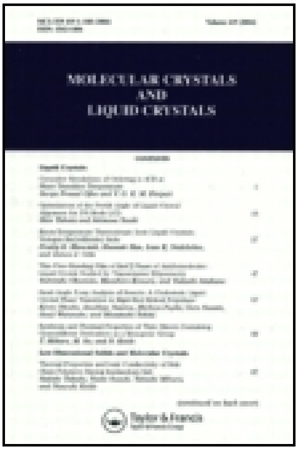

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Organic Electroluminescent Devices Using a Polymer Hole Transport Material

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Organic Electroluminescent Devices Using a Polymer Hole Transport Material

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Poly[N-(*p*-diphenylamine)phenyl methacrylamide] (PDPMA) was prepared for a polymer hole transport material in the multilayered organic electroluminescent (EL) device. 2-(4′-tert-butylphenyl)-5-(4″-biphenyl)-1,3,4-oxadiazole (PBD) and 1,1,4,4,-tetraphenyl-1,3-butadiene (TPB) were used as an emitting layer and an electron transport layer, respectively. PDPMA showed better thermal and electrochemical properties than poly(*N*-vinylcarbazole) (PVK), or low molecular weight material, triphenylamine (TPA). MgAg/PBD/TPB/PDPMA/ITO device emitted blue light with high brightness (350 cd/m^2) at a drive voltage of 8 V. The stability and luminescent properties were improved by PDPMA than PVK or TPA.

Keyword: multilayered organic EL device, polymer hole transport material

INTRODUCTION

Recently, EL devices based on thin organic materials have attracted much attention for their possible application to large area flat displays[1]. They resulted in significant decrease in driving voltage to a value of few volts as well as a variety of emission colors. The high performances may be partly due to the additional organic layers, called electron transport layer (ETL) and hole transport layer (HTL)[2]. The HTL enhances the injection of hole from electrode to emitting layer and its properties play crucial roles on the performances of EL devices. Triphenylamine (TPA) or its derivatives are most common HTL materials at present.

However, low molecular weight HTL has several problems such as low stability and degradation of thermal/mechanical property over long cycle life. We, therefore, synthesized a new polymer hole transport material to increase stability, lower driving voltage and improve emitting efficiency.

In this study we reported EL properties and current-bias voltage (I-V) characteristics of the multilayered device, MgAg/PBD/TPB/PDPMA/ITO, and the results were compared with the case using poly(*N*-vinylcarbazole) (PVK) or TPA.

EXPERIMENTAL

Poly[N-(*p*-diphenylamine)phenyl methacrylamide] (PDPMA) was prepared by radical polymerization of its monomer prepared by catalytic reaction of 1-fluoro-4-nitrobenzene with diphenyl amine. The thermal properties of PDPMA was measured by thermogravimmetric analyzer (TGA, Dupont System 9000)

HTL was dissolved in monochlorobenzene and spin-coated on indium tin oxide (ITO) glass (20 Ω). 1,1,4,4,-tetraphenyl-1,3-butadiene (TPB) and 2-(4′-tert-butyl phenyl)-5-(4″-biphenyl)-1,3,4-oxadiazole (PBD) were successively vacuum deposited on to HTL at 10^{-6} torr. The thickness of TPB and PBD is 1100 and 500 Å, respectively. Finally, magnesium/silver (Mg:Ag = 10:1) alloy was codeposited on the organic layer with a diameter of 0.5 cm.

UV/VIS spectrophotometer (JASCO V550) and spectrofluorometer (Acton Co.) was used to investigate the photoluminescent (PL) and EL spectrum. I-V curves were monitored by Keithley SMU model 236. The brightness was measured by luminance meter (Minolta LS 100).

RESULTS AND DISCUSSION

The synthesis of PDPMA was confirmed by FTIR spectra, which indicated that the peak at 1620 cm^{-1} due to vinyl group in monomer disappeared after polymerization. Fig. 1 compares TGA thermograms of TPA and PDPMA. TPA starts to thermally degrade at 194.5 ℃ while PDPMA was stable up to 300 ℃ and PDPMA was expected to show high durability and stability during EL device operation over long cycle life.

Fig. 2 shows EL spectra of TPB/PDPMA and TPB/PVK bilayers. The PL peak of TPB at 432 nm shifts to longer wavelength (red-shift), 448 and 470 nm, respectively. The red shift may be due to formation of exciplexes between emitter layer and HTL or trapping of exciting energy on excimer [3]. Thus, the holes injected from ITO are easy to transport in PDPMA than PVK and PDPMA is preferred for blue emission.

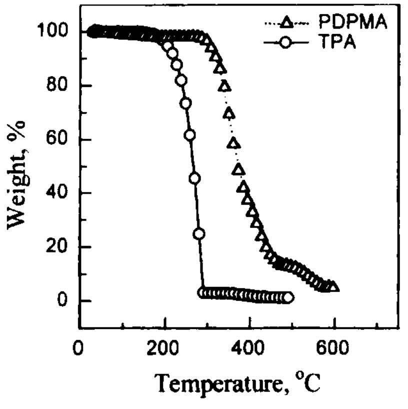

FIGURE 1 TGA themorgams of HTLs.

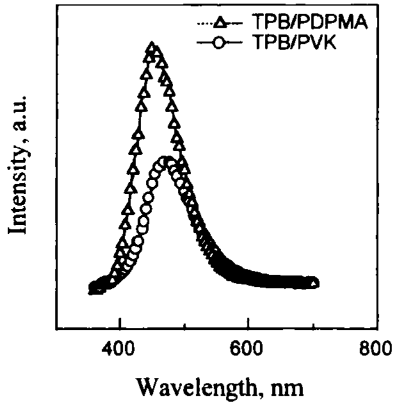

FIGURE 2 EL spectra of TPB/HTL bilayers.

Fig. 3 shows EL spectra of PBD/TPB/TPA and PBD/TPB/PDPMA. Both devices show blue emission at 448 nm with high brightness (~350 cd/m^2) at a drive voltage of 8 V (Fig. 4).

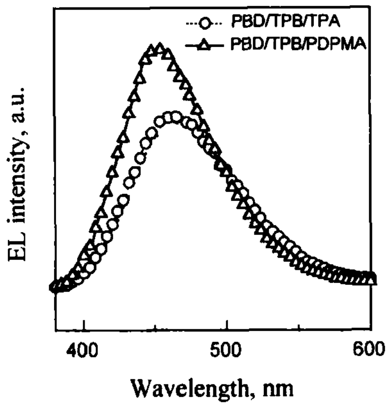

FIGURE 3 EL spectra of multilayer organic EL devices.

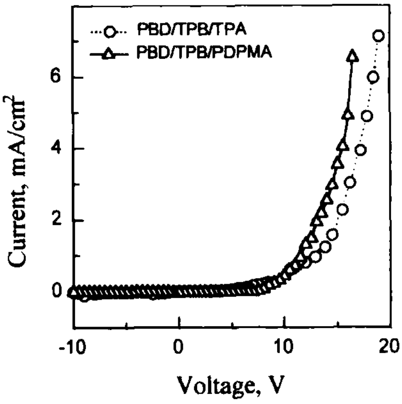

FIGURE 4 I-V curves of multilayer organic EL devices.

Acknowledgment

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