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# Investigation for Optical Band Gap Energy of Polyindole/Poly(Vinyl Acetate) Composite Film

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**Abstract**

*In present paper, optical properties of polyindole/poly(vinyl acetate) (PIN/PVAc) composite film are presented. The produced composite film was characterized through UV–Visible (UV–Vis) spectroscopy and X–ray diffraction (XRD). The polymer chain separation was calculated using XRD analysis. The value of optical band gap energy of PIN/PVAc composite film is calculated as 2.29 eV. The semiconducting nature of composite film reflects from optical band gap value.*

**Keywords:** Polyindole/poly(vinyl acetate); composite; optical; band gap.

## Introduction

Recently, polyaniline, polythiophene, polyphenylene, polypyrrole are the conducting polymers which has incredible research attention in the field of progress due to their flexibility of their industrial applications. The conducting polymer composites are most useful materials due to their optical and electrical properties. Nowadays, these materials are used in various applications like photocell, anticorrosion materials, super capacitors, fuel cells, polymer light emitting diodes, electrochemical displays devices, electronic devices, rechargeable battery materials, solar cells and various optical devices and etc. The application potential of conducting polymer composites in electronic devices is produces the attention of most of the researchers towards it [1–11].

Nevertheless, the polyindole (PIN) and its composites are turn into growing class of conducting polymers that have nicely collective mechanical, optical and electrical properties. These properties could be modified for precise applications [12,13]. With this particular endeavour lots of researchers have made their contribution to the field like Ramesan et al. presented preparation and characterization of PIN/copper sulphide nanocomposites [14]. Tuken et al. studied the utilization of polyindole for copper corrosion protection [15]. Tayalan et al. synthesized the conducting poly(vinyl chloride)/polyindole composites and freestanding films through chemical polymerization [16].

The present research paper reports the optical band gap investigation of polyindole/poly(vinyl acetate) (PIN/PVAc) composite film. As–prepared composite film was characterized through X–ray diffraction (XRD) technique and ultraviolet–visible (UV–Vis) spectroscopy.

## Experimental

All chemicals used in this study were of AR grade and purchased from SD Fine Chemicals, India, such as monomer indole, oxidant cupric chloride ($CrCl_3$), organic media methanol. Polyvinyl acetate (PVAc) (Himedia Chemicals, India) used as counter polymer.

The polyindole/poly(vinyl acetate) (PIN/PVAc) composite was synthesized by chemical oxidative polymerization route using oxidant $CrCl_3$. Poly(vinyl acetate) (1 g) was dissolved in methanol (9 ml) and stirred 2 h then kept solution for 24 h to get homogenous solution. The monomer indole (0.5 g) was added in PVAc solution and stirred for 2 h. The indole was polymerized using oxidant $CrCl_3$ (0.1097 g) and stirred it for 2 hr to complete polymerization reaction. Then reaction mixture was kept for 1 h to settle down. Then composite solution was cast on dry and cleaned glass plate. To dry the film through an isothermal evaporation of organic media, whole assembly was placed for 24 h in dust free chamber maintained at constant temperature. After that film was washed with double distilled water and removes from glass plate then dried for 6 h at room temperature. In this way, PIN/PVAc composite was prepared chemically.

As–synthesized composite was characterized through UV–VIS spectroscopy (Agilent Technologies, Cary 60 UV–VIS).

**Results and discussions**

The Fig. 1 represents the XRD pattern of the PIN/PVAc composite. The amorphous nature of composite is observed from the noisy peaks and broad hump seen in XRD pattern. The polymer chain separation is calculated via the given equation [17, 18],

$$R = 5\lambda / 8\sin\theta \quad (1)$$

Where, θ is diffraction position and λ=Wavelength of X–ray source. The chain separation for synthesized composite is established to be 4.3247 Å. The broad hump appears at 2θ positions in the range 17–25°. The 2 theta scale is observed in the between the range 10–70.

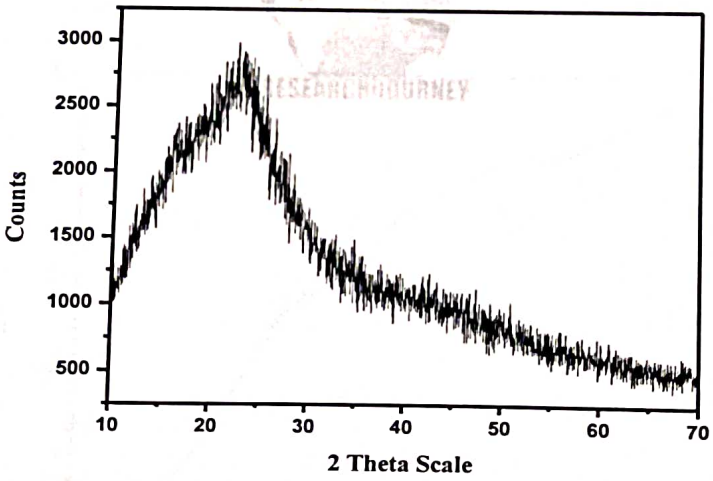


**Fig 1.** XRD pattern.

The Fig. 2 represents the UV–VIS spectrum of PIN/PVAc composite film. The % absorption spectra were studied in ultraviolet and visible range (190–420 nm). It clearly seen that % absorption is higher on lower wavelength side. It is examined that strongest absorption peak emerge at wavelength 224 nm due to optical transition from valence band to conduction band.

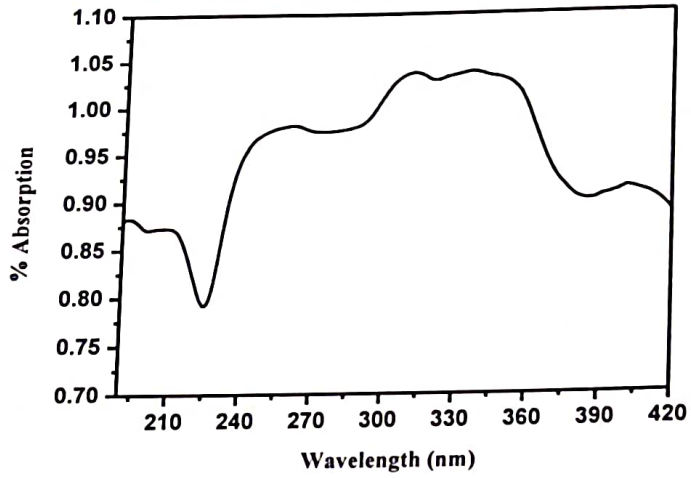


**Fig. 2.** UV–VIS spectrum.

The optical band gap value of PIN/PVAc composite is calculated from plot of αhv versus photon energy (eV) as display in Fig. 3. The optical band gap of composite can be calculated from given equation [19].

$$\alpha = \frac{A(hv-Eg)^n}{hv} \qquad (2)$$

Where, α is absorption coefficient, hv is incident photon energy, A is constant and Eg is optical band gap of material. The optical band gap value of sample is calculated as 2.29 eV. It is clearly observe that composite have application potential in optical devices and photo catalytic activities from optical band gap value of composite.

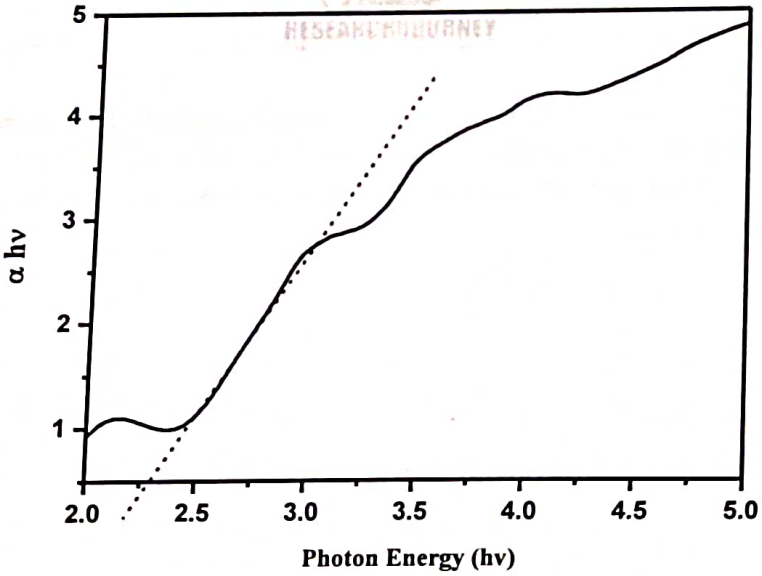


**Fig. 3.** Plot of photon energy versus αhv.

## Conclusions

In summary, the amorphous nature of prepared material was reflects from the XRD pattern of PIN/PVAc composite film. The optical band gap of composite is established as 2.29 eV. The value of optical band gap show composite has potential application in optical devices.

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