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Enhancement of Optical Properties for Poly Vinyl Alcohol by Addition of Biomaterial

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ABSTRACT

The improvement of optical properties of (PVA-PEG) has been studied. The bio composites were manufactured with different volumetric concentrations of extract of willow leaves and (PVA-PEG) blend. The FTIR analysis of composites were examined. The optical properties studied at wavelength ranged (220-800) nm. The experimental results presented that the optical properties of bio composites changed with increase of extract of willow leaves concentrations.

KEY WORDS: Bio composites, Optical Properties, Polyethylene Glycol.

1. INTRODUCTION

The blends of polymer are defined as a physical mixtures of structurally different polymers. Some of an interactions present in blends are hydrogen bonding and ionic and dipole interactions. Two or more different constituents connected into material to find new engineering materials characterized by variety of different properties composite substances because of these diverse properties are successfully used in almost all areas of industry and science. Especially popular are composites in electrical and electronic, automotive and aerospace etc. Polymer composites exhibit clear properties and have many applications in aerospace, military, marine, sports and recreational industries. The study of optical properties useful for the determine direct and indirect transitions and electronic structure. The developments of structures of polymer due to their ease of production and processing, good adhesion with reinforcing elements, resistance to corrosive environment, light weight and in some cases ductile mechanical performance.

2. MATERIALS AND METHODS

The bio composites consisting blend of (PVA-PEG) as matrix and biomaterial as filler. The bio composites were manufactured by using casting technique. The biomaterial (extract of willow leaves) is added to (PVA-PEG) blend solution (82 wt% PVA and 18 wt% PEG) with different volumetric percentages are (0, 5, 10 and 15) vol%. The (PVA-PEG-EWL) bio composites were casted in the template (petri-dish has diameter 10 cm) and glass slides. The bio composites optical properties were recorded by UV/1800/ Shimadzu spectrophotometer in wavelength range of (220-800) nm. The coefficient of absorption α (ν) can be found from the optical absorption spectrum by the following equation:

$$\alpha = 2.303 \frac{A}{t} \qquad (1)$$

Where, t is the sample thickness and A is absorbance.

The direct and indirect transitions can be defined in view of the models proposed by:

$$\alpha h\nu = B\,(h\nu - E_g^{opt})^r \qquad (2)$$

Where, ν is the frequency, B is a constant, h is Planck's constant, E_g^{opt} is the energy band gap between the valence band and the conduction band and r can take the values 2, 3, 1/2 or 3/2 for transitions designated as indirect allowed, indirect forbidden, direct allowed and direct forbidden, respectively.

The extinction coefficient of a particular substance is given by:

$$K = \frac{\alpha\lambda}{4\pi} \qquad (3)$$

The real part of refractive index (n) can be determined by:

$$n = \frac{1+\sqrt{R}}{1-\sqrt{R}} \qquad (4)$$

Where R is the reflectance.

The real part (ε_1) and imaginary part (ε_2) of the dielectric constant are given by

$$\varepsilon_1 = (n^2 - K^2) \qquad (5)$$

$$\varepsilon_2 = (2nK) \quad \ldots\ldots\ldots\ldots\ldots\ldots(6)$$

3. RESULTS AND DISCUSSION

The spectra of FTIR for (PVA-PEG-EWL) composites can be showed in figure.1. The FTIR studies of composites show the interactions in composites. The FTIR studies show the not interactions between (PVA-PEG) polymer matrix and extract of willow leaves.

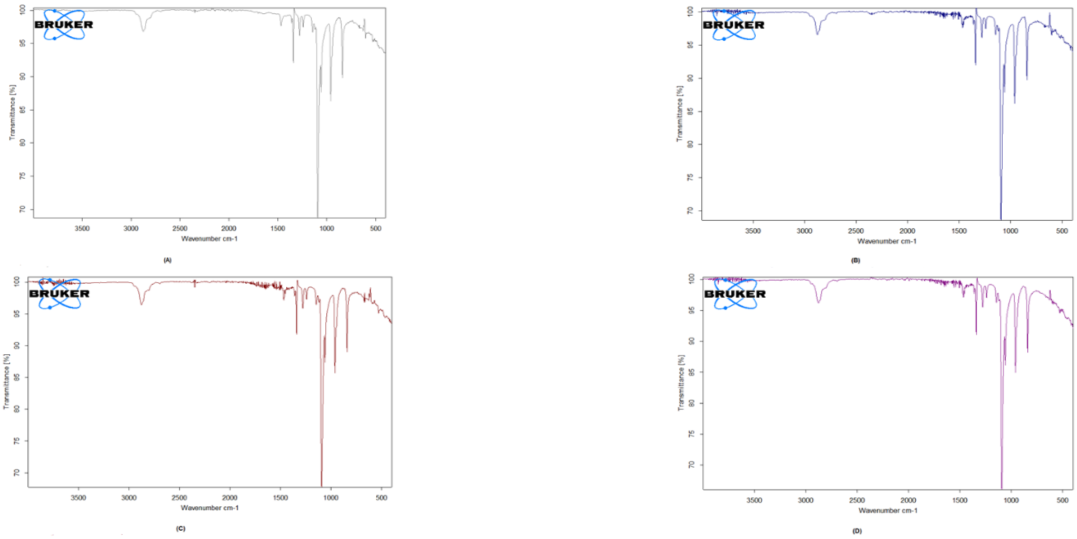

Figure.1. FTIR spectra of (PVA-PEG-EWL) composites, A- pure, B- 5 vol%, C- 10 vol%, D- 15 vol%

Figure.2, shows the absorbance spectra of bio-composites with wavelength. As shown in figure, the absorbance increases with increasing the volumetric percentages of extract of willow leaves which attributed to maximize the charges carries in bio composites. The coefficient of absorption for composites are low ($\alpha<10^4$) cm^{-1}; the transition of electron is indirect. The coefficient of absorption for bio composites is increased with increasing of the concentrations of EWL (as presented in figure.3), this is lead to increase the optical absorbance.

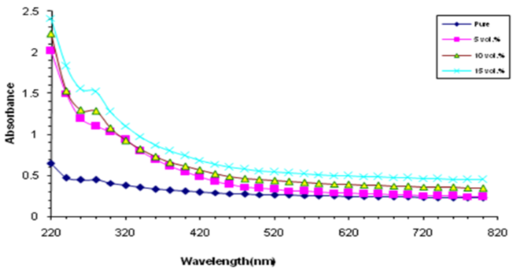

Figure.2. The absorbance spectra of (PVA-PEG-EWL) bio composites with wavelength

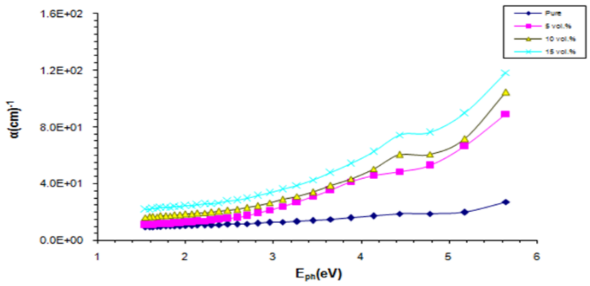

Figure.3. The absorption coefficient of bio composites with photon energy

The electronic transitions are presented in figures.4 and 5, for indirect allowed, indirect forbidden respectively. As shown in figures, the energy gap decreases with increase the concentrations of extract of willow leaves which due to the create of levels in the energy gap.

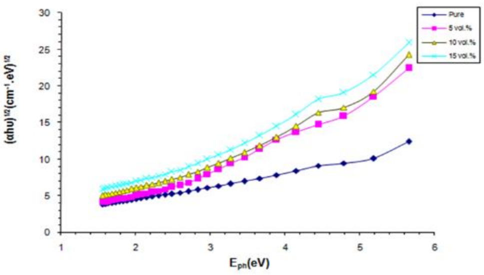

Figure.4. Variation of $(\alpha h\upsilon)^{1/2}$ for bio composites with photon energy

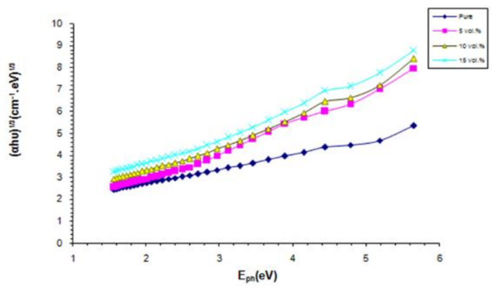

Figure.5. Variation of $(\alpha h\upsilon)^{1/3}$ for bio composites with photon energy

Figure.6, shows the extinction coefficient variation for (PVA-PEG-EWL) composites with wavelength. The extinction coefficient is increased when extract of willow leaves concentrations increasing, which is led to the increase in optical absorption. The refractive index of bio composites as a function of wavelength is shown in figure.7. The bio composites refractive index is increased with increasing of the EWL concentrations, this increase attributed to the density increasing of bio composites.

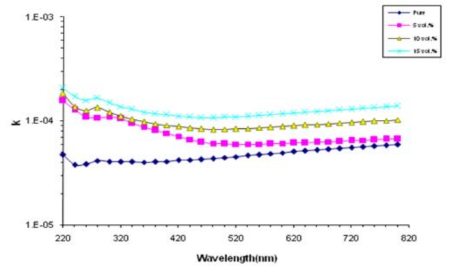

Figure.6. The variation of extinction coefficient for bio composites as a function of wavelength.

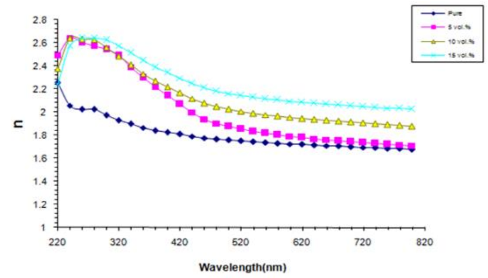

Figure.7. The refractive index of bio composites as a function of wavelength.

Figure.8, shows the relationship between real dielectric constant and wavelength for bio composites. The effect of EWL on dielectric constant (imaginary part) is presented in figure.9. The figures fund that the real and imaginary parts blend are increased when EWL concentrations increasing, which due to the ε_1 depends on (n^2), while ε_2 depends on the (k) which is due to the variation of absorption coefficients.

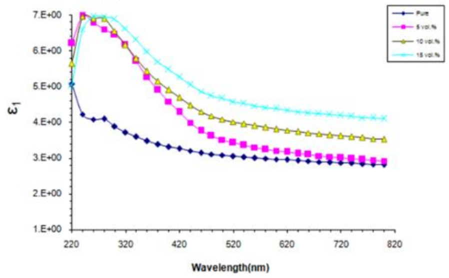

Figure.8. The variation of the real dielectric constant with the wavelength.

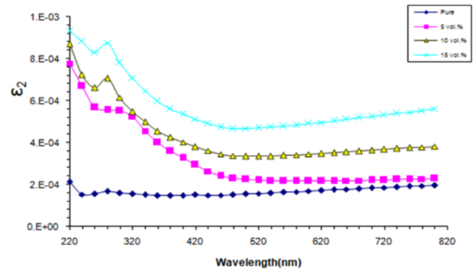

Figure.9. The variation of the imaginary dielectric constant with the wavelength of bio composites

4. CONCLUSIONS

- The absorbance of blend is increased with increasing of the extract of willow leaves concentrations.
- The energy gap is decreased with increasing of the extract of willow leaves volumetric percentages.
- The optical constants of bio composites are increased with increasing of the extract of willow leaves concentrations.

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