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Electroluminescence of Organic EL Device using PDPMA Doped by Various Fluorescent Dyes

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Organic electroluminescent (EL) devices with color tunable function using poly[*N*-(*p*-diphenylamine)phenylmethacrylamide], PDPMA doped by various fluorescent dyes (nile red, DCM, TPP) as a polymer hole transporting material and Alq_3 as a host emitting material were fabricated. The fluorescent dyes used as guest emitting materials. The luminescence of the doped devices was significantly influenced by the amount and the structure of the fluorescent dyes. Especially, the DCM doped device emitted red light with the brightness of 1500 cd/m^2.

Keywords PDPMA; fluorescent dyes; guest emitting materials; luminescence; red light

INTRODUCTION

Considerable efforts have been made to study novel organic electroluminescent (EL) devices through various approaches during the last few years [1]. Recently, it has been reported that the EL devices of host-guest type using a dye doped emitting material have high EL

efficiency [2]. However, the EL device of host-guest type has some significant problems such as low stability and short operation life time, because fluorescent dye molecule is very sensitive to light, heat, humidity and oxygen.

In this study, we fabricated organic EL devices consisting of ITO/dye doped PDPMA/Alq_3/Al whose the stability is superior than that of EL device using dye doped Alq_3. Especially, we will study the important parameters in choosing a good dye dopant for a given EL device structure.

MATERIALS AND EXPERIMENTAL

PDPMA film was spin-cast from a monochlorobenzene solution containing PDPMA and dye dopant onto the ITO coated glass. The speed of spin casting was about 2000 rpm. Alq_3 and Al were deposited by a ULVAC VPC-200F evaporator at a pressure below $1\square10^{-5}$ Torr. EL spectra were obtained from the measurements of an Acton 300i spectrofluorometer. Luminance was measured with a Minolta LS 100 portable luminance meter. Current-voltage characteristics were measured using a programmable Kiethley 236 electrometer.

RESULTS AND DISCUSSION

Figure 1 showed the changes in EL spectra of devices doped with various dye molecules. For the DCM doped device, the maximum emission intensity appeared at 3 wt% which compares to nile red or TPP.

I-V characteristics of the doped EL devices were shown in Figure 2. As the concentration of dye dopant increases, turn-on voltage increases, indicating that the dye molecule behaves as a hole-blocking material. However, the optimally doped EL device for EL efficiency had low turn-on voltage. As shown in Figure 2, DCM doped EL device exhibited high luminous efficiency because of the increase in recombination sites and the high quantum efficiency of DCM molecule. As a consequence, it can be concluded that among the dye dopants used here, DCM molecule is the most preferable for emission color and EL perfomance.

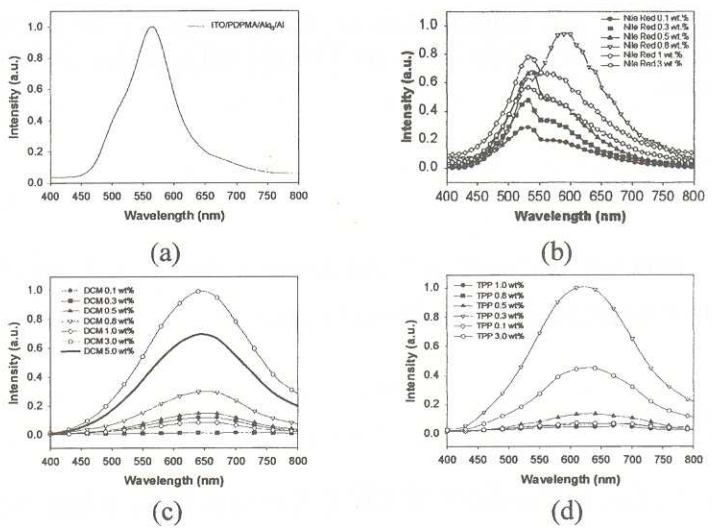

FIGURE 1 The EL spectra of ITO/dye doped PDPMA/Alq_3/Al : (a) undoped, (b) nile red, (c) DCM and (d) TPP.

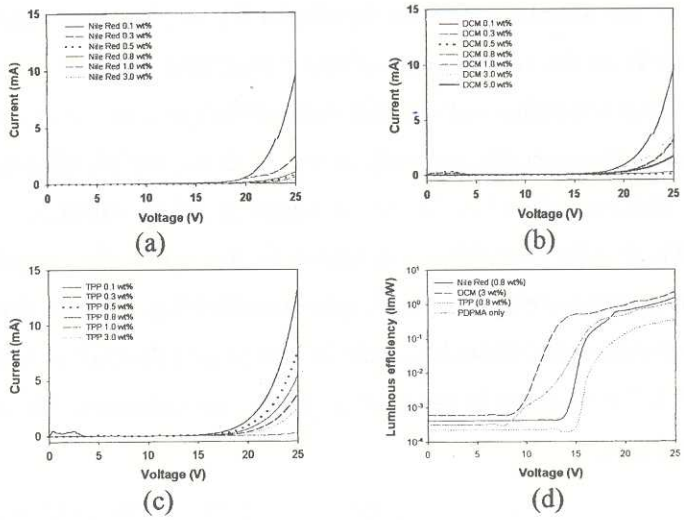

FIGURE 2 I-V characteristics of ITO/dye doped PDPMA/Alq_3/Al device : (a) nile red, (b) DCM, (c) TPP and (d) luminous efficiency of devices.

Acknowledgments

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