



OPTICAL PROPERTIES MODIFICATION OF POLY (VINYL CHLORIDE) USING COMPLEXES OF 2-AMINO ACETATE BENZOTHAIAZOLE

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ABSTRACT

The optical properties of PVC in the region from (200-600 nm) were studied by preparing the composites with 2-amino acetate benzothiazole complexes. The optical data analyzed and interpreted in term of the theory of phonon assisted direct electronic transition; it is observed that the energy is affected by doping type of inorganic complexes used.

Keywords: PVC, optical properties, energy gap.

INTRODUCTION

In recent years, studies on the electrical and optical properties of polymers have attracted much attention in view of their applications in optical devices with remarkable reflection, antireflection, interference and polarisation properties [1-3]. The optical properties of polymers can be suitably modified by the addition of dopants depending on their reactivity with the host matrix. 2-amino Acetate Benzothiazole complexes are fast-conducting complexes in a number of crystalline and amorphous materials, its incorporation in a polymeric system may be expected to enhance its electrical and optical performance. In this paper, we present results of such a study on the optical properties of pure and doped PVC films.

MATERIALS AND METHODS

Bis(2-amino acetate benzothiazol) copper (II) Cu(H)₂, Bis(2-amino acetate benzothiazol) nickel (II) Ni(H)₂, Bis(2-amino acetate benzothiazol) zinc(II) Zn(H)₂ and Bis(2-amino acetate benzothiazol) cadmium (II) Cd(H)₂ were prepared by the method described by Yousif *et al.* [4].

Synthesis of potassium-2-amino acetate benzothiazole

A mixture of 2-amino benzothiazole (0.1 mole) and chloroacetic acid (0.1 mole) in presence of KOH to make the medium alkaline was refluxed for two hours to give potassium-2-amino acetate benzothiazole the yellow precipitate which formed was filtered and recrystallized from ethanol to give the final product.

Preparation of complexes

Addition of ethanol solution of the suitable metal salt (Nickel acetate tetrahydrate, Tin chloride, Copper acetate, Cadmium acetate dihydrate and Zinc acetate dihydrate) to an ethanol solution of potassium-2-amino acetate benzothiazole (KH) in 2:1 (ligand: metal) molar ratios was carried out. After reflux for half an hour, crystalline colored precipitates formed at room temperature. The rustling solids were filtered off, washed

with distilled water, dried and recrystallized from ethanol and dried at 50 °C.

Films preparation

0.5% concentrations of PVC solution in THF was used to prepare 30 micrometer thickness of polymer films, (measured by a micrometer type 2610 A, Germany) with out and with 0.5% of the metal complexes prepared. The films were prepared by evaporation technique at room temperature for 24 hours. To remove the possible residual tetrahydrofuran (THF) solvent, film samples were further dried at room temperature for three hours under reduced pressure. The optical absorbance (A) of the sample was measured as a function of wavelength (λ) ranged from 200 to 600 nm by using computerized Shimadzu Uv-vis 160A-Ultraviolet-spectrophotometer full-scale absorbance up to (2.5). The light sources are halogen lamp and socket-deuterium lamp. The detector is Si-photodiode and all measurements were performed at room temperature. UV/VIS absorption spectroscopies were made for prepared samples before and after conjunction. The spectra were used to carry out the energy gap by plotting $(\alpha h\nu)^2$ versus $(h\nu)$ with (r) value (1/2) which indicates a transition of direct type. The linear portion was best fitted with $(r = 1/2)$, and $(\alpha h\nu)^{1/2}$ versus $(h\nu)$ with (r) value (2) which indicates a transition of indirect type. The linear portion was best fitted with $(r = 2)$. Energy gap shift for all samples plotted as a function to conjunction type [5].

RESULTS AND DISCUSSIONS

The relation between $(\alpha h\nu)^2$ versus photon energy for the PVC samples are shown in Figures 1 to 5 for allowed transition. For doped samples shown in Figures 1 to 4, the shift in the energy gap could be attributed to the formation of polarons in the doped films. The evidence of Polaron formation is made that the reaction in band to band transition due to shifting the band density of state toward the energy gap. This observation is not similar to the doping in conventional semiconductors when the band to band absorption strength does not affected by the formation of dopant state in the energy gap.



The effect of the organic addition on the values of phonon energies is also investigated and the results are shown in Table-1. The results presented in Figures 1 to 5 indicate the existence of two polaron bands in the energy gap. The first one represents the transition from valance band to bonding polaron band. The second band represents the transition from valance band to anti-bonding polaron band, which is in a good agreement with results, are obtained by Yousif *et al.* [4-7].

The Energy gaps were measured as behavior of a conductivity measurement of PVC with and without additive can obtain by adopting the data of energy gap, (Table-1 and Figures 1 to 5).

The conductivity measurement for PVC in the presence of additive increase in the following order.

PVC, Cd (H)₂, Zn (H)₂, Ni (H)₂, Cu (H)₂,

The ligand was prepared by the reaction of benzoyl chloride with phenylalanine in presence of sodium hydroxide. Table-1 shows the physical data for the ligand and the prepared complexes. The purity of the ligand and its complexes were checked by TLC using silica gel-G as adsorbent. The conductance of these complexes has been recorded in DMF at room temperature in the range 9-19 ohm⁻¹ cm² mol⁻¹, suggesting their non-electrolytic nature. The data of CHNS and Tin analysis were obtained using flame atomic absorption technique. The calculated values were in a good agreement with the experimental values.

Table-1. Indicate the energy band gap according to the direct allowed transition.

Sample	Eg (eV)
Cu(H) ₂	3.18
Ni(H) ₂	3.19
Zn(H) ₂	3.20
Cd(H) ₂	4.80
PVC	5.20

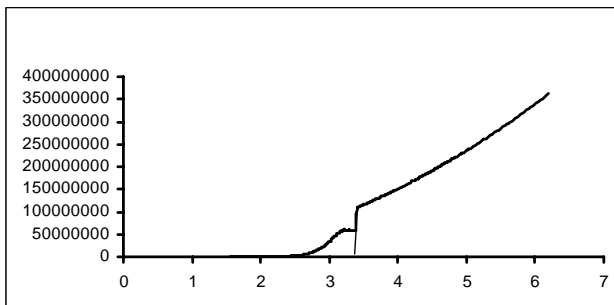


Figure-1. Allowed direct transition $(\alpha h\nu)^2$ Vs. energy for the sample Cu (H)₂.

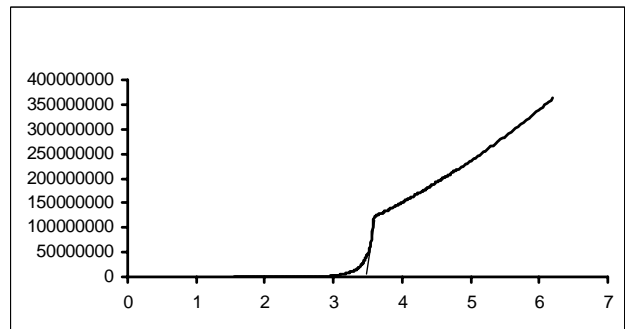


Figure-2. Allowed direct transition $(\alpha h\nu)^2$ Vs. energy for the sample Ni (H)₂.

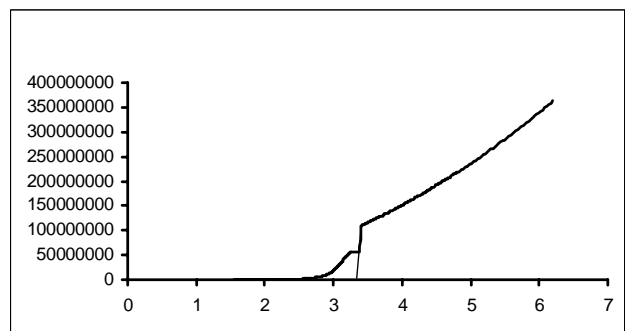


Figure-3. Allowed direct transition $(\alpha h\nu)^2$ Vs. energy for the sample Zn (H)₂.

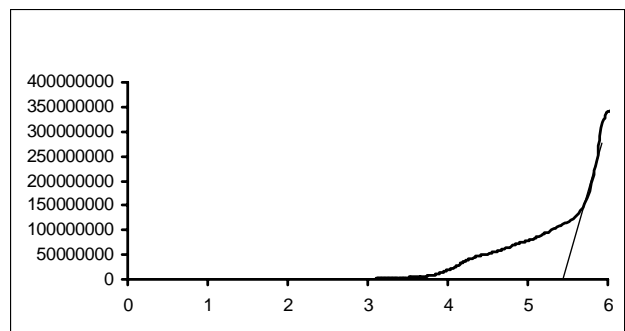


Figure-4. Allowed direct transition $(\alpha h\nu)^2$ Vs. energy for the sample Cd (H)₂.

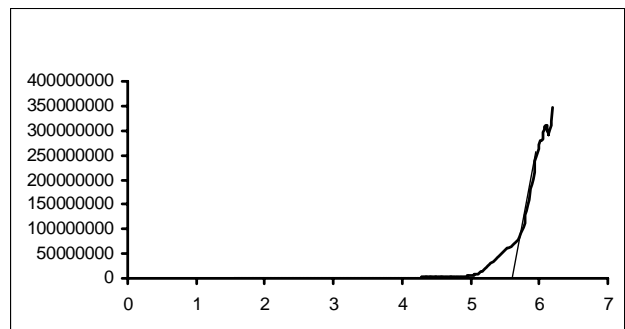


Figure-5. Allowed direct transition $(\alpha h\nu)^2$ Vs. energy for the sample (PVC).



CONCLUSIONS

The optical absorption in the UV-visible region for PVC polymer doped with 2-amino Acetate Benzothiazole complexes. The energy gaps were measured as behavior of conductivity and it is conceded that the energy is affected by doping type of metal complexes used.

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