

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>

Light-Emitting Diodes Based on Poly 3-(2-(5-chlorobenzotriazolo)ethyl) Thiophene Langmuir-Blodgett Films

Yu Mi Lee ^a, Jin Hee Ahn ^b, Eung-Ryul Kim ^a & Haiwon Lee ^a

^a Department of Chemistry, Hanyang University, Seoul, 133-791, Korea

^b Department of Chemistry, Sogang University, Seoul, 121-742, Korea

Version of record first published: 04 Oct 2006

To cite this article: Yu Mi Lee, Jin Hee Ahn, Eung-Ryul Kim & Haiwon Lee (1998): Light-Emitting Diodes Based on Poly 3-(2-(5-chlorobenzotriazolo)ethyl) Thiophene Langmuir-Blodgett Films, Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals, 316:1, 285-288

To link to this article: <http://dx.doi.org/10.1080/10587259808044510>

Full terms and conditions of use: <http://www.tandfonline.com/page/terms-and-conditions>

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae, and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

Light-emitting Diodes Based on Poly 3-(2-(5-chlorobenzotriazolo)ethyl) thiophene Langmuir- Blodgett Films

YU MI LEE¹, JIN HEE AHN², EUNG-RYUL KIM¹ AND HAIWON LEE¹

¹Department of Chemistry, Hanyang University, Seoul 133-791, Korea

²Department of Chemistry, Sogang University, Seoul 121-742, Korea

A multilayer polymer thin film electroluminescence (EL) device has been prepared by fully using the LB film method. We synthesized a novel polythiophene derivative poly-3-(2-(5-chlorobenzotriazole)ethyl)thiophene (PCBET) and studied the EL effect of LB LEDs PCBET as the emitting materials. The PL spectra of polymer shows a peak at around 605 nm, which is about 65 nm blue shifted compared with poly 3-decylthiophene results from the benzotriazole group.

Keywords: novel polythiophene derivative, LB film, electroluminescence.

INTRODUCTION

Recently, organic thin film EL devices have been constructed by the method of evaporation and have undergone great development.¹ The Langmuir-Blodgett(LB) technique could prove useful in molecular electronics because of the possibility to manipulate mono-layers, thus allowing a more precise control of the thickness and composition of the film.² The advantage of LB films is that it's thickness is controlled in nanometer range. PPV and its derivatives are promising new materials for polymeric LEDs because of their good physical, chemical and optical properties compared with other conjugated polymers. However, PPV have many problems remained. For example, PPV has low solubility in organic solvent. Recently, polythiophene

derivatives are very promising for a series of applications in the electro-optical field.³ The preparation of LB multilayers could prove a material with improved electro-optical properties owing to the high degree of order.

EXPERIMENTAL

Poly 3-(2-(5-chlorobenzotriazolo)ethyl)thiophene (PCBET) structure is shown in figure 1.

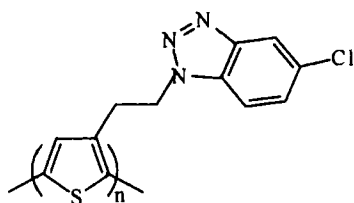


FIGURE 1 Structure of the Poly 3-(2-(5chlorobenzotriazolo)ethyl)thiophene.: (PCBET)

PCBET was synthesized by the shown in figure 1. Monomer was prepared from 3-(2-bromoethyl)thiophene with 5-chlorobenzotriazole under reflux in the presence of potassium carbonate and bromination of 3-(2-hydroxyethyl)thiophene was carried out in phosphorus tribromide. Polymer was obtained by oxidation with FeCl_3 . The PCBET of LB multilayers were prepared on quartz surface and ITO-glass by vertical dipping method at a pressure of 15 mN/m, and a temperature of 25 °C. The EL device consist of aluminum-calcium evaporated on the surface of the LB film. UV-Vis spectra of polymer were recorded with a HP Diode Array Spectrophotometer. The polymer was excited at 365 nm and PL spectra were recorded with a ISS Spectrophotometer.

RESULTS AND DISSCUSION

The polymer(PCBET) average molecular weight (M_w) detected by GPC and

M_w is 60,300. The polymer weight decrease was less than 5% on heating up to 300 °C under nitrogen and the polymers was found to be thermally stable.

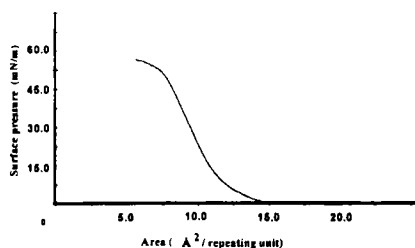


FIGURE 2. Π - A isotherm curve of PCBET at 25 °C.

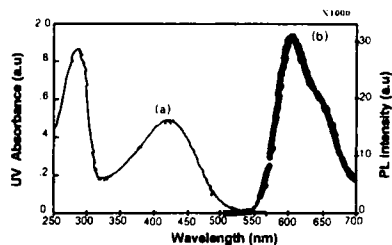


FIGURE 3. UV-Vis absorption and PL spectra of PCBET in solution and spin-coating film.

Π - A isotherm of PCBET is shown in figure 2, and the area of repeating unit is about $15(\text{\AA})^2$. The one layer thickness of PCBET is about 15 Å. Figure 3 shows the absorption spectrum (a) of dilute polymer solution and the PL spectrum (b) of polymer thin film coated on glass. Polymer has strong absorption bands at around 424 nm and 288 nm, which is attributed to the π - π^* transition of the conjugated segments and substituted benzotriazole derivative. The PL spectrum shows a peak at around 605 nm, which is about 65 nm blue shifted with respect to the 670 nm of poly (3-decylthiophene)⁴. The blue shift probably results from steric induced backbone distortion resulting from the benzotriazole group. In figure 4, PL and EL spectra of LB films shows a peak at around 600 nm. A peak at 680 nm was appeared in LB films, which results from the excimer formation. Figure 5 shows polarized PL spectra. The presence of two maxima in the spectra has been attributed to different orientation properties of the polymer chains, depending on their length: short conjugation chains are unoriented, whereas longer conjugation chains are oriented.⁵ The PL polarization

spectrum of polymer shows a peak at around 605 nm (exc=453 nm), the intensity of p-polarization spectrum (thick line) is higher than that of s-polarization spectrum because of dichroic.

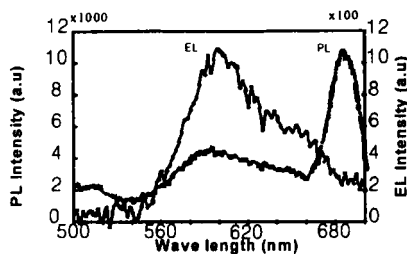


FIGURE 4. PL and EL spectra of PCBET LB 10 layer films.

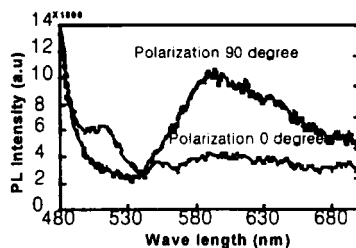


FIGURE 5. Polarized PL spectra of PCBET LB 10 layer films.

CONCLUSION

The new polymer was synthesized. Maximum absorption of UV at 420 nm was absorbed. The PL spectra of polymer shows a peak at around 605 nm, which is about 65 nm blue shifted with respect to the 670 nm of poly (3-decylthiophene). The blue shift probably results from the steric induced backbone distortion of the benzotriazole group.

Acknowledgement

This work was supported by the 1997 Hanyang University Faculty Research Grant. The authors would like to thank Prof. Y. Jiang for helpful discussion.

References

- [1] C. W. Tang, S. A. Vanslyke, and C. H. Chen, *J. Apply. Phys.* **65**, 1 (1989)
- [2] A. J. Pal, T. Ostergard, J. Paloheimo, and H. Stubb, *Appl. Phys. Lett.* **69**, 19 (1996)
- [3] I. D. Parker, *J. Appl. Phys.* **75**, 1656 (1994)
- [4] A. Bolohnesi, C. Botta, Z. Geng, C. Flores, and L. Denti, *Syn. Met.* **71**, 2191 (1995)
- [5] A. Bolognesi, G. Bajo, J. Paloheimo, T. Ostergard, and H. Stubb, *Adv. Mat.* **2**, 121 (1997)