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EFFECT OF THE SENSITIZER IN POLYVINYLCARBAZOLE (PVK) THERMOELECTRET

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ABSTRACT

The major developments in polymer science during the past few decades have been enriching our knowledge about the relationship between the structure of polymers and their thermo-electrical properties. Pure and malachite green sensitized Polyvinylcarbazole (PVK) films have been prepared by solution caste technique. The absorption spectra, ultraviolet (UV) spectroscopy and energy dispersive x-rayEDX have been studied. At lower wavelengths i.e300 nm) absorption in pure PVK sample is found to be high and also confirm the decrement in visible range within the region. It also confirms that band gap of malachite green sensitized PVK decreases from 4.2 to 4.1 eV. The results of UV and EDX are obtained in pure and malachite green sensitized PVK samples. Understanding the changes in the morphology and the dynamic behavior of polymers and the resulting properties of the material is a prerequisite to any controlled processing and functioning, and for ensuring the long-term stability of these materials.

KEYWORDS: ***Polyvinylcarbazole, Energy Dispersive X-rayUltraviolet, Malachite Green, Band Gap***

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INTRODUCTION

Electrical properties of a polymer are partly dependent on their physical as well as chemical structure. Chemical structure of polymers may be modified by doping, copolymerization, substitution and blend formation etc. These processes affect the electrical behavior to various extent, determined by their influence on inter and intermolecular interactions.[1-4]Morphological changes produced by polling of polymers have been studied using X-Ray and infra-red technologies. The polymer interface in PVK depends upon the morphology of polymer. During energy dispersive x-ray(EDX) analysis, the specimen is bombarded with an electron beam inside the scanning electron microscope.[5-7] A position vacated by an ejected inner shell electron is ultimately taken by a higher-energy electron from an outer shell. However, the transferring outer electron must give up some of its energy by emitting an X-Ray.[8] The amount of energy released by the transferring electron depends on which shell it is transferring from, as well as which shell it is transferring to. Furthermore, the atom of every element releases X-Rays with unique amounts of energy during the transferring process in the polymer matrix. Thus, by measuring the amounts of energy present in the X-rays being released by a specimen during electron beam bombardment.[9] The output of an EDX analysis is an EDX spectrum and it normally displays peaks corresponding to the energy levels for which the most X-Rays had been received.[10-12]

Experimental

The solution caste method was used for forming pure and malachite green sensitized PVK samples. The transmittance spectra were record by UV-VIS spectrophotometer (i.e. Hitachi U-2800 double beam spectrophotometer) in the wavelength range from 185 to 1200 nm. All the observations were carried out with the accuracy of ± 5% experimental error. The optical band gapcalculated using UV-Vis spectroscopy. The SEM (LEO 435 VP) was used to observe the dispersion in pure and sensitized polymer matrix. When an electron beam strikes the coated thin film sample; X-rays secondary electron are radiated. The images recorded on the computer as well as on camera.[13-15]

RESULTS AND DISCUSSION

The transmittance curves of pure and malachite green sensitized PVK are shown in Figure 1 and 2 respectively and its comparative curves is shown in Figure 3. Transmittance versus wavelength curve for PVK show an increasing trend from 300 nm wavelength and get saturated after 450 nm. However, for malachite green sensitized samples too sharp peaks at around 360 and 500 nm are observed. Figures 4 and 5 shows the plot of $(\alpha h\nu)^{1/2}$ versus hν for PVK and malachite green sensitizedPVK samples. It has been observed that the plot of $(\alpha h\nu)^{1/2}$ v/s hν is linear over a wide range of photon energies indicating a direct type of transition for PVK, however, for malachite green sensitizedsample the plot is not linear indicating some formation of complexes with pure samples . The intercepts (extrapolations) of these plots (straight lines) on the energy axis reflect the energy band gaps. Figure 4 and 5 reveals the value of optical band gap of pure and malachite green sensitized PVK is 4.2 and 4.17 respectively. Therefore, it is clear that band gap is decreasing after incorporate malachite green in PVK matrix. Pure and malachite green doped PVK play dominant role and transform charge transfer complex. This charge transfer complex is widely used in microelectronics applications.

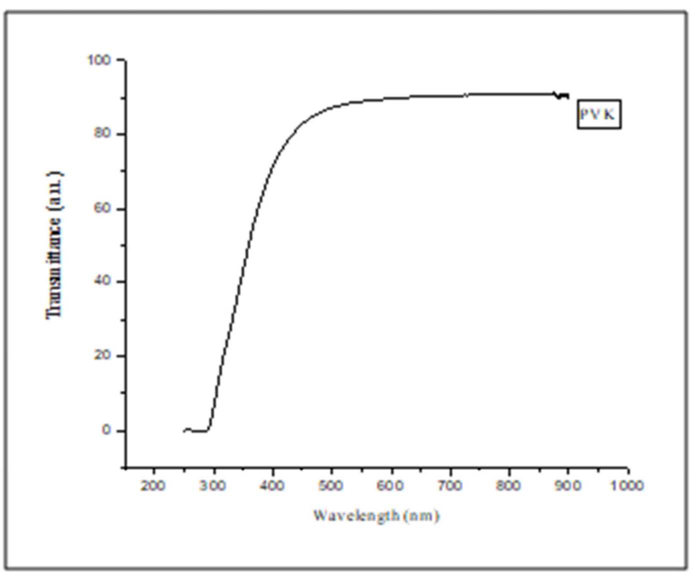

Figure 1
Transmittance versus wavelength curve for PVK sample.

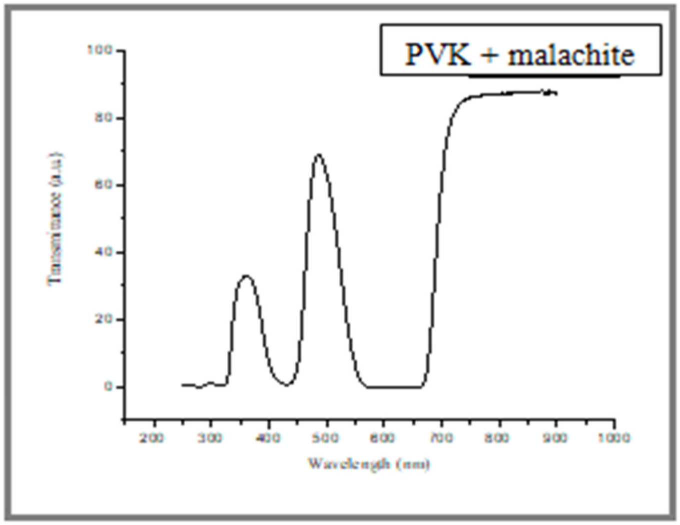

Figure 2
Transmittance versus wavelength curve for malachite green sensitized PVK sample.

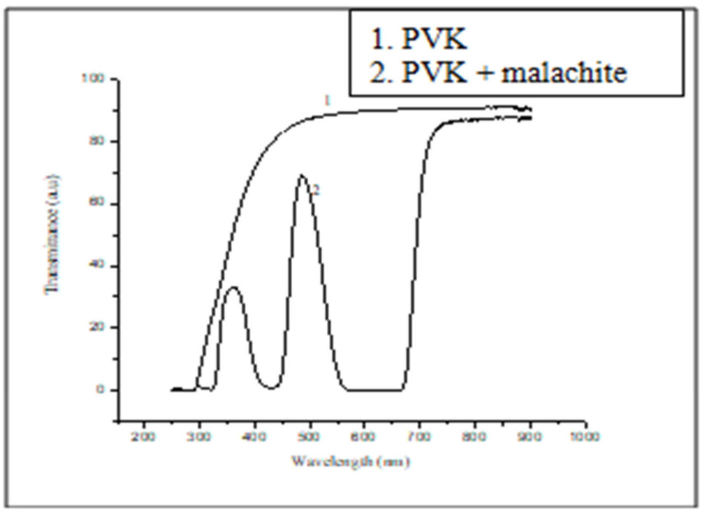

Figure 3
Transmittance versus malachite green sensitized PVK samples.

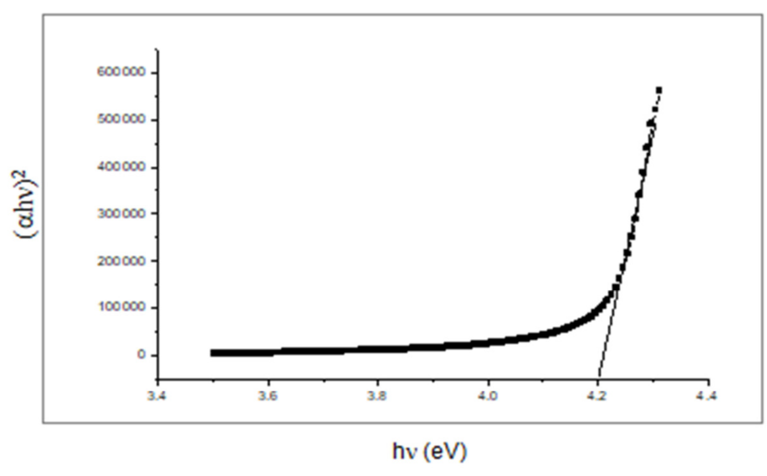

Figure 4
Energy band plot between $(\alpha h\nu)^2$ versus $h\nu$ for PVK sample

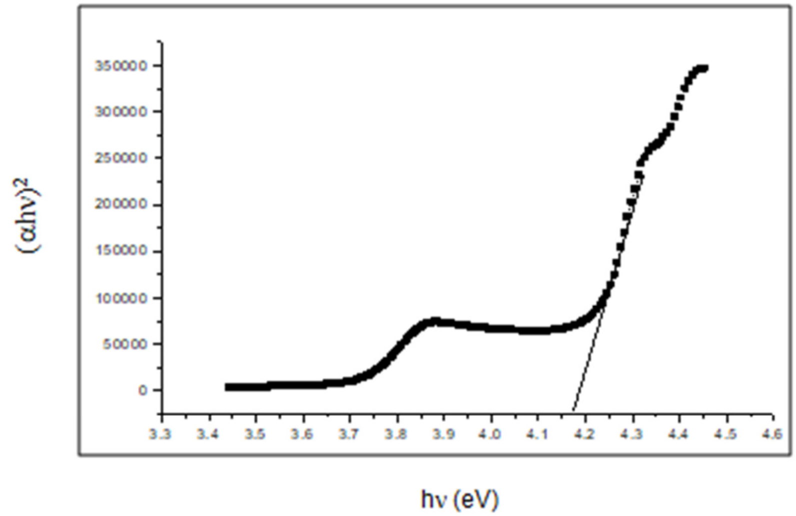

Figure 5
Energy band plot between $(\alpha h\nu)^2$ versus $(h\nu)$ eV for malachite green sensitized PVK sample.

Energy dispersive x-ray (EDX) analysis

The graphical representation of Energy Dispersive X-Ray (EDX) analysis of PVK and malachite green sensitizedsample are shown in Figures 6 and 7 respectively. It is evident from these figures and tables 1and 2 shows that an increases in the percentage of C, N_2 and O_2 and show presence of Cl with malachite green doping.

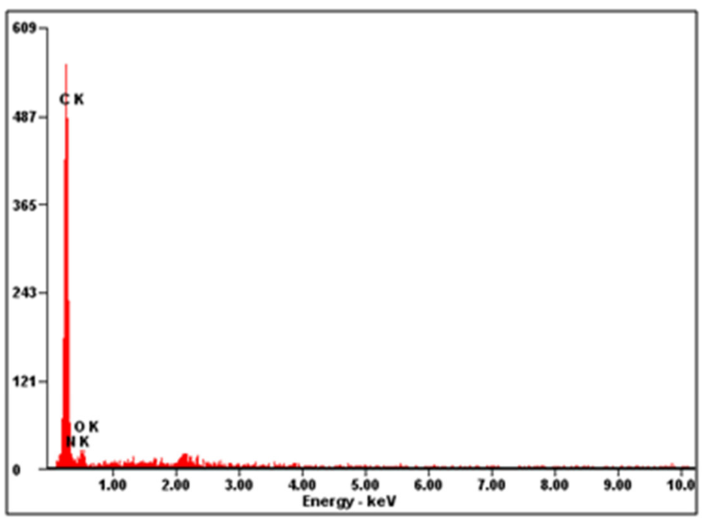

Figure 6
Graphical representation of PVK samples using EDX technique

Table 1
Compositional analysis of PVK sample

Element	Wt%	At%
CK	81.09	84.18
NK	09.73	08.66
OK	09.18	07.15

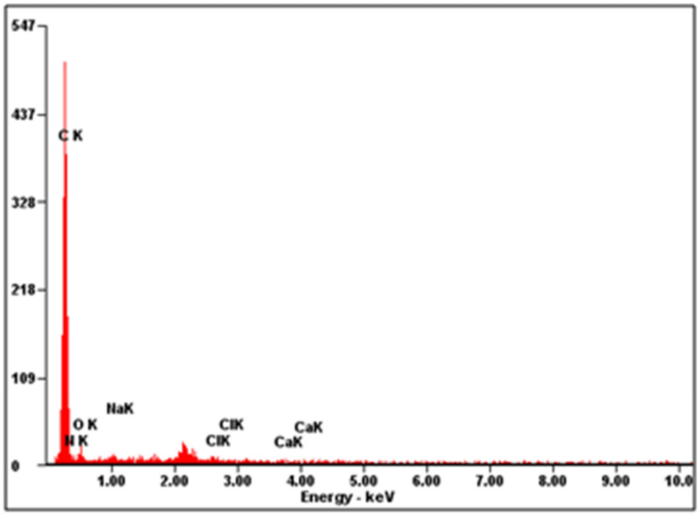

Figure 7
Graphical representation of malachite green sensitized PVK sample using EDX technique.

Table 2
Compositional analysis of malachite green sensitized PVK sample.

Element	Wt%	At%
CK	83.42	87.04
NK	07.42	06.64
OK	07.02	05.50
NaK	00.49	00.27
ClK	01.01	00.36
CaK	00.64	00.20

CONCLUSION

In the above said studies we have concluded that impregnation of malachite green in PVK polymer matrix forms charge transfer complexes.

1. The absorption band in the I.R. spectrum arises from the vibrations of pairs or small groups of atoms in the molecules forms characteristic bands.
2. It has been observed that the plot of $(\alpha h\nu)^{1/2}$ vs. $h\nu$ is linear over a wide range of photon energies indicating a direct type of transition and optical band gap of undoped and doped PVK is 4.2 and 4.1 respectively.
3. EDX analysis confirms the increase in percentage of C, N_2 and O_2, after doping malachite green in PVK.

The charge storage and transport mechanisms in pure and malachite green sensitized polyvinylcarbazole has been investigated in detail. Various information derived from the studies undertaken have been found to be sufficiently important in understanding the manifestation of electret state by this polymer. The broad relaxation behavior exhibited by PVK to resolve the overlapping relaxations. The formation of CTC will result in the reduction of the crystalline amorphous interface and provide conducting paths through the amorphous regions and thus interconnect the crystallites. Due to the reduced barrier at the interfaces the mobility of the dipoles and/or charge carriers will increase.As a result of this CTC forms.

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CONFLICT OF INTEREST

Conflict of interest declared none.

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