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Blue EL Devices with Arylethynylbenzene Derivatives as Emissive Materials

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New arylethylbenzene derivatives were prepared as emissive material for organic electroluminescent (EL) device. In the EL device using an arylethynylbenzene with naphthyl group, intense blue emission was successfully observed; emission was peaking at 450 nm, and maximum luminance was 788 cdm^{-2} at a current density of 3.05 Acm^{-2}.

Keywords: electroluminescence; blue emission; arylethynylbenzene

INTRODUCTION

Family of arylethynylbenezenes (AEBs) is one of efficient emissive materials. In addition, their emission color and electric properties are tunable by substitution of aryl or arylethynyl group. These attractive properties motivate us to employ AEBs as emissive material for organic light emitting device (LED). In this work, we newly prepared two AEB with intense blue photoluminescence (PL), and evaluated electroluminescence (EL) performance of LEDs using the AEBs as emissive material.

EXPERIMENTAL

Figure 1 shows molecular structures of blue-luminescent AEBs newly prepared in this study, 2C6FluEB and NEB. The AEBs were prepared by a modified method of cross-coupling reaction between arylbromide and acethylene[1]. The method were developed When 2C6FluEB was employed as emissive materials, we fabricated an EL device combined with an electron-transporting layer of oxadiazole derivative OXD7 (Fig.2 device A). Because 2C6FluEB possesses high value of ionization potential (5.88eV), copper phthalocyanine was vacuum-deposited as hole injection layer on ITO coated glass substrates. 2C6FluEB film (thickness = 40 nm) was prepared by spin-coating form the dichloromethane solution.

Because of polycrystalline film-formation, NED was not suit for emissive layer material. Accordingly, NED was employed as emissive dopant in EL device (Fig.2 device B). Emissive layer of NEB-doped CBP layer (conc.=1wt% and thickness 20 nm) was prepared by simultaneous vacuum-deposition of NEB and CBP.

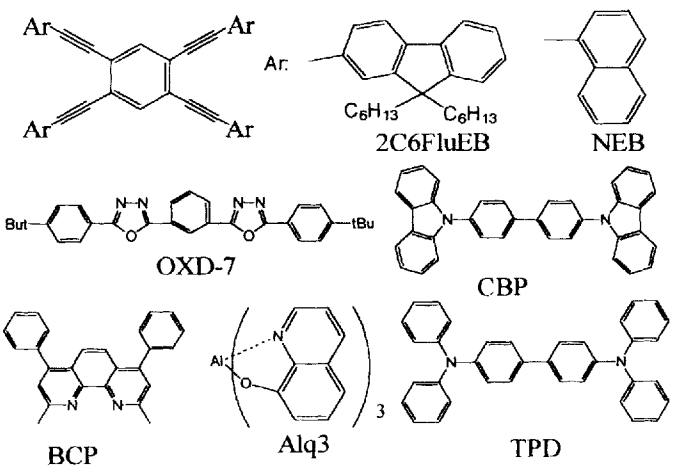

FIGURE 1 Molecular structures of AEBs and organic dyes employed in this study.

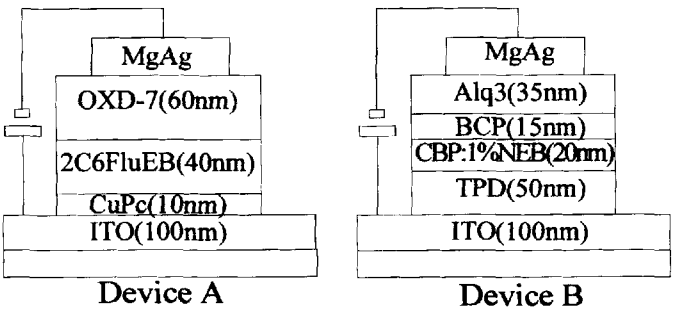

FIGURE 2. EL devices with AEBs as emissive materials

RESULT AND DISCUSSIONS

Figure 3 shows EL spectrum of device A. EL was peaking at 450 nm and 490 nm. EL spectrum was basically agreed with the PL spectra of 2C6FlueEB spin-coated film. However, appearance of EL peak at 490 nm, which does not correspond to PL spectrum of 2C6FlueEB spin-coated film, may demonstrate that a part of 2C6FlueEB molecules form exciplex with OXD7 molecules.

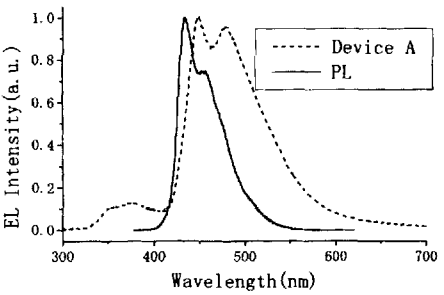

FIGURE.3 EL spectrum of device A.

Device A using 2C6FlueEB did not exhibit bright blue emission. Maximum luminance and external quantum efficiency of the device were 35.7cdm^{-2} at 125mAcm^{-2} and 0.036% at 12.8cdm^{-2}, respectively. The low values of luminance and efficiency may be due to formation of the exciplex between 2C6FlueEB and OXD7.

Figure 4 shows EL spectrum of a device with NEB as emissive dopant (device B). The device exhibits EL corresponding well to PL

from NEB doped in poly(vinylcarbazole), demonstrating that the emission originates from NEB molecules doped in CBP layer.

Figure 5 shows Luminance-current density characteristics of device B. Device B exhibited bright blue EL. Maximum luminance was 788 cdm^{-2} at 3050 $mAcm^{-2}$. However, external quantum efficiency was very low (maximum value of 0.14% at 0.93 $mAcm^{2}$).

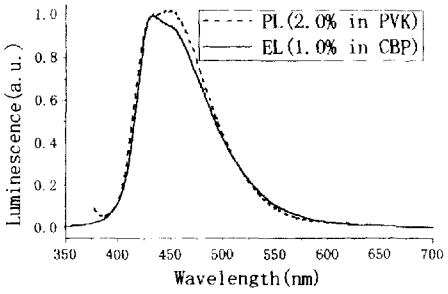

FIGURE 4. EL spectrum of device B.

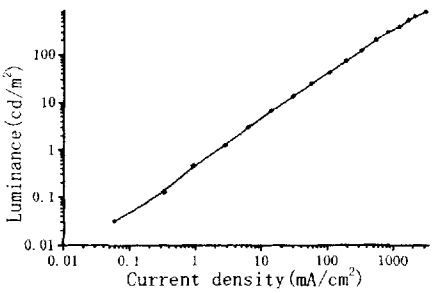

FIGURE 5. Luminance-current density characteristic of device B

CONCLUSION

Two arylethynylbenzene derivatives with strong blue photoluminescence, 2C6FluEB and NEB, were newly prepared. In the EL device using NEB as emissive dopant, intense blue emission was successfully observed; emission was peaking at 450 nm, and maximum luminance was 788 cdm^{-2} at a current density of 3.05 Acm^{-2}.

Reference

[1] T. X. Neean, G. M. Whitesides, *J. Org. Chem.*, **53**, 2489 (1988)