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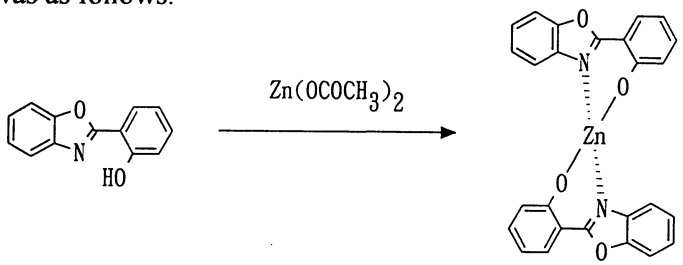
A Novel Blue Light Emitting Material Prepared from 2-(o-Hydroxyphenyl)benzoxazole

Norikazu NAKAMURA,* Shinichi WAKABAYASHI, Keiichi MIYAIRI,† and Tsuneo FUJII††
Shinko Electric Industries Co., Ltd., Kurita 711, Nagano 380
†Department of Electrical and Electronic Engineering, Faculty of Engineering,
Shinshu University, Wakasato 500, Nagano 380
††Department of Chemistry and Materials Engineering, Faculty of Engineering,
Shinshu University, Wakasato 500, Nagano 380

A new organozinc compound, zinc bis-2-(o-hydroxyphenyl)benzoxazolate, was prepared from 2-(o-hydroxyphenyl)benzoxazole and electroluminescent properties of the compound was investigated. An electroluminescent device was composed of glass substrate/indium-tin-oxide/hole transporting layer/zinc benzoxazolate/Al thin films. The electroluminescence of blue light was observed with the electric field of over 90 MV/m.

Fundamental research works on organic electroluminescent(EL) devices have been made intensively for the development of a flat display since 1987.[1] The devices emitting red, green, and blue light for full color displays were already fabricated with various organic electroluminescent materials, but excellent bright blue light emitting materials have not been yet reported except a few organic compounds of oxadiazole dimer dyes,[2] distyrylbenzenes,[3] and azomethin-zinc complexes.[4] The object of this study is to fabricate a bright and efficient EL device which can achieve a full color display. This paper shows that a zinc compound of 2-(o-hydroxyphenyl)benzoxazole is available for a bright blue light emitting material. This compound, zinc bis-2-(o-hydroxyphenyl)benzoxazolate (ZnPBOX), was prepared easily from 2-(o-hydroxyphenyl)benzoxazole and zinc acetate. Besides, it is one of the heat-stable materials which have a melting point of high temperature(351 °C). The synthesis of ZnPBOX was as follows.



In this synthesis, a clear solution of zinc acetate dihydrate(1.108 g; 5.05 mmol) in methyl alcohol(50 ml) was slowly added to a clear solution of 2-(o-hydroxyphenyl)benzoxazole(2.3147 g; 10.16 mmol) in methyl alcohol(200 ml) at 50 °C and the mixture was stirred for 3 h at 50 °C.

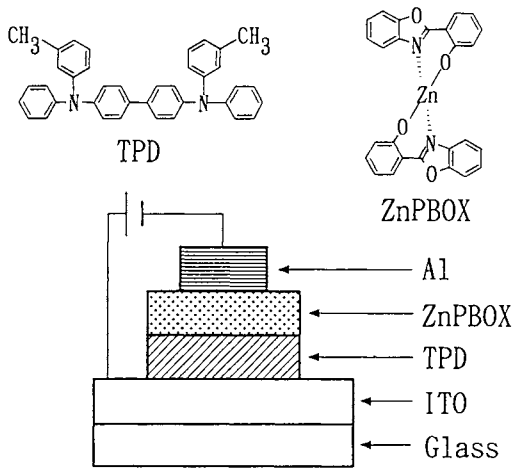


Fig. 1. Configuration of EL device and molecular structures of TPD and ZnPBOX.

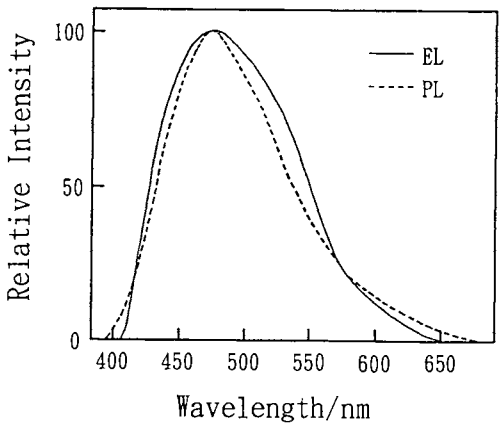


Fig. 2. PL spectrum of ZnPBOX and EL spectrum of ITO/TPD/ZnPBOX/Al device.

A white precipitate obtained was filtered, washed alternately with warm water and saturated $NaHCO_3$ aqueous solution several times. After then, it was washed with methyl alcohol and finally with hexane. The resulting white powder was dried in vacuo at room temperature to yield 2.152 g(87.8 %)of ZnPBOX. mp. 351 °C; Found: C, 64.32; H, 3.21; N, 5.47 %. Calcd. for $C_{26}H_{16}N_2O_4Zn$: C, 64.28; H, 3.32; N, 5.77 %.

The structure of the EL device is shown in Fig. 1. The first layer(100 nm) on a glass substrate coated with ITO(10 - 20 Ω/□, Matsunami Co. Ltd.) is N,N'-diphenyl-N,N'-bis(3-methylphenyl)-[1,1'-biphenyl]-4,4'-diamine(TPD) which is one of the hole transporting compounds. The second layer (100 nm) is made with ZnPBOX as a emitting material. These organic layers were successively deposited on an ITO glass substrate at room temperature under the pressure of 4 - 6 × 10^{-6} Torr. The deposition rate was 0.1 - 0.4 nm/s. The top aluminum electrode on the emitting layer was deposited owing to the technical simplicity and the excellent stability. The emitting area was 4 mm^2. Light emission was observed under the forward bias with the pulse voltage on the ITO electrode. The brightness of the blue light emission was 20 cd/m^2 at the current of 100 mA/cm^2 with 29 V. The EL spectrum and the photoluminescence(PL) spectrum of ZnPBOX thin film are shown in Fig. 2. The peak wavelengths for EL and PL were 475 nm and 473 nm, respectively. The EL spectrum is similar to the PL spectrum of ZnPBOX than that of TPD. This result suggests that the layer of ZnPBOX is responsible for electroluminescence. Further details on the electroluminescence from metal 2-(o-hydroxyphenyl)benzoxazolates are in progress. The authors wish to thank Mr. Masayasu Tomiyama for measurement of the EL spectrum.

References

1) C. W. Tang and S. A. VanSlyke, Appl. Phys. Lett., 51, 913(1987).
2) Y. Hamada, C. Adachi, T. Tsutsui, and S. Saito, Jpn. J. Appl. Phys., 31, 1812(1992).
3) H. Higashi, C. Hosokawa, H. Tokailin, and T. Kusumoto, Nippon Kagaku Kaishi, 1162(1992).
4) Y. Hamada, T. Sano, M. Fujita, T. Fujii, Y. Nisio, and K. Shibata, Jpn. J. Appl. Phys., 32, L511(1993).

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