Electroluminescence Properties of Pure PVK and Doped TiO_2 Polymer Thin Films

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Abstract

Polymeric thin films of poly (N-vinylcarbazole) (PVK) with titanium oxide (TiO_2) were fabricated by using spin coating technique. The X-ray diffraction (XRD) data revealed the amorphous nature of PVK polymer matrix and increased with increase of TiO_2 concentration. The complexation of the polymer was confirmed by Fourier transform infrared (FTIR) and UV-Visible studies. The Electroluminescence (EL) spectra of the thin films of polyvinylcarbazole (PVK) with titanium oxide (TiO_2) showed an enhancement in the electroluminescence properties with various molar concentration of dopant. Moreover, the TiO_2 based Poly (N-vinylcarbazole) (PVK) exhibited a remarkable variation at higher molar concentration of the EL spectrum as compared to that of the pure polyvinylcarbazole film. The current-voltage characteristics of the various molar concentrations of TiO_2 shows the same trained in comparison with EL.

Keywords: Electroluminescence (EL), Poly (N-vinylcarbazole) (PVK)

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1. Introduction

Poly (N-vinylcarbazole) (PVK) has well known for its photoconducting and Electroluminescence properties. PVK have widely use for electronic display, many electrical & electronic devices and home appliances [1-2]. In the present study PVK modified thin films have been prepared by using spin coating technique. Due to its high tensile strength and good abrasion resistance, PVK is used in double-layer capacitors and electrochemical windows etc [3]. Polymer thin films are formed by incorporating a metal into highly polar polymer complexes. During the last few decades, the utilization of polymer light emitting diode in various applications has led to intensive interest in these materials [4-6]. Aiming to enhance its electroluminescence properties, TiO_2 was doped into PVK host matrix in the present work. TiO_2 was taken as a dopant for a variety of reasons like its low cost, thermal stability and good electrical properties. In this paper an effort has been made to study the effect of addition of Titanium oxide to PVK and study its structural and electroluminescence properties. The results obtained from these measurements are analyzed and reported.

2. Experimental Setup

2.1 Sample preparation

Commercially available Poly (N-vinylcarbazole) (PVK) (Across manufacturing Belgium) material dissolved in chloroform in air ambient and modified with different molar concentration of TiO_2. The nanocomposite blends were use in a spin coating techniqueonto the glass substrates and the samples are further dried in an air ambient for 1 h. The thicknesses of the films were measured to by Michelson interferometer which is found to be around 120 nm. The absorption spectra of the coated films were recorded using a Shimadzu UV–Visible spectrometer. Electrolumenencec characteristics of various samples and photo physical measurements were performed at room temperature in air.

2.2 Analytical techniques

In the present study, Infrared spectra of polymer complexes films were recorded using EO-SXB IR spectrometer with a resolution of 4 cm-1 in the range 400-4000 cm-1 and UV-Visible spectrometer were recorded. The I-V characterization and voltage-EL intensity measurements were carried by a computer controlled.

3. Results and discussion

3.1 UV-Visible Analysis

UV-Visible spectra of bulk films of PVK and TiO_2 exhibits absorption in ultraviolet region with maximum absorption is as shown in figure-1.

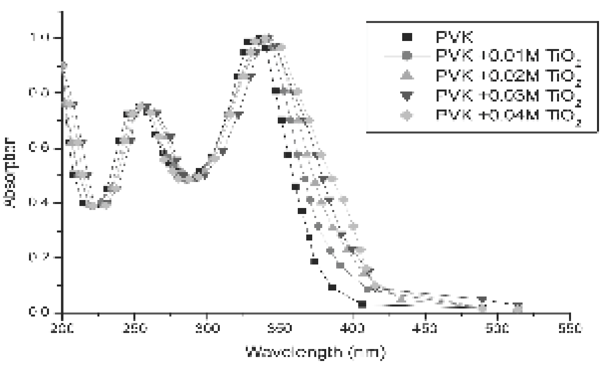

Figure 1: UV-Visible spectra of pure PVK and doped TiO_2 polymer thin films.

The photoconductive polymers have some of the conventional transfers in the UV-visible region, such as σ-σ*, Π-Π*, n-Π* etc. The σ-σ* transition of conjugated double bonds are related to near UV regions around 200 nm, UV-visible spectra of Polyvinyl carbazole (PVK) show two absorption bands at 250 nm and 333nm associated with Π-Π* and n-Π* transition respectively [7-8]. These two bands are shifted towards the higher wavelength as the doping molar concentration of TiO_2 is increases.

3.2 FTIR

FTIR characterization of pure PVK and doped TiO2 thin films has observed by using Spin coating technique.

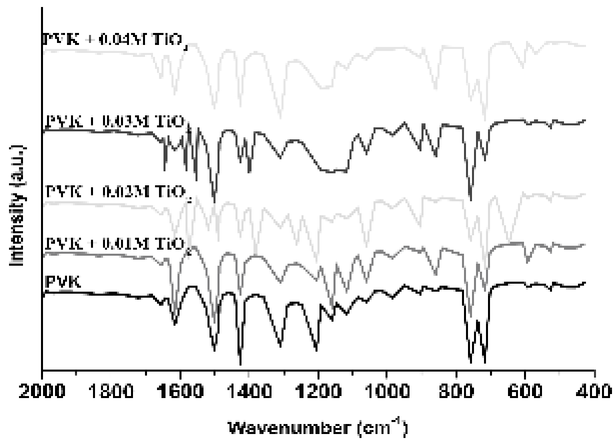

Figure 3: FTIR Spectra of pure PVK and doped TiO_2 thin films

3.3. XRD analysis

The XRD profiles of pure polyvinylcarbazole (PVK) and doped TiO_2 with deferent molar concentration are shown in Figure-4, pure polyvinylcarbazole shows characteristics broad peak for an orthorhombic lattice centered at 250 including with semicrystaline nature [12] with addition of Titanium oxide , intensity of this peak decreases suggesting the decrease in degree of crystallinity of the complex [13].This would due to the disruption of the PVK crystalline structure by TiO_2 as suggested by Hodge et al [14].They are compared with JCPDS88-1175, JCPDS 84-1286 and observed that the intensity of XRD pattern decreases as the amorphous nature increases with addition of dopent this amorphous nature result in greater ion diffusivity with high ionic conductivity, which can be expressed amorphous polymers having flexible back bone [15-18].

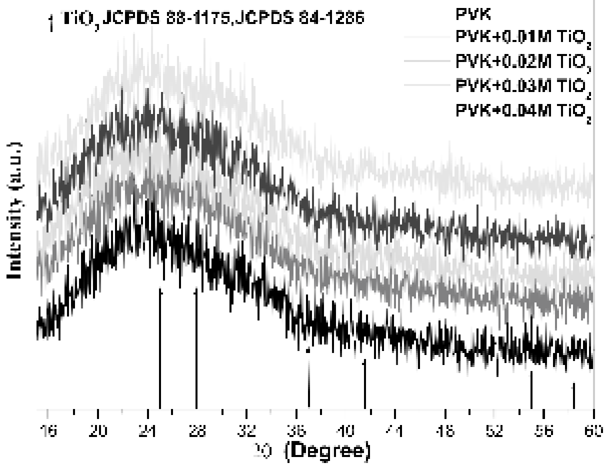

Figure 4: XRD patterns of pure PVK and TiO_2 doped PVK polymer thin films.

4. Electroluminescence Properties

4.1 Voltage-EL intensity

In spin coating technique the relationship between voltage-EL intensity of pure PVK and doped TiO_2 thin films has observed. Figure shows the relationship between voltage Vs. EL intensity. The turn on voltages are in the 5-9 volt range and the highest emission intensity was observed for the 0.04M TiO_2 sample as found for the film electroluminescence, peak at 644 nm, with the brightness of 66 cd m^{-2} at 7.7 volt .

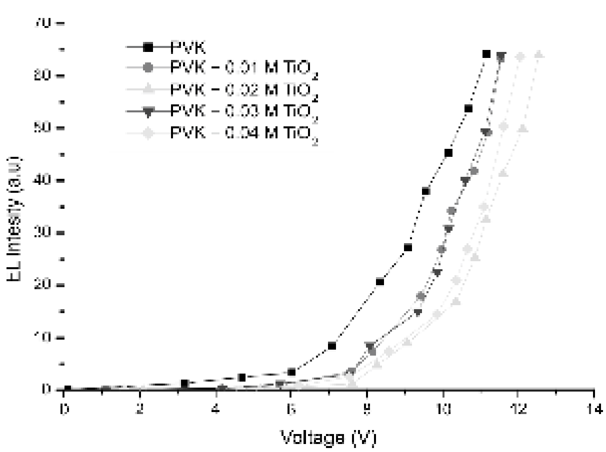

Figure 6: Voltage-EL Intensity characteristic of pure PVK and doped TiO_2 polymer thin films.

5. Conclusions

Formation of polymer thin films PVK with different molar concentration TiO_2 is confirmed by XRD UV-Visible and FTIR studies. Result show that PVK polymer thin films materials emits strong red luminescence when excited by UV-Visible light. The Voltage-EL intensity is found to increase with increasing dopant concentration. The dopent PVK materials has higher sensitizes luminescent efficiency and longer life time than pure PVK.

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