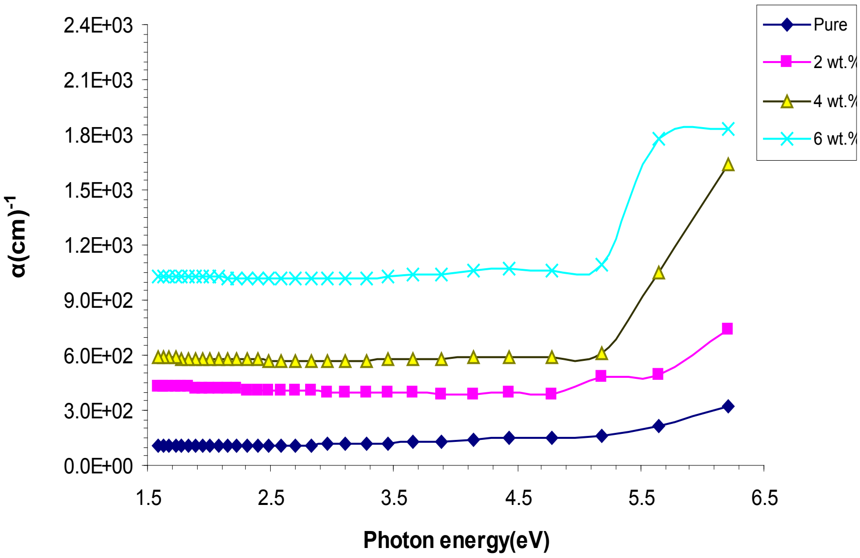

Fig. 7 . Variation of absorption coefficient (α) for(PVA-PEO-MnO_2) nanocomposites with photon energy.

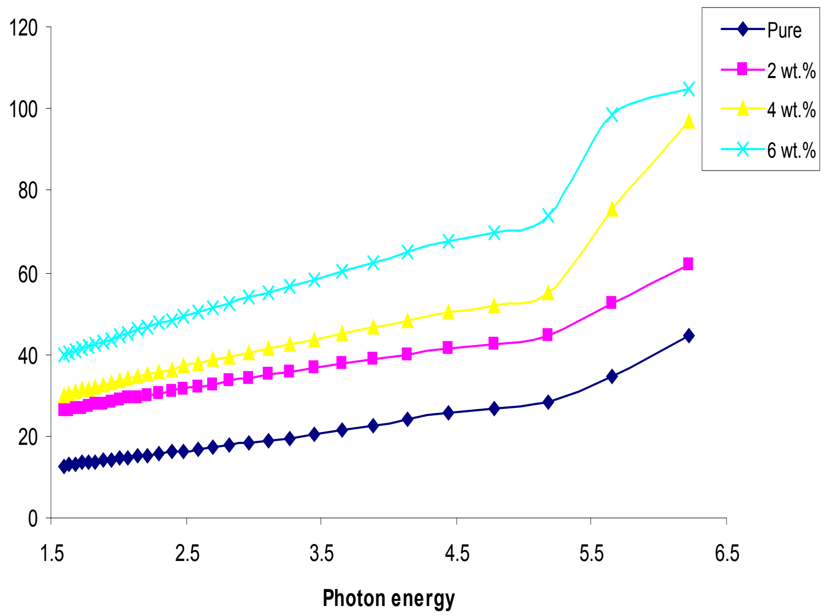

Fig. 8 . Variation of $(\alpha h\upsilon)^{1/2}$ for (PVA-PEO-MnO_2) nanocomposites with photon energy.

Figure 9 shows the variations between absorbance edge $(\alpha h\upsilon)^{1/3}$ for (PVA-PEO-MnO_2) nanocompositesvs. photon energy. With increasing manganese oxide nanoparticles concentration the values of forbidden energy gap (prevent) for (PVA-PEO- MnO_2) nanocomposites are decreased, this attribute to forms new levels and the transition of electrons between the tails of localize of the new levels made by the MnO_2NPs additive [14].

Figure 10 shows the variations of extinction coefficientas a function of wavelength for (PVA-PEO-MnO_2) nanocomposites. It showsby increasing of manganeseoxide nanoparticles for (PVA-PEO) blend the extinction coefficient is increased, due to high absorption coefficient for (PVA-PEO- MnO_2) nanocomposites . Where manganese oxide nanoparticles will modify the structure of the host (PVA-PEO) blend. An interesting result that when the concentration of MnO_2NPs increases the absorbance in the visible region increases [13].

To describe the electromagnet waves in the medium of propagation must be studied refractive index Fig.11 illustrates the plot of the variations of refractive indexwith wavelength for (PVA-PEO-MnO_2) nanocomposites. There fractive index of (PVA-PEO) blend increases with increasing the manganese oxide nanoparticles which attributed to increase in the intensity of (PVA-PEO- MnO_2) nanocomposites [11]. In addition to increase the scattering of incident photon on surface of samples which causes to increase the reflectance this leads to increase in refractive index for (PVA-PEO- MnO_2) nanocomposites [14].

Figure 12 shows the variations of real part dielectric vs. wavelength for (PVA-PEO- MnO_2) nanocomposites. It can be indicated that real part dielectric mainly proportional to the square of refractive index. So, it is increased with increasing MnO_2NPs additive.

Figure 13 showsthe variations of imaginary part dielectric vs. wavelength for (PVA-PEO-MnO_2) nanocomposites. Its proportional to the extinction coefficient as shown in equation (11) and its increased with the increasing of the manganese oxide nanoparticles [15].

Figure 14 shows the optical conductivity with wavelength for (PVA-PEO-MnO_2) nanocomposites. The optical conductivity is increased for (PVA-PEO- MnO_2) nanocomposites due to manganese oxide nanoparticles MnO_2NPs are increased which leads to increase the absorption coefficient [5,46]. In addition to;. This increase due to the creation of new levels in the band gap, lead to ease of passage carrier charges from the valence to the conduction band, as a result decreasing in the band gap and the conductivity increase [7].

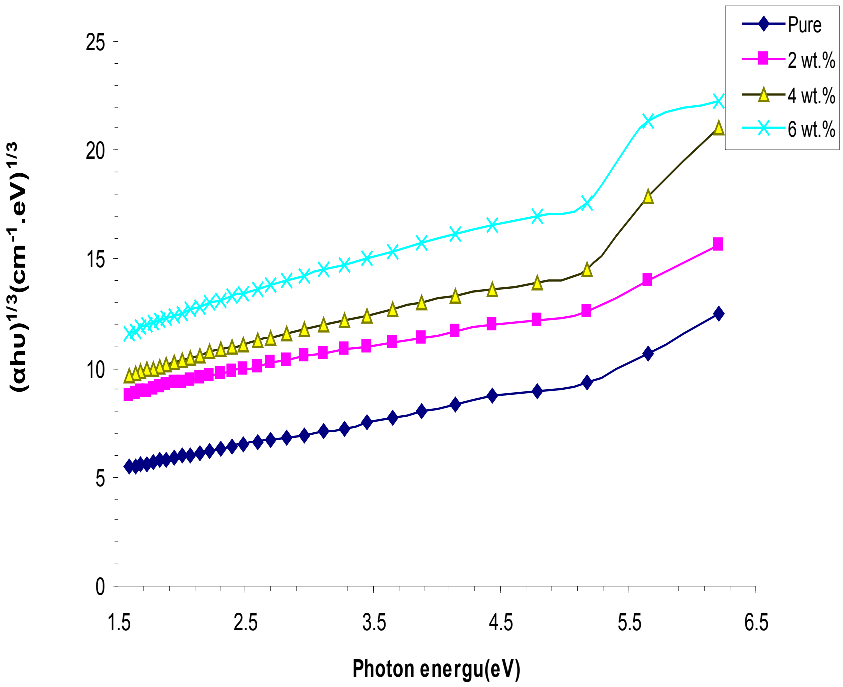

Fig. 9 . Variation of $(\alpha h\upsilon)^{1/3}$ for (PVA-PEO-MnO_2) nanocomposites with photon energy.

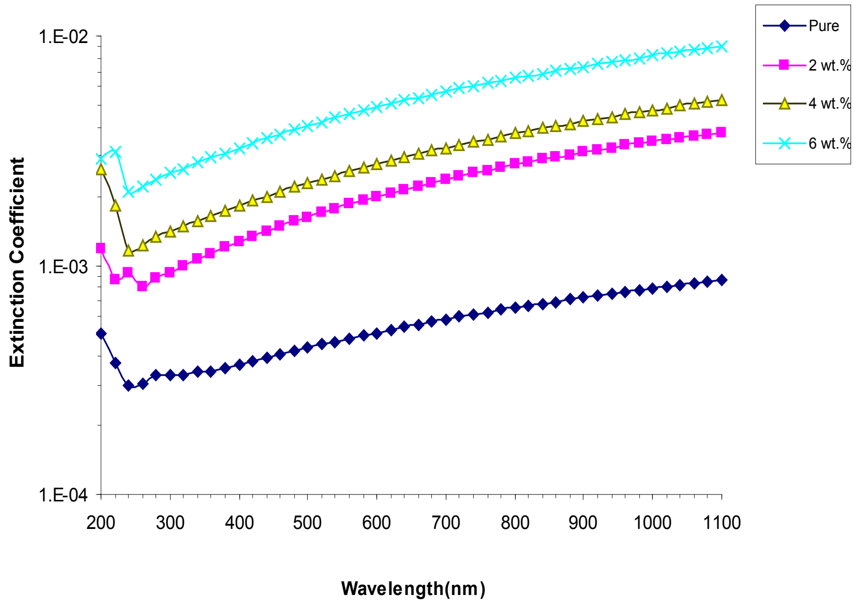

Fig. 10 . Variation of extinction coefficient for (PVA-PEO-MnO_2) nanocomposites with wavelength.

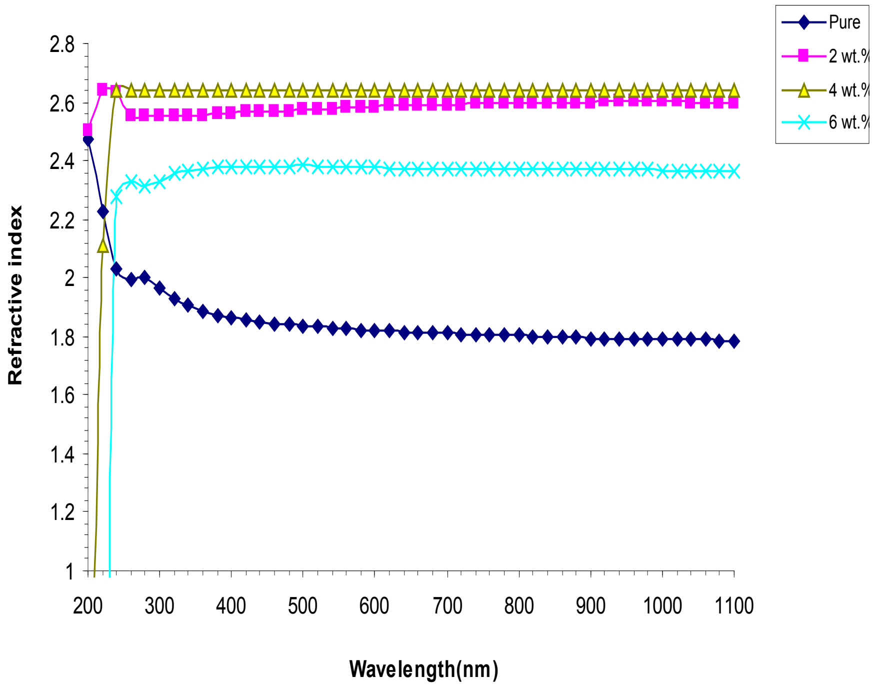

Fig. 11 . Variation of refractive index for (PVA-PEO-MnO_2) nanocomposites with wavelength.

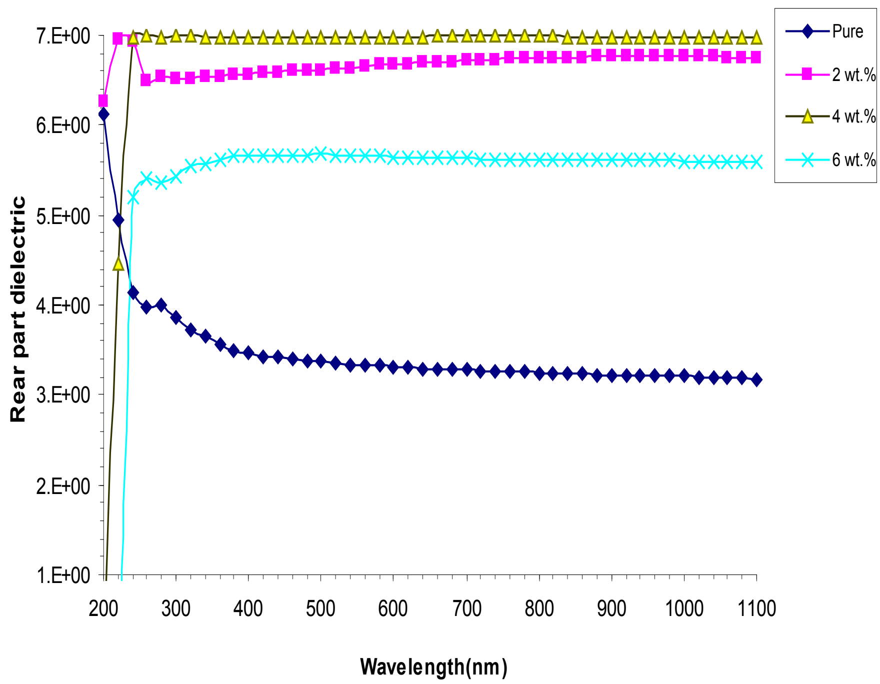

Fig. 12 . Variation of real part of dielectric constant for (PVA-PEO-MnO_2) nanocomposites with wavelength.

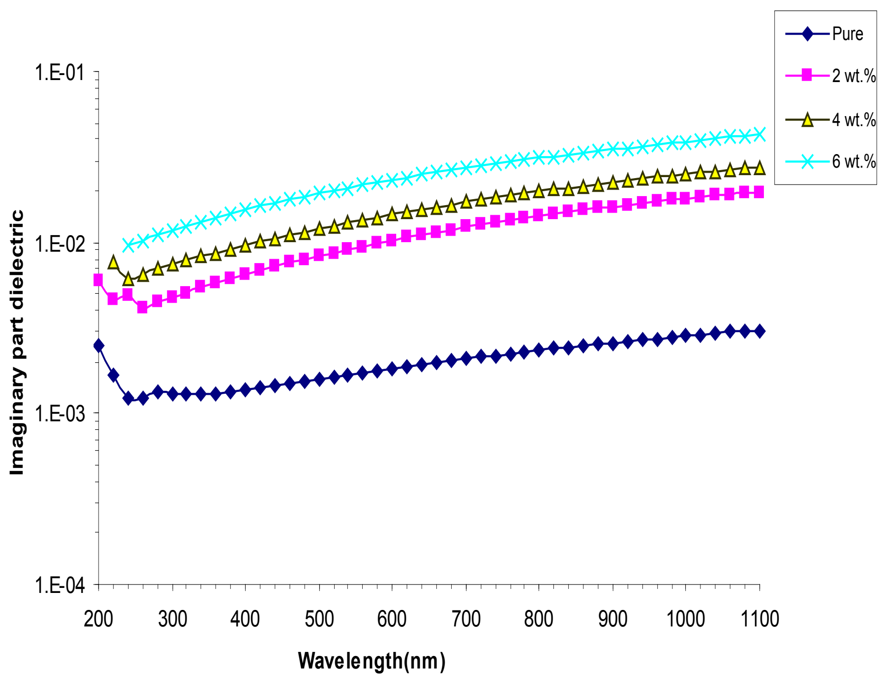

Fig . 13 . Variation of imaginary part of dielectric constant for (PVA-PEO-MnO_2) nanocomposites with wavelength.

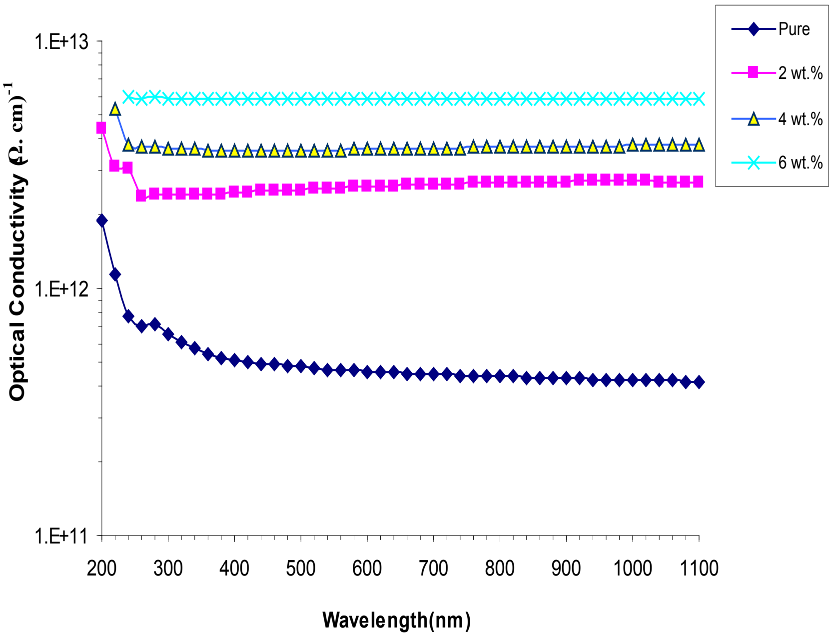

Fig. 14 . Variation of optical conductivity for (PVA-PEO-MnO_2) nanocomposites with wavelength.

Conclusions

1- The dielectric constant, dielectric loss and A.C electrical conductivity of (PVA-PEO) blend are increased with an increase the MnO_2 nanoparticles concentrations.
2- The dielectric constant and dielectric loss of (PVA-PEO- MnO_2) nanocomposites are decreased while the A.C electrical conductivity increases with increasing of the frequency. The experimental results of dielectric properties showed that the (PVA-PEO- MnO_2) nanocomposites enhancement of dielectric properties for (PVA-PEO) blend by addition the MnO_2 nanoparticles concentrations which is useful for different electronic applications.
3- Due to the absorption coefficient of less than (10^4). The transition electronic of (PVA-PEO-MnO_2) nanocomposites was indirect.
4- With increasing weight percentage of manganese oxide nanoparticles for (PVA-PEO-MnO_2) nanocomposites, each of (extinction coefficient, refractive index, real and imaginary part) increases.
5- With higher photon energy, optical conductivity for (PVA-PEO-MnO_2) nanocomposites is increased and decrease with low photon energy.

References

1. S. Chatterjee, J.Anita , Aa. Subramanian and S. subramanian,“ Synthesis and Characterization of Manganese Dioxide using Brassica Oleracea“, *Journal of Industrial Pollution Control,* Vol. **33**, No.2,(2017).

2. Ahmed Hashim and Majeed Ali Habeeb, Structural and Optical Properties of (Biopolymer Blend-Metal Oxide) Bionanocomposites For Humidity Sensors, *Journal of Bionanoscience,* Vol.**12**, No.5 (2018).

3. Ahmed Hashim, Majeed Ali Habeeb, and Aseel Hadi, Synthesis of Novel Polyvinyl Alcohol–Starch-Copper Oxide Nanocomposites for Humidity Sensors Applications with Different Temperatures, *Sensor Letters*, Vol.**15**, No.9, PP.758–761, (2017).

4. P.Henrique Cury Camargo, K. Gundappa Satyanarayana, F. Wypych,“ Nanocomposites: Synthesis, Structure, Properties and New Application Opportunities“, *Journal of Materials Research,* Vol. **12**, No. 1, (2009).

5. Mi Zhang, Yu Gao, Yixing Zhan, Xiaoqing Ding, Ming Wang and Xinlong Wang, Preparing the Degradable, Flame-Retardant and Low Dielectric Constant Nanocomposites for Flexible and Miniaturized Electronics with Poly(lactic acid), Nano ZIF-8@GO and Resorcinol Di(phenyl phosphate), *Materials,* Vol. **11**, doi:10.3390/ma11091756, (2018).

6. M.Augustin, D. Fenske , I. Bardenhagen , A. Westphal , M. Knipper , T.Plaggenborg , J. Kolny-Olesiak and J. Parisi,“ Manganese oxide phases and morphologies: A study on calcination temperature and atmospheric dependence“, *Beilstein Journal of Nanotechnol,* Vol.**6**, (2015).

7. Roberto Ambrosio, Amanda Carrillo, Maria de la Luz Mota, Karla de la Torre, Richard Torrealba, Mario Moreno, Hector Vazquez, Javier Flores and Israel Vivaldo, Polymeric nanocomposites membranes with high permittivity based on PVA - ZnO nanoparticles for potential applications in flexible electronics, *Polymers*, Vol. **10**, 1370; doi:10.3390/polym10121370, (2018).

8. Amal M. Abdel-karim, A. H. Salama, Mohammad L. Hassan, Electrical conductivity and dielectric properties of nanofibrillated cellulose thin films from bagasse, *J. Phys Org Chem.*;e3851, doi.org/10.1002/poc.3851(2018).

9. F. Skaryna Av., Minsk“Optical Properties of Thin-Film Metal-Dielectric Nanocomposites“, *Physics and Chemistry of Solid State*,Vol. 4, No. 4 (2003).

10. L. E. Regalado, R. García-llamas,“ Determination of the optical properties of thin-films“, R*evitta Mezicana,* Vol. **39**, No. 5 (1999)

11. C. Pecharroma´ Ny and F. J. Gordillo-va´ zquezz,“ Optical properties of binary composite materials with two nonlinear components“, *Journal of Modern Optics,* Vol. 50, No. 12,(2003).

12. M. Strankowski, D. WBodarczyk, A. Piszczyk, and J. Strankowska,“ Polyurethane Nanocomposites Containing Reduced Graphene Oxide, FTIR, Raman, and XRD Studies“, *Journal of Spectroscopy* (2016).

13. E. Fonseca dos Reisa , A.Pereira Lagea , R. Cerqueira Leitea , L. Guilherme Heneineb , W. Luiz Vasconcelosc , Z.Ines Portela Lobatoa ,“ Synthesis and Characterization of Poly (Vinyl Alcohol) Hydrogels and Hybrids for rMPB70 Protein Adsorption“, *Journal of Materials Research,* Vol. **9**, No. 2 (2006).

14. A. Hashim, M. A. Habeeb, A. Hadi, Q. M Jebur, W. Hadi,“Fabrication of Novel (PVA-PEG-CMC-Fe3O4) Magnetic Nanocomposites for Piezoelectric Applications“, *Journal of American Scientific Publishers,*Vol. **15**, No. 12 (2017).

15. R. G. Kadhim , M. A. Habeeb and Q. M. Jebur,“ Dielectric and optical properties for (Poly vinyl alcohol-Carboxymethyl Cellulose –Copper Oxide) Nanocomposites and their Applications“, *Journal of Chemical and Pharmaceutical Sciences,* Vol. **10**, No.1 (2017)

16. C. Cela Mardare, D. Tanasic, A. Rathner, N.Mϵuller, and A. Walter Hassel,“Growth inhibition of Escherichia coli by zinc molybdate with different crystalline structures ”, *Phys. Status Solidi A,* Vol. **213**, No. 6 (2016)

17. I. Keranov , M. Michel, A. Kostadinova, S. Miloshev, T.Vladkova,“ Well-defined nanoparticles from poly(N-vinyl pyrrolidone-b-dimethylsiloxane) prepared by conventional radical polymerization“, *International Journal of Engineering and Innovative Technology (IJEIT)* Vol. **3**, No. 7, (2014).

18. K. Vimala, Y. Mohan2, K. Varaprasad, N. NarayanaRedd, S. Ravindra, N. Sudhakar Naidu, K. Mohana Raju,“ Fabrication of Curcumin Encapsulated Chitosan-PVA Silver Nanocomposite Films for Improved Antimicrobial Activity“, *Journal of Biomaterials and Nanobiotechnology*, Vol., **2** (2011).

19. H. M. Ahmad, S. H. Sabeeh, S. A. Hussen,“Electrical and Optical Properties of PVA/LiI Polymer Electrolyte Films“, *Journal of asian Transactions on Science & Technology*, Vol. **1**, No.6,(2012).

20. O. Gh. Abdullah, D. A. Tahir, S. S. Ahmad, and H.T. Ahmad,“ Optical Properties of PVA:$CdCl_2$.H_2O Polymer Electrolytes“, *Journal of Applied Physics,* Vol. **4**, No. 3 (2013).

21. Suman Mahendia, A.K. Tomar, Shyam Kumar, Electrical conductivity and dielectric spectroscopic studies of PVA–Ag nanocomposite films, *Journal of Alloys and Compounds,* Vol.508 (2010).

22. Ahmed Hashim and Majeed Ali Habeeb, Synthesis and Characterization of Polymer Blend-$CoFe_2O_4$ Nanoparticles as a Humidity Sensors For Different Temperatures, *Transactions on Electrical and Electronic Materials*, DOI: 10.1007/s42341-018-0081-1 (2019).

23. Hashim A and Hadi A. , Novel Pressure Sensors Made From Nanocomposites (Biodegradable Polymers–Metal Oxide Nanoparticles): Fabrication and Characterization. *Ukrainian Journal of Physics,* **63** (8), DOI:https://doi.org/10.15407/ujpe63.8.754 (2018).

24. Kadhim K J, Agool I R and Hashim A., Synthesis of (PVA-PEG-PVP-TiO_2) Nanocomposites for Antibacterial Application. *Materials Focus*, 5

(5), DOI: https://doi.org/10.1166/mat.2016.1371 (2016).

25. Majeed Ali Habbeb, Ahmed Hashim, Abdul-Raheem K. AbidAli, The dielectric properties for (PMMA-LiF) composites , *European Journal of Scientific Research,* Vol. **61**, No. 3, pp.367-371, (2011)

26. Hashim A and Hadi A., synthesis and characterization of novel piezoelectric and energy storage nanocomposites: biodegradable materials–magnesium oxide nanoparticles. *Ukrainian Journal of Physics,* **62** (12), doi: 10.15407/ujpe62.12.1050 (2017).

27. Kadhim K J, Agool I R and Hashim A., Effect of Zirconium Oxide Nanoparticles on Dielectric Properties of (PVA-PEG-PVP) Blend for Medical Application. *Journal of Advanced Physics* **6** (2), DOI: https://doi.org/10.1166/jap.2017.1313 (2017).

28. B.H. Rabee, A. Hashim, Synthesis and characterization of carbon nanotubes -polystyrene composites, *European Journal of Scientific Research,* **60** (2), 247-254 (2011).

29. Hashim A, Agool I R and Kadhim K J. 2018. Novel of (Polymer Blend-Fe_3O_4) Magnetic Nanocomposites: Preparation and Characterization For Thermal Energy Storage and Release, Gamma Ray Shielding, Antibacterial Activity and Humidity Sensors Applications. *Journal of Materials Science: Materials in Electronics,* **29** (12), DOI: https://doi.org/10.1007/s10854-018-9095-z.

30. Qayssar M. Jebur, Ahmed Hashim, Majeed A. Habeeb, Structural, Electrical and Optical Properties for (Polyvinyl Alcohol–Polyethylene Oxide–Magnesium Oxide) Nanocomposites for Optoelectronics Applications, *Transactions on Electrical and Electronic Materials,* https://doi.org/10.1007/s42341-019-00121-x, (2019).

31. A. Hashim, M. A. Habeeb, A. Khalaf, and A. Hadi, Fabrication of (PVA-PAA) Blend-Extracts of Plants Bio-Composites and Studying TheirStructural, Electrical and Optical Properties for Humidity Sensors Applications, *Sensor Letters,* Vol. **15**, PP. 589–596 (2017).

32. M. A. Habeeb, A. Hashim, and A. Hadi, Fabrication of New Nanocomposites: CMC-PAA-PbO_2 Nanoparticles for Piezoelectric Sensors and Gamma Radiation Shielding Applications, *Sensor Letters,* Vol. **15**, No. 9, pp. 785–790 (2017).

33. Hind Ahmed, Ahmed Hashim and Hayder M. Abduljalil, Analysis of Structural, Electrical and Electronic Properties of (Polymer Nanocomposites/ Silicon Carbide) for Antibacterial Application, *Egypt. J. Chem.,* Vol. 62, No. 4. pp.1167– 1176, DOI: 10.21608/EJCHEM.2019.6241.1522, (2019).

34. Ahmed Hashim, Hayder M. Abduljalil, Hind Ahmed, Fabrication and Characterization of (PVA-TiO2)1-x/ SiCx Nanocomposites for Biomedical Applications, *Egypt. J. Chem.,* DOI: 10.21608/EJCHEM.2019.10712.1695, (2019).

35. Hind Ahmed, Ahmed Hashim, Fabrication of PVA/NiO/SiC Nanocomposites and Studying their Dielectric Properties For Antibacterial Applications, *Egypt. J. Chem.,* DOI: 10.21608/EJCHEM.2019.11109.1712, (2019).

36. Qayssar M. Jebur, Ahmed Hashim, Majeed A. Habeeb, Fabrication, Structural and Optical properties for (Polyvinyl Alcohol–Polyethylene Oxide– Iron Oxide) Nanocomposites, *Egypt. J. Chem.,* DOI:10.21608/EJCHEM.2019.10197.1669, (2019).

37. Z. Al-Ramadhan, A. J. K. Algidsawi and Ahmed Hashim, The D.C Electrical Properties of (PVC Al_2O_3) Composites, *AIP Conf. Proc.* 1400 (180) (2011); https://doi.org/10.1063/1.3663109.

38. Agool I R, Kadhim K J, Hashim A. 2017. Fabrication of new nanocomposites: (PVA-PEG-PVP) blend-zirconium oxide nanoparticles) for humidity sensors. *International Journal of Plastics Technology,* **21** (2), DOI: https://doi.org/10.1007/s12588-017-9192-5.

39. Agool I R, Kadhim K J, Hashim A. 2017. Synthesis of (PVA-PEG-PVP-ZrO_2) Nanocomposites For Energy Release and Gamma Shielding Applications. *International Journal of Plastics Technology,* **21** (2), DOI: https://doi.org/10.1007/s12588-017-9196-1.

40. Ahmed Hashim and Zinah Sattar Hamad, Fabrication and Characterization of Polymer Blend Doped with Metal Carbide Nanoparticles for Humidity Sensors, *J. Nanostruct.,* Vol. **9**, No. 2, pp.340-348, (2019).

41. Hadi A, Hashim A. 2017. development of a new humidity sensor based on (carboxymethyl cellulose–starch) blend with copper oxide nanoparticles. *Ukrainian Journal of Physics,* **62** (12), doi: 10.15407/ujpe62.12.1044.

42. Hashim A and Hadi A. 2017. novel lead oxide polymer nanocomposites for nuclear radiation

shielding applications. *Ukrainian Journal of Physics,* **62** (11), doi: 10.15407/ujpe62.11.0978.

43. Hashim A and Hadi Q. (2018) Structural, electrical and optical properties of (biopolymer blend/ titanium carbide) nanocomposites for low cost humidity sensors. *Journal of Materials Science: Materials in Electronics,* **29**, 11598–11604, DOI: https://doi.org/10.1007/s10854-018-9257-z.

44. Hashim A and Hadi Q. (2018) Synthesis of Novel (Polymer Blend-Ceramics) Nanocomposites: Structural, Optical and Electrical Properties for Humidity Sensors. *Journal of Inorganic and Organometallic Polymers and Materials,* **28** (4), DOI: https://doi.org/10.1007/s10904-018-0837-4.

45. Ahmed Hashim and Ali Jassim, Novel of (PVA-ST-PbO_2) Bio Nanocomposites: Preparation and Properties for Humidity Sensors and Radiation Shielding Applications, *Sensor Letters,* Vol. **15**, No.12 (2017).

46. Farhan Lafta Rashid, Aseel Hadi, Naheda Humood Al-Garah, Ahmed Hashim, Novel Phase Change Materials, MgO Nanoparticles, and Water Based Nanofluids for Thermal Energy Storage and Biomedical Applications, *International Journal of Pharmaceutical and Phytopharmacological Research,* Vol. **8**, Issue 1 (2018).

47. Ahmed Hashim, Hayder Abduljalil, Hind Ahmed, Analysis of Optical, Electronic and Spectroscopic properties of (Biopolymer-SiC) Nanocomposites For Electronics Applications, *Egypt. J. Chem.,* DOI: 10.21608/EJCHEM.2019.7154.1590, (2019).

48. Ahmed Hashim, Zinah S. Hamad, Lower Cost and Higher UV-Absorption of Polyvinyl Alcohol/ Silica Nanocomposites For Potential Applications, *Egypt. J. Chem.,* DOI: 10.21608/ EJCHEM.2019.7264.1593, (2019).

49. Hashim A. and Jassim A., Novel of Biodegradable Polymers-Inorganic Nanoparticles: Structural, Optical and Electrical Properties as Humidity Sensors and Gamma Radiation Shielding for Biological Applications, *Journal of Bionanoscience,* Vol. **12** (2018), doi:10.1166/jbns.2018.1518.

50. Alaa J. Kadham, Dalal Hassan, Najlaa Mohammad, Ahmed Hashim, Fabrication of (Polymer Blend-magnesium Oxide) Nanoparticle and Studying their Optical Properties for Optoelectronic Applications, *Bulletin of Electrical Engineering and Informatics,* Vol. **7**, No. 1, (2018), DOI: 10.11591/eei.v7i1.839.

51. Sannakki Nagaraja, S.M. Ambalagi, H.K. Inamdar, B. Bharathi, D. Mahalesh, M.V.N. Ambika Prasad, S. Basavaraja, P.S. Naik, Synthesis and Characterization of PANI/PVDF Composites for Dielectric and AC Conductivity, *J. Nanosci. Tech.,* Vol. **4**, Issue 5 (2018).

الخصائص التركيبية، والعزلية والبصرية للمتراكبات النانوية (بولي فينيل الكحول- بولي اثيلين اوكسايد- اوكسيد المنغنيز)

احمد هاشم[١] ، مجيد علي حبيب[١] و قيصر مهدي جبر[٢]
[١]جامعة بابل- كلية التربية للعلوم الصرفة - قسم الفيزياء - العراق
[٢]وزارة التربية - العراق

نظرًا للأهمية العلمية والصناعية والكهربائية والطبية، كان من الضروري دراسة خصائص المتراكبات النانوية. لذا فقد لفتت انتباه العلماء والباحثين في دراسة الخصائص التركيبية والكهربائية وغيرها من الخصائص. لذلك، في هذا العمل، تم تحضير متراكبات نانوية (بولي فينيل الكحول- بولي إثيلين اوكسايد- أوكسيد المنغنيز) بتراكيز مختلفة من الخليط البوليمري وجسيمات اوكسيد المنغنيز النانوية. تمت إضافة جسيمات أوكسيد المنغنيز النانوية إلى خليط (بولي فينيل الكحول- بولي إثيلين اوكسايد) بنسب وزنية (٢ ، ٤ ، ٦). تشير صور المجهر الضوئي إلى أن توزيع جسيمات أوكسيد المنغنيز النانوية كان متجانسًا في خليط (بولي فينيل الكحول- بولي إثيلين اوكسايد) .تشير FT-IR إلى عدم حدث أي تغيير في التركيب الكيميائي بين خليط (بولي فينيل الكحول- بولي إثيلين اوكسايد) ومضافات جسيمات أوكسيد المنغنيز النانوية. تمت دراسة الخصائص العزلية للمتراكبات النانوية. بينت النتائج أن ثابت العزل الكهربائي والفقدان العزلي والتوصيلية الكهربائية للخليط (بولي فينيل الكحول- بولي إثيلين اوكسايد) يزداد مع زيادة تراكيز جسيمات أوكسيد المنغنيز النانوية. ينخفضا ثابت العزل الكهربائي وفقدان العزل الكهربائي بينما تزداد التوصيلية الكهربائية AC مع زيادة تردد المجال الكهربائي المسلط. أظهرت القياسات البصرية زيادة الامتصاصية لمتراكبات (PVA-PEO-MnO٢) النانوية مع زيادة تركيز جسيمات اوكسيد المنغنيز النانويـــة. مع زيادة تركيز جسيمات أوكسيد المنغنيز النانوية فـــأن فجـــوة الطاقـــة غيرالمباشرةEg) g) لخليط (بولي فينيل الكحول- بولي إثيلين اوكسايد) ستقل. وبزيادة النسب الوزنية لجسيمات أوكسيد المنغنيز النانوية، فأن الثوابت البصرية كمعامل الامتصاص، و معامل الخمود، و معامل الانكسار، و ثابت العزل الحقيقي والخيالي للمتراكبات النانوية ستتغير.