Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gmcl19

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Version of record first published: 24 Sep 2006

To cite this article: Ho-Sik Lee, Tae Wan Kim, Won-Jae Lee, Jong-Wook Park & Dou-Yol Kang (2001): Characteristics of Organic Light-Emitting Diodes Using PECCP Langmuir-Blodgett Film as an Emissive Layer, Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals, 371:1, 451-454

To link to this article: http://dx.doi.org/10.1080/10587250108024781

Mol. Cryst. and Liq. Cryst., 2001, Vol. 371, pp. 451-454

Characteristics of Organic Light-Emitting Diodes Using PECCP Langmuir-Blodgett Film as an Emissive Layer

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We have synthesized green light-emitting material, poly(*3,6-N-2*-ethylhexyl carbazolyl cyanotere-phthalidene)(PECCP), which has an electron-donor and electron-acceptor moiety in a repeated unit of polymer. Organic light-emitting diodes were made with PECCP Langmuir-Blodgett(LB) films in a sandwich structure between indium-tin-oxide(ITO) and aluminum electrodes. Z-type LB films were manufactured using a Kuhn type to use for an emissive layer. We have observed green photoluminescent and electroluminescent spectra at λ_{max} = 536 nm corresponding to 2.31 eV.

Keywords: Organic light-emitting diodes; Langmuir-Blodgett film; PECCP

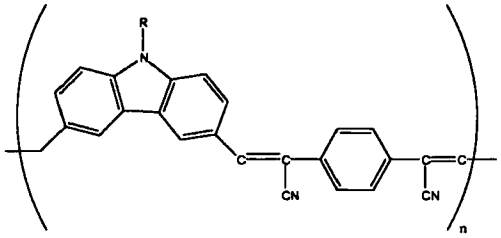
INTRODUCTION

Organic light-emitting diodes(OLEDs) have received a lot of attention since the first report of efficient visible-light emission from amorphous

molecular and polymeric materials[1,2]. The LB technique offers a simple means to deposit high-quality, large-area films of conjugated polymers. Wu *et al.*, fabricated OLEDs using poly(p-phenylene vinylene) (PPV), obtained by thermal treatment of PPV precursor LB films[3]. In this paper, we describe a preparation and characterization of electroluminescent devices using Z-type LB layers of poly(*3,6-N-2*-ethylhexyl carbazolyl cyanotere-phthalidene) (PECCP).

EXPERIMENTS

Figure 1 shows a molecular structure of PECCP. This material has an electron-donor and an electron-acceptor moiety, and shows a good solubility in common organic solvents such as a chloroform and THF.



R=ethylhexyl group

FIGURE 1. Molecular structure of PECCP.

LB film deposition was undertaken using a Kuhn-type apparatus (NIMA 611). The PECCP was dissolved in chloroform to a concentration of 0.5 g/l. A floating film was prepared by spreading this solution(10 μl) over the surface of a pure-water subphase at room temperature. Z-type film deposition was performed with a dipping speed of 10 mm/min, and a

transfer ratio of about 1~ 1.2 recorded for each upstroke.

RESULTS AND DISCUSSION

Figure 2a shows a surface pressure(π)-area(A) isotherm of PECCP with barrier compression speed of 50 cm^2/min. The PECCP LB films were made at the surface pressure of 20 mN/m. Figure 2b shows a UV/visible absorption and photoluminescence(PL) spectrum of the PECCP LB film. In the UV/visible absorption spectrum, it exhibits a broad absorption band at 410 nm, which may be due to a conjugated double bond. The PECCP LB film shows a PL peak at around λ_{max} = 536 nm.

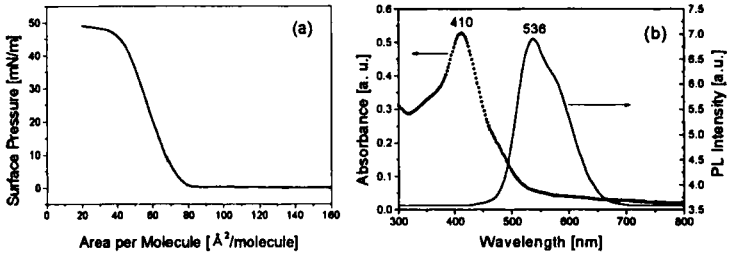


FIGURE 2. (a) π-A isotherm of PECCP molecules, and (b) UV/visible absorption and PL spectrum of the PECCP LB film.

Figure 3a shows a current density-voltage(J-V) characteristics in ITO/PECCP LB film/Al devices. It clearly shows a diode characteristics. Figure 3b shows the EL spectrum in ITO/PECCP LB film/Al structure when the operation voltage is 10 V. It shows that there is a green-light emission with λ_{max} = 536 nm, which is almost the same as that of PL of the

PECCP LB film. Here, we have used 15 layers of PECCP LB films.

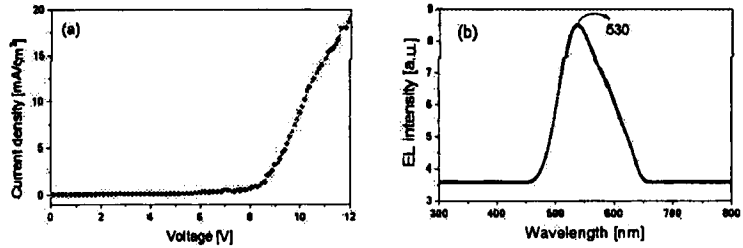


FIGURE 3. (a) Current density-voltage(*J-V*) characteristics, and (b) EL spectrum in ITO/PECCP LB film/Al device.

CONCLUSION

An electroluminescent diode consisting of LB layers of PECCP sandwiched between ITO and aluminum electrodes has been fabricated. Above a threshold bias voltage of ca. 6 V, green light emission was observed, which has λ_{max} = 536 nm. We are going to study on recombination zone in OLEDs using the LB films by varying the film thickness.

Acknowledgment

This work was supported by Korea Research Foundation Grant (KRF-99-005-E00018).

References

[1] C. W. Tang and S. A. VanSlyke, *Appl. Phys. Lett.*, **51**, 913 (1987).
[2] J. H. Burroughes, D. D. C. Bradley, A. R. Brown, R. N. Marks, K. Mackay, R. H. Friend, P. L. Burn, and A. B. Holmes, *Nature* (London), **347**, 539 (1990).
[3] A. P. Wu, T. Fujihara, T. Jikei, M. A. Kakimoto, Y. Imai, Y. Kubota, and M. Iwamoto, *Thin Solid Films*, **285**, 901 (1996).