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Organic electroluminescent (EL) device was fabricated with copper phthalocyanine(CuPC), poly[N-(p-diphenyl amine) phenyl methacrylamide], PDPMA, LB film and rubrene doped Alq_3 as hole injection layer, polymer hole transport material and emitting material, respectively. A stable condensed PDPMA monolayer was obtained using arachidic acid (AA) as a surface active material. The ITO/CuPC/PDPMA LB film/rubrene doped Alq_3/Al device emitted green light with high brightness of 2400 cd/m^2 at a DC 15 V. The effects of a hole injection layer or rubrene dopant on EL performance were investigated.

Keywords: organic EL device; PDPMA LB film; hole injection layer; rubrene dopant; EL performance

INTRODUCTION

Considerable efforts have been made to incorporate and study novel organic electroluminescent(EL) device through various approaches during the last few years. Recently, it has been reported that the EL device of host-guest type using a dye-doped emitting material has high efficiency and durability. Moreover, the use of Langmuir-Blodgett(LB) technique in light emitting diode has been considered to have crucial effects on EL performance [1].

In the previous work, we fabricated an organic EL device using PDPMA LB film as a polymer hole transport material and discussed the effects of thickness control and molecular orientation of the PDPMA

LB film on EL characteristics [2, 3]. In this paper, the characteristics and performance of organic EL device consisted of ITO/CuPC/PDPMA LB film/rubrene doped Alq_3/Al have been investigated.

MATERIALS AND EXPERIMENTAL

Preparation of PDPMA-AA LB film was carried out with a circular LB trough(NIMA 2000). Special grade chloroform was used without purification and distilled water was purified by Milli-Q ultra water system prior to use. Monolayer was spread from a 200 ml chloroform solution of PDPMA 0.091 g(0.7 mmol) and AA 0.037 g(0.3 mmol) onto the ultra pure water. The multilayers were built up by the vertical dipping method at 20 mN/m and 18 °C. A layer of CuPC was deposited on ITO glass at a pressure below 1×10^{-5} Torr and PDPMA multilayers were formed by the Langmuir-Blodgett technique. Rubrene doped Alq_3 was deposited onto the LB film by coevaporation. Aluminum was used as a cathode material. The photoluminescence and EL properties of the organic multilayered devices were studied through the measurements of spectrofluorometer. Luminance was measured with a Minolta LS 100 portable luminance meter. I-V characteristics were measured using a programmable Kiethley 236 electrometer. The thickness of LB film was obtained by a PLASMOS 2100 ellipsometer.

RESULTS AND DISCUSSION

The PDPMA-AA composite is able to form a stable, condensed monolayer. The intensity in the maxium absorbance of UV-Visible

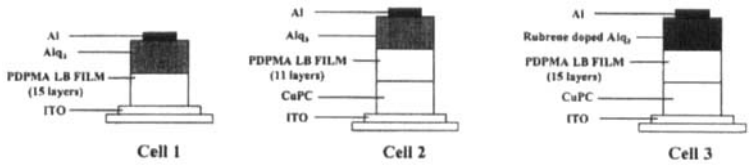

FIGURE 1 EL cell configurations

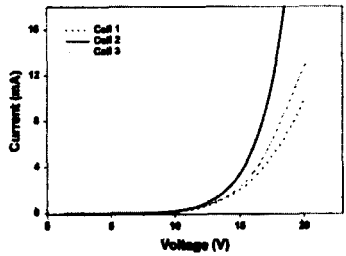

FIGURE 2 I-V characteristics of EL cells

and the thickness of PDPMA multilayers linearly increased with increasing number of layers, indicating that the PDPMA LB film was well-deposited with high stroke numbers. Figure 1 showed the configurations of organic EL devices fabricated in the present study. The I-V characteristics of the cells were shown in Figure 2. The introduction of hole injection layer such as a CuPC in cell 2 resulted in the decrease of drive voltage due to the improvement of hole transfer from ITO to PDPMA LB film. A significant change in the drive voltage was not observed in cell 3. The EL and PL spectra of cells 3 with different doping ratios were shown in Figure 3. As the concentration of rubrene molecules increases, the fluorescence intensity first increases rapidly, and then decreases.

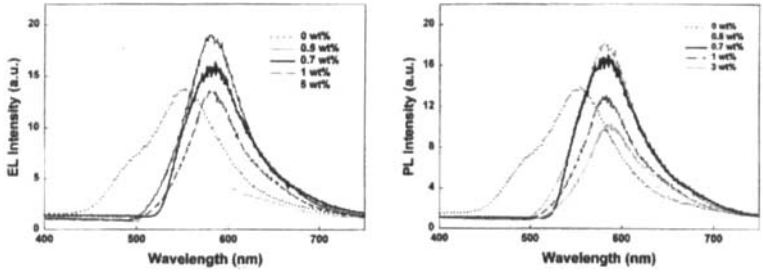

FIGURE 3 The PL and EL spectra of devices with different doping ratios

The fluorescence peaks of cells 3 shifted to the longer wavelength. This

shift is perhaps attributable to the excimer fluorescence of rubrene

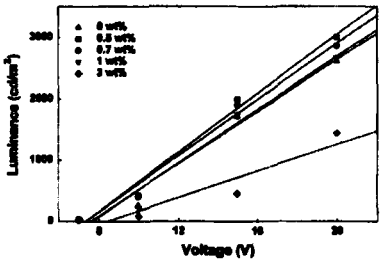

FIGURE 4 The Luminance-voltage characteristics of devices with different doping ratios

dopant. The EL spectra of cells 3 were essentially identical to the PL spectra. Figure 4 showed the luminance-applied voltage characteristics for the cells. It can be seen that 0.5 wt% rubrene doped cell was about a factor of 1.3 times more efficient than the undoped cell. It should come from the energy transfer from Alq_3 to rubrene molecules with high fluorescence efficiency.

ACKNOWLEDGMENTS

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