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The Optical and Electronical Property of New Blue Emitting Material

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Linear conjugated fluorene derivatives (TetF and DiF) were synthesized. The bulky substituents attached on each fluorene moiety are expected to suppress the quenching processes from exciton state by preventing the aggregation effect.[1] The TetF and DiF showed UV0visible absorbance and photoluminescence (PL) in the ranges of 315-350nm and about 390nm. Electroluminescence (EL) maximum of OLEDs using DiF was shown at 410nm corresponding to the pure blue emission. Also, new emission appeared at 420nm. Adequate balancing of the hole and electron transport layers (HTL, ETL) can enhance the luminance and efficiency of the OLEDs. The injection of HTL does not affected in emission range of devices. The emission of devices with ETL was dependent on the thickness of ETL. The Alq_3 and PBD were used as ETL.

Keywords: fluorene derivatives; blue emission; OLEDs

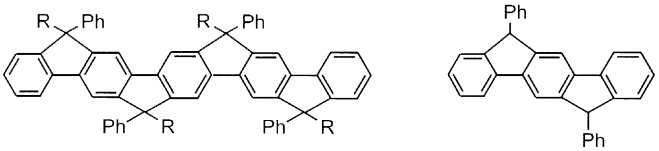
INTRODUCTION

OLEDs that generate light by applying an electrical bias are very important for full color displays. Demonstration of EL from organic molecules has accelerated the researches on the OLEDs utilizing organic small molecules. The OLEDs using the monomer by thermal evaporation method need to design efficient blue emitting material. Pure blue light emission is necessary for application to the display.

In this paper, the synthesis and characterization of the electrical and optical properties of new fluorene derivatives are discussed. We fabricated OLEDs using the fluorene derivatives, which has high fluorescence quantum efficiency and exhibits pure blue emission[2,3]. To improve the power efficiency, balance of holes and electrons ratio were studied.

EXPERIMENTAL

To decrease the quenching f excitons by preventing the aggregation, the orthogonal structure fluorene derivatives were synthesized [figure 1] [1].



(a) (b)

FIGURE 1. molecule structure of fluorene derivatives
(a) TetF (b) DiF

We studied the optical and electrical properties of TetF and DiF[3]. Table 1 showed UV-visible absorbance and PL peaks of TetF and DiF.

	TetF	DiF
UV(λ-max)[nm]	394	344
PL[nm]	436.5	400

TABLE 1 Maxima peaks of UV-visible absorbance and Photoluminescence spectra

The DiF has larger energy gap (Eg = 3.47eV) than TetF (Eg = 3.01eV). As the decrease of molecular conjugation length, energy band gap was expanded.[4] The basic structure that we studied was OLEDs structure:
Device structure : ITO / TPD (40nm) / fluorene derivatives (50nm) / Alq_3 & PBD (10nm) / Al (150nm)
TPD and Alq_3, PBD were used as a hole and electron transport material to increase efficiency of emission.. All organic materials were evaporated at 10^{-6} torr by means of ultra high vacuum (UHV) system.

RESULTS AND CONCLUSION

Figure 2 showed electroluminescence (EL) spectra of OLEDs using TetF and DiF.

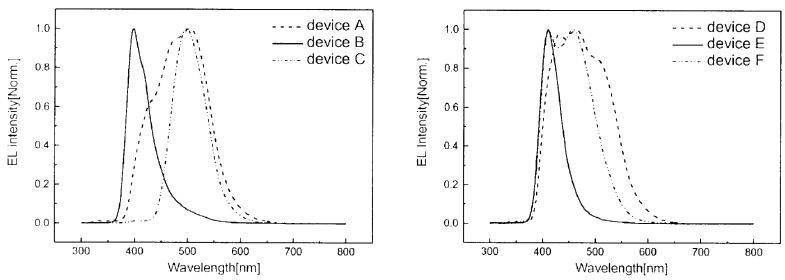


FIGURE 2. EL spectra of OLEDs using fluorene derivatives

device A : ITO/TPD(40nm)/TetF(50nm)/Alq3(10nm)/Al, B : ITO/TPD(40nm)/TetF(50nm)/PBD(10nm)/Al,
C : ITO/TPD(40nm)/Alq3(60nm)/Al, D : ITO/TPD(40nm)/DiF(50nm)//Alq3(10nm)/Al,
E : ITO/TPD(40nm)/DiF(50nm)/PBD(10nm)/Al, F : ITO/TPD(40nm)/PBD(60nm)/Al

The new peak around 500nm was observed in OLEDs using TetF as emitting layer. The cause of new peak was the energy transfer from emitting layer to ETL or bi-emission between TetF and ETL. As Gaussian spectrum spectral analysis, the peaks of device A were 419, 457, 501nm and the peaks of device D were 415, 449, 502nm. The spectra of device A and D were affected the emission of ETL (device D : 497nm, device F : 410, 460nm) by energy transfer. The efficiency of devices using TetF was very low because of the quenching.[5] The spectra of LOEDs with DiF was bosrved peak at 400nm. The power efficiency of device E and F was 0.194 lm/W and 0.242 lm/W

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