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Preparation of Polymer Blend- Biomaterial: Optical Properties and their Application

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Abstract

In this paper, preparation of new bio-composite consisting of polyvinyl alcohol and polyethylene glycol blend as matrix and vegetarian lotion of pomegranate as additive. The optical properties was studied in wavelength range (200-800) nm. The results show that the optical properties of polymer blend are improved by adding the VLP concentrations. The capacitance for different humidity range (40-90) % was measured for sensors application. The results found that the bio-composites have higher sensitivity at high values of humidity.

KEY WORDS: Bio composite, Sensor, Capacitance, Optical Properties, Humidity.

1. INTRODUCTION

In recent years energy conversion devices based on organic semiconductors are an emerging research field with substantial future prospects and it has attracted great attention due to the advantages of flexibility, light weight, and low cost of production with the possibility of fabricating large area devices based on solution processing. PVA polymer is soluble in water and other solvents and is widely used in synthetic fiber, paper, contact lens, textile, coating, and binder industries, due to its excellent chemical and physical properties, nontoxicity, process ability, good chemical resistance, high dielectric strength, good charge storage capacity, wide range of crystallinity, good film formation capacity, complete biodegradability, and high crystal modulus dopant-dependent electrical and optical properties. Polymer composites have found ever-increasing applications as engineering components and structures in land transportation, aerospace, aviation, military, sports marine and recreational industries. This paper aims to preparation of bio composites for humidity sensors.

2. MATERIALS AND METHODS

The bio-composites were prepared by using casting technique. The VLP was added to polymer blend solution (89 wt.% PVA and 11 wt.% PEG) with different volumetric percentages are (0, 4, 8 and 12) Vol.%. The bio composites were casted in the template (petri-dish has diameter 10 cm) and glass slides. The absorbance spectra of bio composites were recorded by UV/1800/ Shimadzu spectrophotometer in range of wavelength (200-800) nm. The sample on glass slides was placed in box and the water vapor was used as a source of humidity. The capacitance was measured for different humidity range (40-90) % by using LCR meter type (HIOKI 3532-50 LCR HI TESTER) at 10 KHz. The absorption coefficient α (ν) is given by the following equation:

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

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:

$$\alpha h\nu = C_0(h\nu - E_g^{opt})^r \quad \text{.....(2)}$$

Where, ν is the frequency, C_0 is a constant, h is Planck's constant, E_g^{opt} is the energy band gap between the valence band and the conduction band. The calculation of values of optical energy band gap includes the plotting of $(\alpha h\nu)^{1/r}$ against hν.

3. RESULTS AND DISCUSSION

The absorbance of bio-composite with different wavelength range as shown in figure.1. The figure shows that the absorption increases with increase the volumetric percentages of biomaterial, this behavior attributed to increase the charges carries in composite.

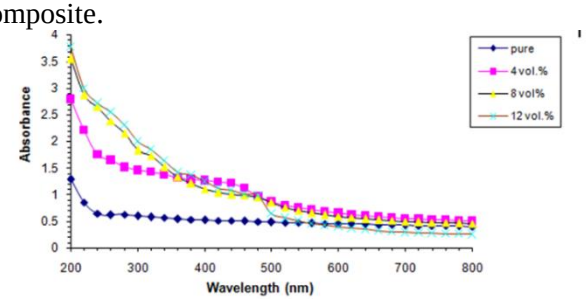
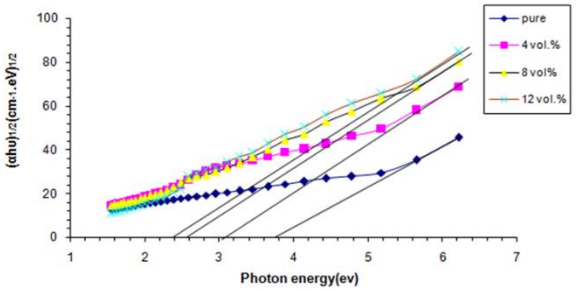


Figure.1. Absorbance of (bio composite with different wavelength

Figure.2, shows the variation of $(\alpha h\nu)^{1/2}$ against hν. The values of optical energy band gap decreases with increase the concentrations of biomaterial. The decrease of energy band gap related to the creation of levels in the energy gap.



Figures.2. Variation of $(\alpha h\nu)^{1/2}$ against hν

The variation of capacitance of bio composite with different humidity range (40-90) % is shown in figure 3. The capacitance of composite increases with increase the humidity. The change of capacitance with RH% is less whereas at higher RH% the change of capacitance is sharp. Variation of dielectric constant occurred due to different level of moisture absorbed by pores of composite material according to moisture content in the closed atmosphere. The water molecule has six degrees of freedom. When the water molecule enters the pores it loses its degree of freedom and a change of state would take place from moisture vapor to liquid and overall dielectric constant of the material will be increased. At low RH% range less water molecules enter into the pores leading to small change in capacitance while at higher RH% range water molecules tend to form cluster into the pores of polymeric composite material and therefore sharp change of capacitance occurs at higher RH% range.

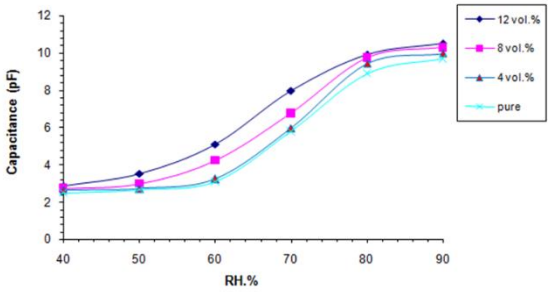


Figure.3. Variation of capacitance of bio composite with different humidity range (40-90) %

4. CONCLUSIONS

- The absorbance of polymer blend increases with increase of biomaterial concentration.
- The energy band gap decreases with increase of biomaterial volumetric percentages.
- The bio-composites have higher sensitivity of relative humidity at high humidity.

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