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White-Light-Emitting Materials for Organic Electroluminescent Devices

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White-Light-Emitting Materials for Organic Electroluminescent Devices

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A chelate-metal complex such as zinc bis(2-(2-hydroxyphenyl) benzothiazolate) ($Zn(BTZ)_2$) was known to show white emission with a broad electroluminescence[1-2]. In this study, the electroluminescent characteristics of $Be(BTZ)_2$ and $Mg(BTZ)_2$, as well as $Zn(BTZ)_2$ were investigated using organic electroluminescent devices with the structure of ITO/TPD/ $Be(BTZ)_2$, $Mg(BTZ)_2$, or $Zn(BTZ)_2$ /Al. It was found that the device containing $Be(BTZ)_2$ shows the highest power efficiency.

Keywords Electroluminescent; $Be(BTZ)_2$; $Zn(BTZ)_2$; white emssion

INTRODUCTION

White emission is important for applying organic EL devices to full-color flat panel display and back-light for liquid crystal display[3]. In this study, the electroluminescent characteristics of $Be(BTZ)_2$ and $Mg(BTZ)_2$, as well as $Zn(BTZ)_2$ were investigated using organic electroluminescent devices with the structure of ITO/TPD/ $Be(BTZ)_2$, or $Mg(BTZ)_2$, or $Zn(BTZ)_2$ /Al. The luminance of the devices using various metal complexes with the same ligand, BTZ were compared and discussed.

EXPERIMENTAL

The organic EL devices consisted of 40nm-thick hole- transport layer and 60 nm-thick emitting layer, where these layers were prepared by the vacuum evaporation method. The vacuum pressure was maintained in the range of 10^{-6} Torr during the whole deposition. The ITO coated glass substrates with a sheet resistance of 15 Ω/□ was used, which were donated by Samsung Corning Co. Ltd.. Photoluminescence(PL) and Electroluminescence(EL) spectra were obtained using a Perkin Elmer LS50B in the air. The current-voltage (I-V) characteristics and luminance of organic LEDs were measured with Keithley 238 electrometer and Minolta chromameter CS100, respectively. Molecular structures of Metal-BTZ complexes, and TPD used in this study were shown in Fig. 1.

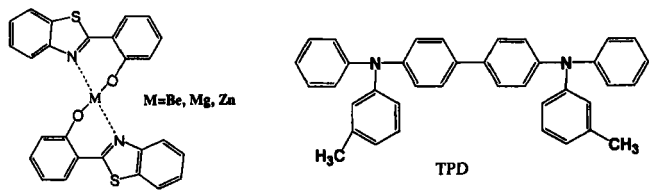
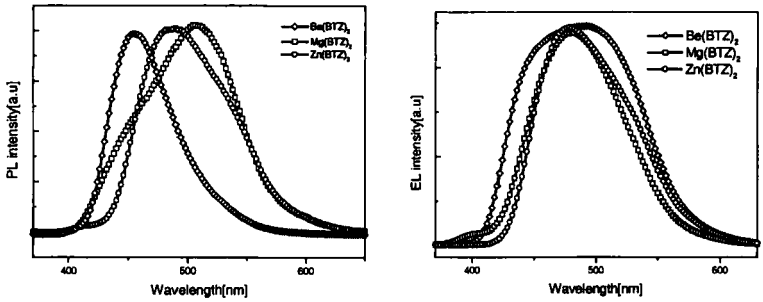


FIGURE 1. Chemical structures of the metal-BTZ complexes, and TPD .

RESULTS AND DISCUSSION

The PL spectra of the various BTZ metal complexes are shown in Fig. 2 (a). It was found in this Fig. 2 (a) that the PL spectra of the various BTZ metal complexes show the broad peak at the wavelength from 400 to 600nm, which is almost in the same peak wavelength range of other metal complexes known as white-light emitting materials.

The EL spectra of the BTZ metal complexes as emitting materials are shown in Fig. 2 (b). $Be(BTZ)_2$ emitted greenish white light(x=0.275,

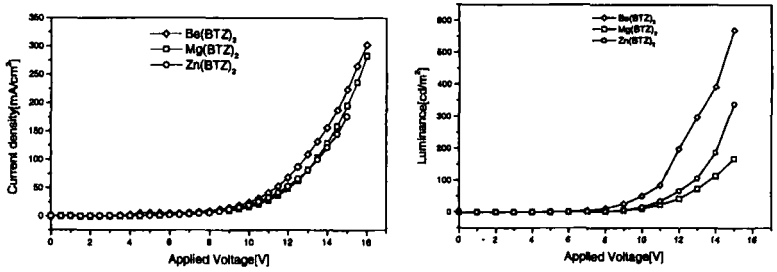


(a) (b)

FIGURE 2. (a) The PL spectra of the various BTZ metal complexes and (b) EL spectra of the BTZ metal complexes.

y=0.368), $Mg(BTZ)_2$ emitted blueish green white light(x=0.247, y=0.366), and $Zn(BTZ)_2$ emitted greenish white light(x=0.261, y=0.393). It can be seen in Fig. 2 that the PL and EL spectra of these BTZ metal complexes show very broad spectra and the peak in the EL spectra of these metal complexes show a half-spectral bandwidth of more than 110nm.

Fig. 3 (a) shows the dependence of the injection current on the applied voltage in three devices under the forward bias condition. The operating voltage of the BTZ metal complexes were similar to each other and found to be 7V. And the current density of the three devices was also almost the same each other. The luminance-voltage characteristics of all devices are shown in Fig. 3(b). It was found in this Fig. 3(b) that the luminance of the devices containing $Be(BTZ)_2$ was higher than those of the devices containing $Mg(BTZ)_2$, and $Zn(BTZ)_2$. The power efficiency of the $Be(BTZ)_2$, $Mg(BTZ)_2$, $Zn(BTZ)_2$ was 0.054lm/W, 0.018lm/W, and 0.040lm/W at the driving voltage of 15, respectively. The reason for the high power efficiency is that $Be(BTZ)_2$ seems to exhibit excellent electron transporting behavior in the device.



(a) (b)

FIGURE 3. (a) The current density-voltage (J-V) characteristics and (b) the luminance-voltage (L-V) characteristics of the BTZ metal complexes.

In conclusion, The simple device with the structure of ITO/TPD/BTZ metal complexes/Al was prepared to evaluate the white-light emitting materials such as $Be(BTZ)_2$, $Mg(BTZ)_2$, and $Zn(BTZ)_2$. The power efficiency of the device using $Be(BTZ)_2$ as an emitting layer was the highest among the devices using other BTZ metal complexes.

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