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Synthesis and Electroluminescence Studies of CdSe Nanocrystals Embedded in PVK Matrix

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***Abstract*—** There is currently a great interest in semiconductor nanoparticles which are organically capped or embedded in polymeric matrices for their ready to use application in devices. These materials show excellent optical and mechanical behaviour at Nano scale. Nano crystalline powder and nanocomposites of II-VI compounds with different doping are being prepared by various routes. Poly-vinylcarbozole (PVK) is a hole transport organic semiconducting polymer. It has been widely used as an organic and optical material. Combination of polymer and semiconductor nanocrystals allows the fabrication of flexible and light weight EL devices. Electroluminescence of the films was studied at different voltage and frequency by placing the films between ITO coated conducting glass plate and aluminium electrodes. It is found that a turn on voltage is required for light emission and brightness increases exponentially with voltage. Turn on voltage is found to decrease as CdSe concentration is increased.

***Keywords*—** CdSe/PVK nanocomposites and Electroluminescence (EL).

I. INTRODUCTION

Now a days a vast amount of publications are devoted to the development and investigation of luminescent nanomaterial's in the form of nanoparticles, nanocomposites, nanorods, nanowires, nanotubes, as well as bulk nanocrystals are of interest not only for basic research, but also for various interesting applications [1-3] such as solar cells, light emitting diodes and photonic switches [4-7]. CdSe is a direct band semiconductor with band gap 1.74 eV [2]. Polymers are used as a host matrix because of its easy processing, solubility and stability. Thin films of CdSe poly - vinylcarbozole (PVK) matrix have been prepared using a sample, low cost chemical method varying CdSe concentration.

The aim of the present study is to obtain and investigate the Electroluminescence characteristics of nanocomposites film based on polyvinylcarbazole (PVK).CdSe semiconductor nanocrystals depending on the concentration of CdSe in the polymeric matrix which seems to be rather promising for their further applications in light emitting devices.

II. RELATED WORK

In Semiconductor nanocrystals and environment friendly polymers like PVA, PVK, PMMA, PVDF and PSF have attracted much attention for many potential applications due to their unique physical and chemical properties. Among these different polymers, poly (vinyl alcohol) (PVA) attracted the great attention of researchers due to its optical characteristics, physical properties, film forming and biocompatibility. I have done research on CdSe/PVA nanocomposites.

III. METHODOLOGY

Chemicals: The following chemicals, sodium borohydride ($NaBH_4$), selenium powder (Se) and Cadmium chloride ($CdCl_2$) was purchased from Merck Specialties' private limited and Ammonia (NH_3) was obtained from Merck. Polyvinylcarbazole was studied as the polymeric matrix, purchased from Aldrich and used without prepurification.

Selenium Source: Selenium source was prepared by adding 0.05 mmol of selenium powder to 20 ml distilled water in two necked flask then 0.10 mmol of sodium borohydride was carefully added to this mixture, and the flask was immediately purged with nitrogen gas. Cadmium Source: Weighing of $CdCl_2$ was done for obtaining 0.05 mmol solutions in 20 ml distilled water.

CdSe/PVK nanocomposites thin films have been prepared with the help of above prepared Selenium source and Cadmium Source. The PVK solution was prepared by dissolving 400mg of PVK in 10 ml of DMF (Di-

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methylformamide) under constant stirring at 60°c temperature. The prepared solution of PVK in beaker was kept magnetic stirrer at 60% temperature and 1ml $CdCl_2$ solution was carefully added to the solution and stirred for 10 minute at 60^0 C. The pH of the solution was adjusted between 9-10 using ammonia solutions. After that 1 ml of selenium solution was added drop wise in this solution stirred and then it was cast on glass substrate [8].The three different samples with different concentration of CdSe in PVK matrix are shown in table 1.

CHARACTERIZATION- for Electroluminescence (EL) studies, the nanocomposites film was deposited on ITO coated conducting glass plate and an aluminum foil was attached over it. The EL brightness was measured with the help of photomultiplier tube (PMT) connected to a picoammeter. Effect of voltage and frequency on the EL brightness was investigated. The EL spectra were obtained by grating monochromator.

IV. RESULTS AND DISCUSSION

ELECTROLUMINESCENCE

Voltage –Brightness characteristic -

In Voltage –Brightness characteristics, there is a specific voltage at which sample starts to show the EL emission that means give response in form of light, is known as threshold voltage of EL emission. Voltage – brightness curves for CdSe/PVK are shown in figure 6 at frequency 1000 Hz. When the applied input voltage increases across the EL cell, the light emission start at threshold voltage and increases rapidly.

Current-Voltage characteristics-

The current voltage characteristics of CdSe/PVK nanocomposites show a linear relation between current and voltage. This relation indicates the ohmic nature. Jiang et.al. have also reported that for CdS/PVK nanocomposites. The linear relation between current and voltage. Figure 2 shows Voltage–Current Characteristics for CdSe/PVK nanocomposites.

V. CONCLUSION AND FUTURE SCOPE

CdSe nanoparticles dispersed in PVK matrix have been synthesized in thin film form by wet chemical technique. The size of particles changed by varying the concentration of CdSe.EL brightness depends on applied voltage and frequency. Voltage – Brightness curve shows that at particular frequency emission starts at threshold voltage, first it increases slowly and then increases rapidly with increasing voltage. EL brightness increases with increasing with increasing the concentration of CdSe in PVK matrix. Voltage-Current curve shows that on increasing the voltage, current increasing continuously and linear relation is found between them, as we increase the concentration of CdSe.

Figures and Tables

Table 1. Experimental Detail to Prepare CdSe/PVK Nanocomposites

Sample name	Amount of PVK	DMF (Di-methylformamide)	Concentration of CdSe solution
CdSe/PVK I	400 mg	10 ml	2ml (0.05 mmol)
CdSe/PVK II	400 mg	10 ml	4 ml (0.05 mmol)
CdSe/PVK III	400 mg	10 ml	6 ml (0.05 mmol)

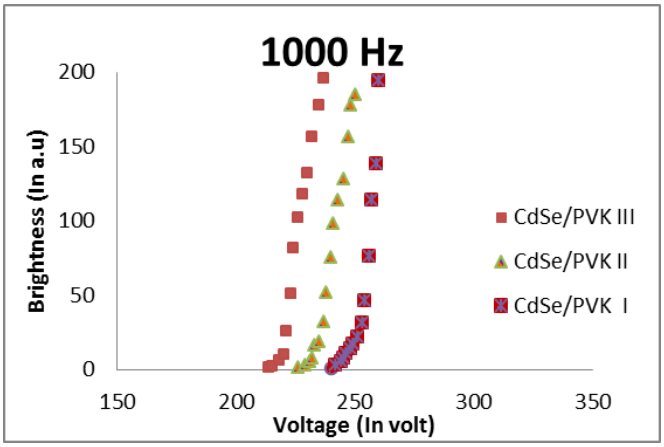

Figure1 Voltage- Brightness Characteristics of CdSe/PVK nanocomposites at 1000 Hz frequency.

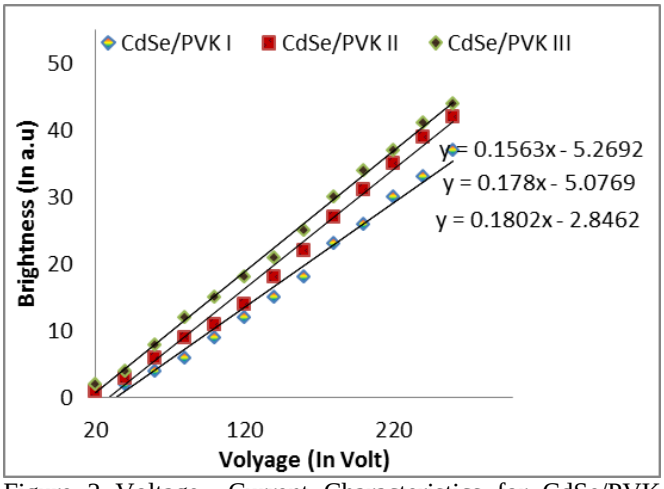

Figure 2 Voltage –Current Characteristics for CdSe/PVK nanocomposites.

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