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$Zn(HPB)_2$를 블루 발광층으로 이용한 White OLED의 색순도 특성

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Properties of color purity as white OLED based on $Zn(HPB)_2$ as blue emitting layer

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Abstract - We synthesized emissive materials, namely $Zn(HPB)_2$. The fundamental structures of the OLEDs were ITO / NPB (40 nm) $Zn(HPB)_2$ (40 nm) / Alq_3:DCJTB (20, 30, or 40 nm) / LiF / Al. We varied the thickness of Alq_3:DCJTB from 20 nm to 40nm. We measured current density-voltage and luminance-voltage characteristics at room temperature. When the thickness of the Alq3:DCJTB layer was 40 nm, white emission is achieved. The CIE coordinates are (0.32, 0.33) at an applied voltage of 14V.

1. Introduction

Electroluminescent(EL) devices based on organic thin films are considered to be one of the next generation of flat-panel displays. The use of white organic light-emitting diode (OLED) devices, in which discrete red, green, and blue (RGB) pixilationprocess can be accomplished without using a tedious and troublesome precision shadow mask, has recently become increasingly popular as one of the major methods to fabricate full-color display combined with RGB color filters, as a backlight of liquid crystal displays, and as solid-state lightings [1,2]. In order to realize full color OLED from white, it needs that the device processing is simple as well as high efficiency [3]. A white light-emitting device can also be applied as paper-thin light source which are mostly useful for places where lightweight lighting devices are required, such as in aircraft and space shuttles, and as a back-light for liquid crystal display [4]. There are three methods being used to obtain white emitting devices. One way is to dope single host emissive layer with some laser dyes that emit at different ranges from the host material or blending two different emissive polymers. Another is to use a structure to get two or three emissions concurrently from one emissive layer [5]. The last is to use a multilayer structure to got different emissions at same time from different emissive electron transport layers [6-7].

We will report a new white OLED using an emitting layer consi sting of a green host Alq_3 and a red dopant DCJTB. And we sy nthesized the $Zn(HPB)_2$ as blue emitting materials.

2. Experiment

The OLED were fabricated on indium-tin-oxide (ITO) coated glass substrates with a sheet resistance of 10 Ω/□ and a thickness of 120 nm. Before film deposition, the ITO substrate received surface treatment by UV-ozone for 1 minute.

The IP and the EA of $Zn(HPB)_2$ were measured using CV (potentiostat 263A, Seiko EG&G Instrument). We obtained the IP from the ITO electrode and the EA from the Al electrode. For all CV, an electrolyte solution of 0.1 M Bu_4NClO_4in acetonitrile was used. The three-electrode compartment electrochemical cell consisted of an ITO or Al glass electrode as the working electrode in the prepared sample, a platinum wire (0.8 mm) as the counter electrode, and Ag/AgCl as the reference electrode. The cyclic voltammograms were obtained at a scan rate of 400 mV/sec.

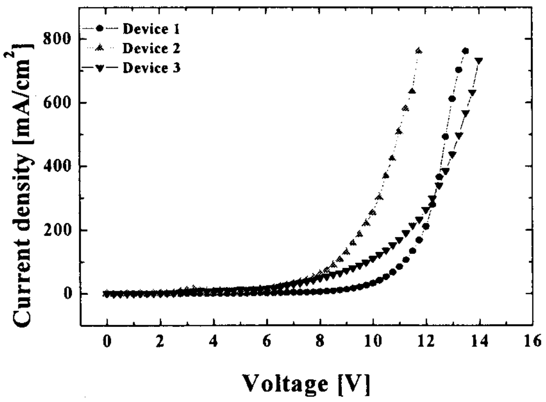
A white OLED was fabricated in which a green light emitting host Alq_3 was doped with a red dye DCJTB. The $Zn(HPB)_2$ was blue emitting layer. The structure of the devices were ITO / NPB (40 nm) / $Zn(HPB)_2$ (40 nm) / Alq_3:DCJTB / LiAl (120 nm). The thickness of doping layer were 20, 30, 40nm. Table 1 shows the device structures. The organic materials were successively evaporated on top of the ITO substrate under 5 x 10^{-6} torr with a deposition rate of about 1.0 Å/s. A metal cathode was deposited under 5 x 10^{-6} torr with a deposition rate of about 10 Å/s. The PL spectrum was measured using a Perkin-Elmer LS45 luminescence spectrometer. The characteristics of the current density-voltage-luminance and the CIE coordinates were measured with an Agliena 66BC. All measurements wrer performed at room temperature in air.

<Table 1> The device structure

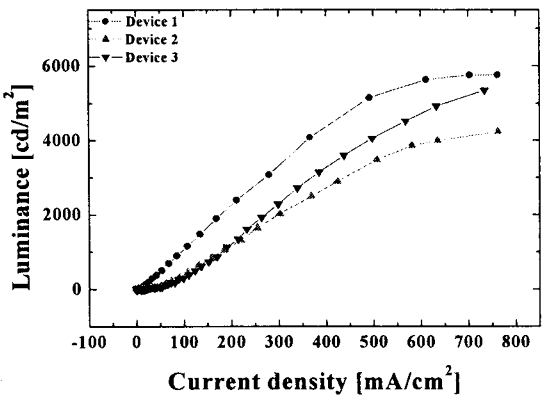
Device	Structure
Device 1	ITO/NPB/$Zn(HPB)_2$/ Alq_3:DCJTB (20nm)/LiF/Al
Device 2	ITO/NPB/$Zn(HPB)_2$/ Alq_3:DCJTB (30nm)/LiF/Al
Device 3	ITO/NPB/$Zn(HPB)_2$/ Alq_3:DCJTB (40nm)/LiF/Al

3. Result and Discussion

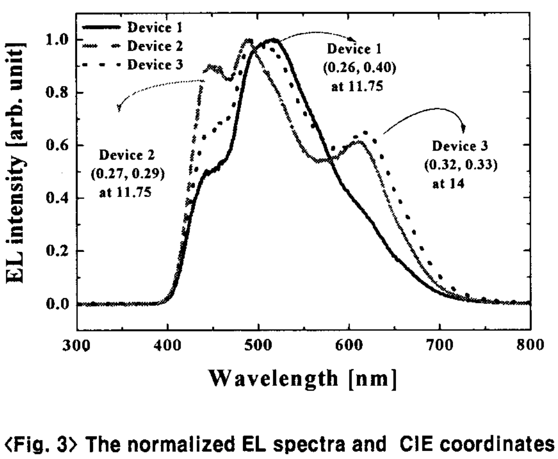
Fig. 1 and 2 show the current density-voltage, luminance-current density characteristics of the devices. Fig. 3 shows the normalized EL spectra and the CIE coordinates of devices with different thicknesses of the Alq_3:DCJTB layer. We can see the three EL peaks for the blue emission, green emission and red emission from Fig. 3. The proportion of red emission increases with the increasing thickness of the Alq_3:DCJTB layer. When a 40 nm thick Alq_3:DCJTB layer was used, white emission can be obtained. The CIE coordinates are (0.32, 0.33) at a voltage 14 V



<Fig. 1> The current density-voltage characteristics



<Fig. 2> The luminance-current density characteristics



<Fig. 3> The normalized EL spectra and CIE coordinates

The maximum luminance of 5400 cd/m^2 at a current density of 740 mA/cm^2. At device 3, as the applied voltage increases from 10 to 14 V, the CIE coordinates change from (0.42, 0.34) to (0.32, 0.33). In addition, with the increasing voltage the blue emission was increased and red emission was decreased, proportionally.

This phenomenon might be explained as follows. At low voltage, red emission was increased because of more electron and hole recombination in Alq_3:DCJTB layer than $Zn(HPB)_2$. At high voltage blue mission was increased because of more electron and hole recombination in $Zn(HPB)_2$ than Alq_3:DCJTB layer. Because in this case, the $Zn(HPB)_2$ is working as a hole blocking layer

4. Conclusion

We synthesized novel emissive materials of $Zn(HPB)_2$. $Zn(HPB)_2$ measured energy level values using cyclic-voltammetry. The IP and EA of $Zn(HPB)_2$ was measured to be 6.5 eV, 2.8 eV. This material was used the blue emitting layer in white OLED. We realized a white emission using $Zn(HPB)_2$ and Alq_3:DCJTB. When the thickness of the Alq_3:DCJTB layer was 40 nm, white emission is achieved. This device showed the blue emission increase with the increase voltage and the red emission decrease with the increase voltage.

The CIE coordinates are (0.32, 0.33) at an applied voltage of 14V. We realized a white OLED using the blue emitting layer of $Zn(HPB)_2$

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