International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Optical Properties of (PVA-PEG-PF, PP) Composites

Zainab Ramdhan[1], Majeed Ali[2], Abdulameer Khalaf[3], Ahmed Hashim[4], Hussein Hakim[5]

[1]Al- Mustansiriah University, Department of Physics, Iraq

[2, 3, 4,5] Babylon University, Department of Physics, Iraq

Abstract: ***The aim of this paper, study of the effect of Palm fronds and Pomegranate peel on optical properties of (PVA-PEG) composites. The Palm fronds and Pomegranate peel were added to the polymers (polyvinyl alcohol $_{0.85}$ and Polyethylene glycol $_{0.15}$) with weight percentages are (0, 2, 4, 6) wt.%.. The optical properties were measured in the wavelength range (200-800) nm. The results show that the absorbance (A), absorption coefficient (α), extinction coefficient (k), refractive index (n) and real and imaginary dielectric constants (ε_1 and ε_2) of polymers are increasing with the increase of the weight percentages of Palm fronds and Pomegranate peel. The energy gap (E_g) of polymers is decreased with the increase of the Palm fronds and Pomegranate peel concentrations.***

Keywords: polyethylene glycol, palm fronds, pomegranate peel, optical constants.

1. Introduction

Polymers are widely used in electrical and electronic applications. In early works, polymers have been used as insulators because of their high resistivity and dielectric properties. Polymer-based insulators are used in electrical equipment to separate electrical conductors without passing current through themselves. The insulator applications of polymers include printed circuit boards, wire encapsulates, corrosion protective electronic devices, and cable sheathing materials. Polymers have several advantages, such as easy processing, low cost, flexibility, high strength, and good mechanical properties. In the microelectronic fabrication industry, polymers are used in the photolithography process [1]. Composites, the wonder materials are becoming an essential part of today's materials due to the advantages such as low weight, corrosion resistance, high fatigue strength, and faster assembly. They are extensively used as materials in making aircraft structures, electronic packaging to medical equipment, and space inexpensive composite polymers with an appropriate weight. Polymer composites have steadily gained growing importance during the past decade. Vigorous developments of polymer composite and extensive utilization of polymer materials in technology have led to the polymer composites. The importance of polymers is mainly because polymers are still regarded as a cheap alternative material that is manufactured easily. The intensive use of polymer has led to the development of materials for specific applications [2]. Studies on optical properties of polymer have widely applications in electronic devices and optical devices like solar cells, fuel cells, solid state batteries. and also exhibits promising medical technological applications. The high dielectric strength (good insulating material), good charge storage capacity as well as the low electrical conductivity and high flexibility make the Poly-vinyl alcohol (PVA) as an exceptional polymer for microelectronic industry. Electrical conduction in polymers has been extensively studied in recent years to understand the nature of charge transport in these materials. Various conduction mechanisms such as Schottky effect, the Pool-frenkel effect, space charge limited conduction and hopping conduction have been suggested for the charge transport [3]. This paper deals with the effect of Palm fronds and Pomegranate peel on optical properties of (PVA-PEG) composites.

2. Materials and Methods

The materials which used in this work are polyvinyl alcohol $_{0.85}$ and Polyethylene glycol $_{0.15}$ as a matrix and the Palm fronds, Pomegranate peel as filler. The polymers was dissolved in distill water. The Palm fronds and Pomegranate peel was added to the polymers with concentrations are (0,2,4 and 6) wt.%. The casting technique was used to preparation the composites. The optical properties of (PVA-PEG-PF, PP) are measured by using UV/1800/ Shimadzu spectrophotometer in range of wavelength (200-800) nm.

3. Results and Discussion

The UV-vis spectra of (PVA-PEG-PF, PP) composites with wavelength (200-800) nm of incident light is shown in Fig.1-a,b. The absorbance of light of polymers (polyvinyl alcohol and Polyethylene glycol) increases with the increase of the Palm fronds, Pomegranate peel concentration respectively, this increase attributed to Palm fronds, Pomegranate peel particles which absorb the incident light.

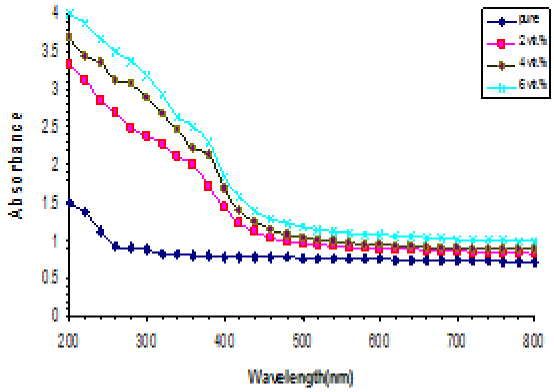

FIG.1-a
The variation of optical absorbance for (PVA-PEG-PF) composite with wavelength

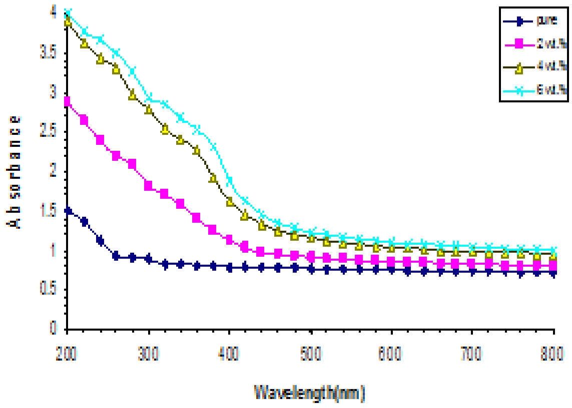

FIG.1-b
The variation of optical absorbance for (PVA-PEG-PP) composite with wavelength

The effect of fillers on the absorption coefficient of the (PVA-PEG) composites is shown in Fig.2-a,b.

Absorption coefficient (α) is defined as the ability of a material to absorb the light of a given wavelength[4]

$$\alpha = 2.303A/t \quad \text{.......... (1)}$$

Where A: is the absorbance, t: the sample thickness in cm. This figures show that the absorption coefficient of composites is increased with increase of the concentrations of the Palm fronds and Pomegranate peel. The increase of absorption coefficient attributed to increase the absorption of the light.

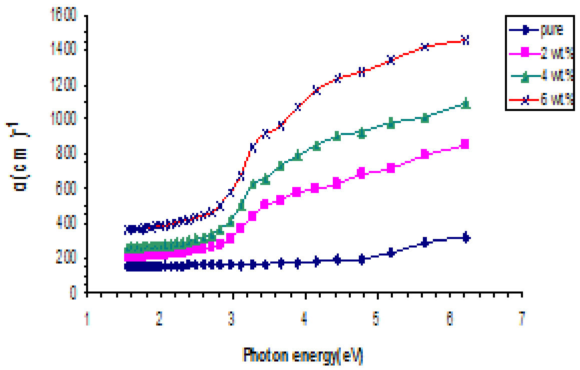

FIG.2-a
The absorption coefficient for (PVA-PEG-PF) composite with various photon energy

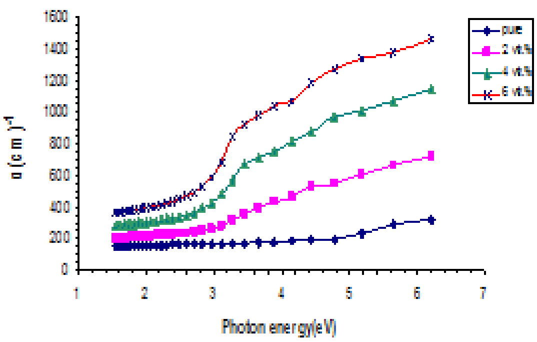

FIG.2-b
The absorption coefficient for (PVA-PEG-PP) composite with various photon energy

The values of absorption coefficient is less than 10^4 cm^{-1}, this mean the composites have indirect energy band gap as shown in Fig. 3a,b which calculated from the following Eq..

$$\alpha h\upsilon = B(h\upsilon - E_g)^r \text{............(2)}$$

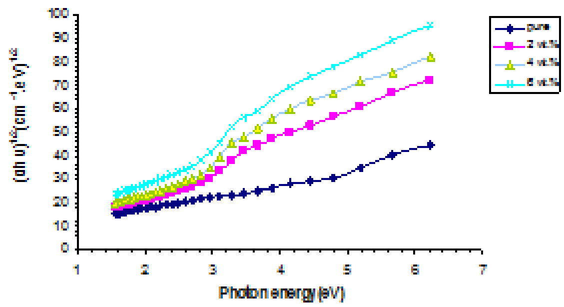

FIG.3-a
The relationship between $(\alpha h\upsilon)^{1/2}(cm^{-1}.eV)^{1/2}$ and photon energy of composites.

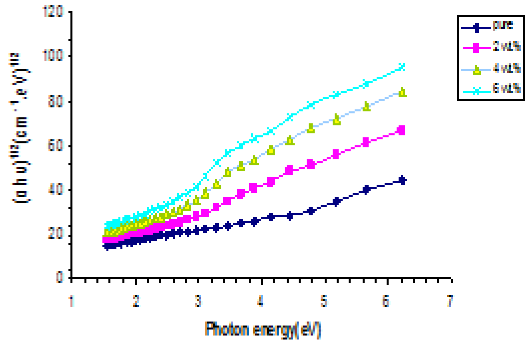

FIG.3-b
The relationship between $(\alpha h\upsilon)^{1/2}(cm^{-1}.eV)^{1/2}$ and photon energy of composites.

The figures show the energy band gap of the (PVA-PEG) composites decreases with increase of the concentrations of fillers which attributed to increase the local level in forbidden energy band gap[5].

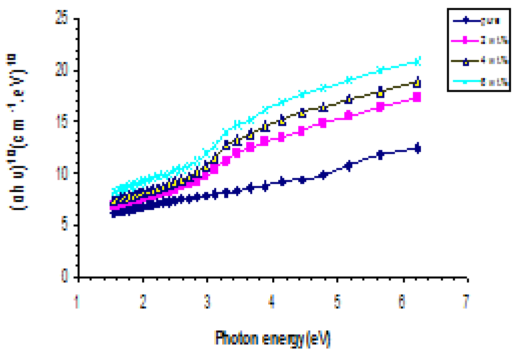

FIG.4-a
the relationship between $(\alpha h\upsilon)^{1/3}(cm^{-1}.eV)^{1/3}$ and photon energy of composites.

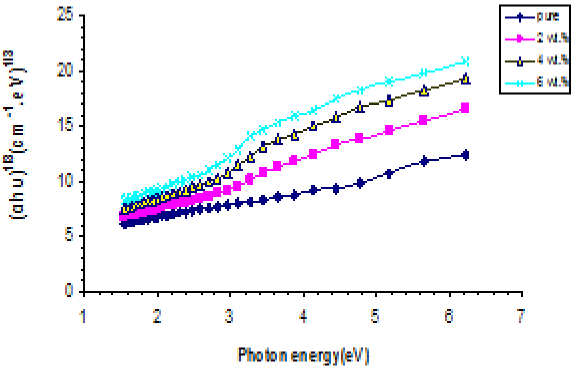

FIG.4-b

the relationship between $(\alpha h\upsilon)^{1/3}(cm^{-1}.eV)^{1/3}$ and photon energy of composites.

Fig.5-a,b: shows the variation of the extinction coefficient ($K=\alpha\lambda/4\pi$) of polymer composites with the photon energy. The figures show the extinction coefficient increases with the increase of the Palm fronds, Pomegranate peel, this attributed to loss of energy because the reaction between the light and the molecules of the medium [6].

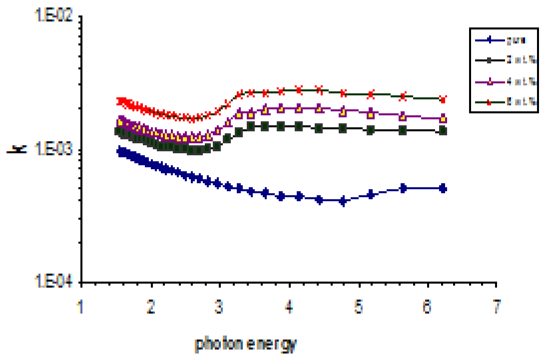

FIG.5-a

The extinction coefficient for composite with various photon energy

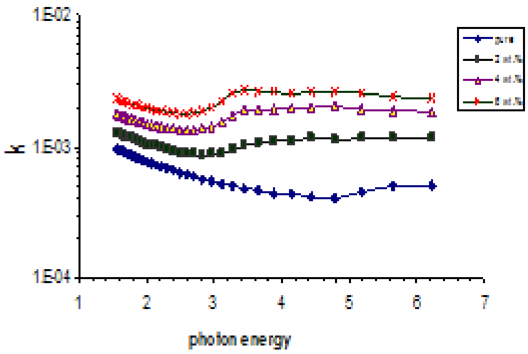

FIG.5-b

The extinction coefficient for composite with various photon energy

The relationship between the refractive index ($n= (1+R^{1/2})/(1-R^{1/2})$)of composites and incident photon energy is shown in Fig. 6-a,b. The refractive index of composite polymer increases with increase of the concentration of fillers which due to increase the scattering of the light [7].

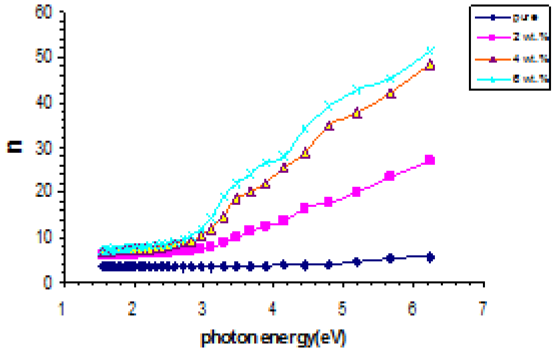

FIG.6

The relationship between refractive index for (PVA-PEG-PP) composite with photon energy

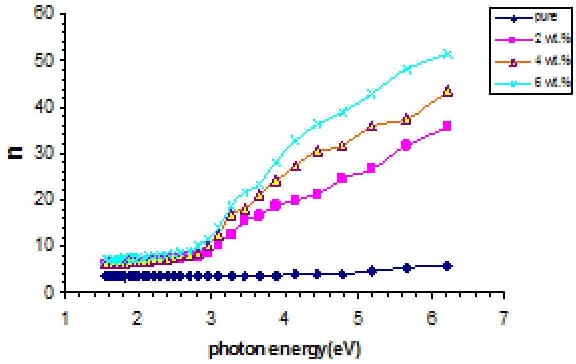

FIG.6-a

The relationship between refractive index for (PVA-PEG-PF) composite with photon energy

The Fig.7-a,b and Fig.8-a,b show the effect of fillers on the real and imaginary parts of dielectric constants of (PVA-PEG) composites of different concentrations of fillers. The real and imaginary parts of dielectric constant can be calculated by using equations :$\varepsilon_1 =n^2-k^2$ (real part) and $\varepsilon_2 =2nk$ (imaginary part). The real and imaginary parts of dielectric constants composites are increased with increase of the concentration of fillers. The increase attributed to increase the absorption and scattering.

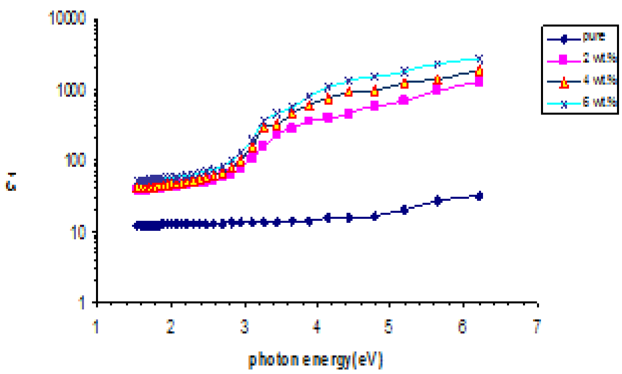

FIG.7-a

The variation of real part of dielectric constant composite with photon energy

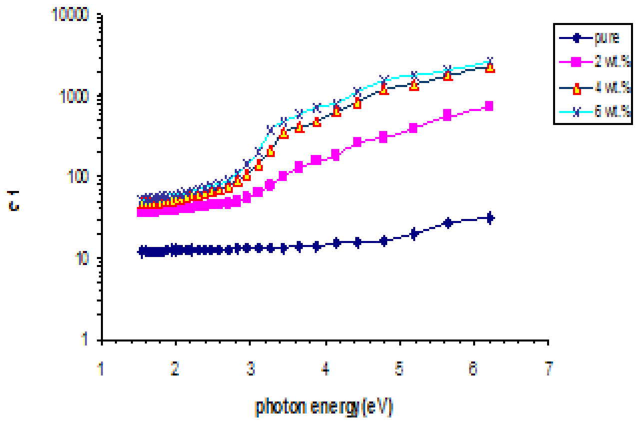

FIG.7-b
The variation of real part of dielectric constant composite with photon energy

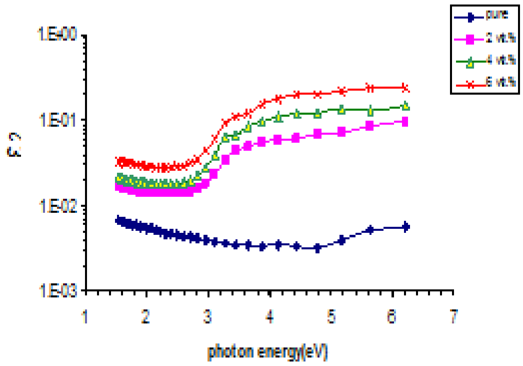

FIG.8-a
The variation of imaginary part of dielectric constant composite with photon energy

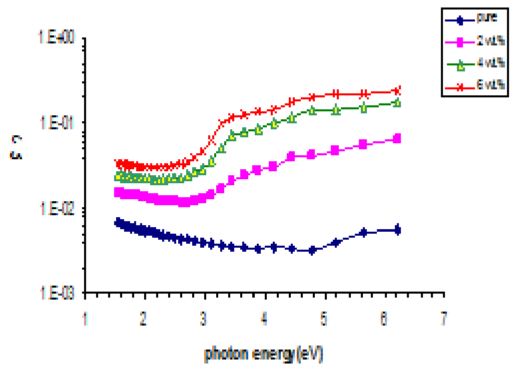

FIG.8-b
The variation of imaginary part of dielectric constantcomposite with photon energy

4. Conclusions

1) The absorbance of composite polymers (PVA-PEG) increases with increase of the concentrations of fillers.
2) The optical constants of (PVA-PEG) composite polymers (absorption coefficient, extinction coefficient, refractive index and real and imaginary dielectric constants) are increasing with increase of the concentrations of the Palm fronds and Pomegranate peel
3) The energy band gap (E_g) of composite polymers (PVA-PEG) decreases with increase of the concentrations of the Palm fronds and Pomegranate peel.

References

[1] A. N. Alias, Z. M. Zabidi, A.M.M. Ali and M. K. Harun, 2013, Optical Characterization and Properties of Polymeric Materials for Optoelectronic and Photonic Applications, International Journal of Applied Science and Technology, Vol. 3, No. 5.
[2] S. Devikala, P. Kamaraj and M. Arthanareeswari, 2013, Electrical Conductivity Studies of PVA/TiO2 Composites, International Research Journal of Pure & Applied Chemistry, Vol. 3, No. 3.
[3] Omed Gh. Abdullah, S. R. Saeed, 2013, Effect of NaI doping on same physical characteristic of (PVA)0.9-(KHSO4)0.1 composite films, Chemistry and Materials Research, Vol.3, No. 11.
[4] F.H. Abd El-kader, N.A. Hakeem, I.S. Elashmawi, A.M. Ismail, 2013, Structural, Optical and Thermal Characterization of ZnO Nanoparticles Doped in PEO/PVA Blend Films, Australian Journal of Basic and Applied Sciences, Vol. 7, No.10.
[5] Faisal A. Mustafa, 2013, THE STRUCTURAL AND OPTICAL CHARACTERISTICS OF POLYVINYLPYRROLIDONE DOPED WITH NANO CRYSTAL NAF FILMS, Natural and Applied Sciences, Vol. 4 No. 3.
[6] G. Attia and M.F.H. Abd El-kader, 2013, Structural, Optical and Thermal Characterization of PVA/2HEC Polyblend Films, Int. J. Electrochem. Sci.,Vol. 8. [7] TINTU, K. SAURAV, K. SULAKSHNA, NAMPOORI, RADHAKRISHNAN, SHEENU THOMAS, 2010, Ge28Se60Sb12 /PVA COMPOSITE FILMS FOR PHOTONIC APPLICATIONS, J. of Non-Oxide Glasses, Vol. 2, No 4.
[7] Ahmad A.H., Awatif A.M. and Zeid Abdul-Majied N., 2007, " J. of Eng. & Technology", Vol.25, No.4.