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Fabrication and Characterization of Organic Electroluminescent Devices Introducing New Blue Emitting Materials

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Various organic electroluminescent devices were fabricated using distyryl biphenyl arylene derivatives (DBA). To improve thermal stability of devices and quantum efficiency, poly(N-vinylcarbazole) (PVK) and poly(4,4′-oxydiphenylene pyromellitimide) (PMDA-ODA PI) were introduced onto the emitting layer by the spin coating method. The device performance was discussed.

Keywords: organic electroluminescent device; thermal stability; quantum efficiency; spin coating; Distyryl biphenyl arylene; PVK; PMDA-ODA PI

INTRODUCTION

Over the past few years, organic electroluminescent devices(OELDs) (or light-emitting diodes) have attracted much attention because of their high luminance, low driving voltage, and a variety of emission color. In these devices, the electric energy is transformed into light through the

excitation of the organic materials [1]. And, extensive researches on OELDs have opened a way to their practical use as a flat panel display (FPD) [2].

In the present study, to improve luminance efficiency and thermal stability, we blended poly(N-vinylcarbazole) (PVK) and poly(4,4'-oxydiphenylene pyromellitimide) (PMDA-ODA PI) with DBA, a blue emitting material. We investigated the electric charateristics of the organic emitting material and designed proper device structures.

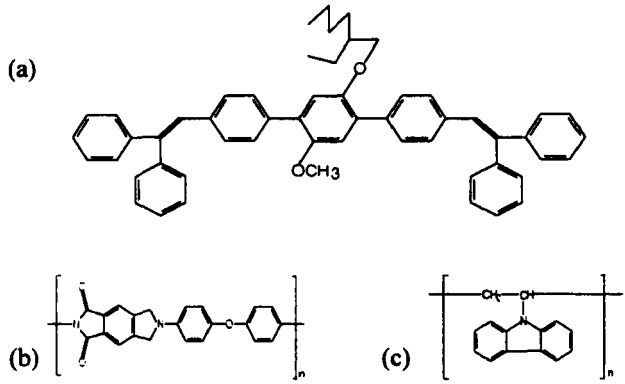

FIGURE 1. (a) Distyryl biphenyl arylene derivative (DBA). (b) Poly(4,4'-oxydiphenylene pyromellitimide) (PMDA-ODA PI). (c) Poly(N-vinylcarbazole) (PVK).

EXPERIMENTAL

We fabricated ITO/DBA-dispersed PI/Al structured devices. The fully aromatic polyimide, poly(4,4'-oxydiphenylene pyromellitimide) (PMDA-ODA PI), was used as a matrix for binding distyryl biphenyl arylene derivatives (DBA) [3,4].

Insoluble PMDA-ODA PI was converted through imidization process from its soluble precursor, poly(4,4'-oxydiphenylene pyromellitamic acid) (PMDA-ODA PAA). N-Methyl-2-Pyrrolidone (NMP) solution containing PMDA-ODA PI and DBA was prepared. The weight ratio of DBA to PMAD-ODA PAA and overall solid concentration was 50/50 and 4wt.%, respectively. The solution was

coated onto an ITO patterned glass substrate via spin-coating method at 3,000rpm for 2 minutes. Metal cathode, Al was vacuum deposited under 2.5×10^{-5} torr.

The photoluminescence(PL) and electroluminescence(EL) of the film was measured by high-sensitive fiber optic spectrometer(S2000, Ocean Optic.Inc.) with 2048-element linear CCD-array silicon detector.

RESULTS AND DISCUSSION

Figure 2 shows the photoluminescent(PL) spectra of DBA solid, PVK film, DBA dispersed PVK film and DBA dispersed PMDA-ODA PI.

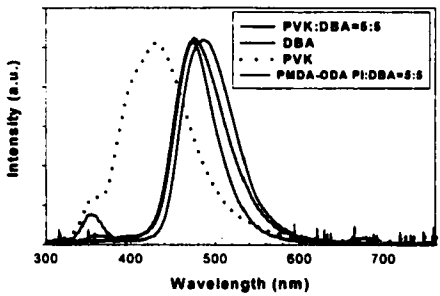

FIGURE 2. Photoluminescent spectra of DBA related materials.

As shown in Figure 2, DBA solid and PVK film exhibit strong PL peaks at ca. 470nm and ca. 430nm, respectively. In DBA dispersed PVK, the emission peak from PVK was not observed. That is, only emission from DBA was observed, and the excitons generated in the PVK were effectively transferred into the DBA, resulting in the emission peak in the DBA region [5]. The red-shifts ocurred in DBA dispersed PMDA-ODA PI and DBA dispersed PVK as compared to that of DBA.

The dependence of the current density and EL intensity on the applied voltage of the device, having DBA dispersed PMDA-ODA PI layer, is shown in Figure 3. The shape of charge injection shows typical device characteristics, meaning the rectification and recombination of

holes and electrons injected from anode and cathode, respectively.

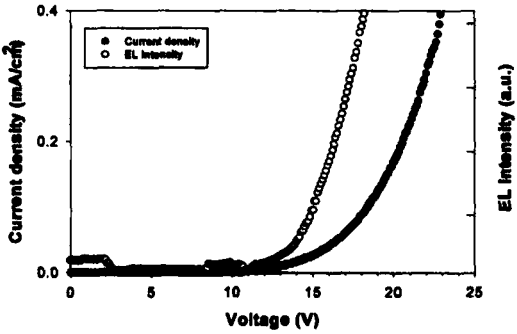

FIGURE 3. I-V-L curve of the device having DBA dispersed PMDA-ODA PI structure.

The initiation of charge injection was at ca. 10V and the turn-on voltage was ca. 11V. It can be considered that the difference between charge injection and turn-on voltage is due to a non-radiative process, an unreliable exciton generation process, a mismatch of energy band in the device structure, and so forth.

Acknowledgments

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