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Mixing Effect on the Electroluminescent Properties of Co-Deposited Thin Films of $BeBq_2$ and $BeMq_2$

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Metal-chelate complexes have been intensively investigated as an emitting layer and recognized to have excellent electroluminescence (EL) properties. Beryllium complexes such as $BeBq_2$ and $BeMq_2$ are known to be green-light emitting materials. In this study, the EL characteristics of co-deposited films of $BeBq_2$ and $BeMq_2$ was investigated using a device structure of ITO/TPD/$BeBq_2$:$BeMq_2$/Al. The brightness and luminescence of the co-deposited films of $BeBq_2$ and $BeMq_2$were improved by a factor of 1.5~2 in comparison with a device structure of ITO/TPD/$BeBq_2$ or $BeMq_2$/Al.

Keywords: electroluminescence; co-deposition; $BeBq_2$ or $BeMq_2$

INTRODUCTION

Organic electroluminescent devices (OELDs) are popular for their potential applications in large-area, flat-panel, and high-luminance full-color displays, utilizing low driving voltage, either as back-lighting sources or direct emitters in emissive displays [1-2]. Various multi-layered structure devices, fluorescent dyes, and electrode materials have been studied to improve the efficiency and stability of the devices [3-4]. In this study, the EL characteristics of co-deposited films of $BeBq_2$ and $BeMq_2$ was investigated using a device structure of ITO/TPD/$BeBq_2$:$BeMq_2$/Al.

EXPERIMENTAL

In this study, TPD was used as a hole transport material and $BeBq_2$ or $BeMq_2$ was used as emitting materials, where the double-layer OELDs were fabricated with a structure of ITO/TPD (40nm)/$Bebq_2$ or $Bemq_2$ (60nm) /Al (100nm) using vacuum-deposition method. The emitting area was 3 x 3 mm^2. The vacuum pressure was maintained in the range of 10^{-7} Torr during the whole sublimation process and the deposition rate was maintained within 0.4 Å/s. UV/vis absorption spectrum of $BeBq_2$ and $BeMq_2$ was obtained using a Hewlett Packard 8425A spectrometer. PL and EL spectra were obtained using a Perkin Elmer LS50B in the air. Thickness measurements of various films were carried out with a-step 200 profilometer and ellipsometer. The current-voltage (I-V) characteristics and luminance of OELDs were measured with Keithley 238 electrometer and Minolta chromameter CS100, respectively. All processing steps were carried out under air and at room temperature. The molecular structures of TPD, $BeBq_2$, and $BeMq_2$ were shown in FIGURE 1.

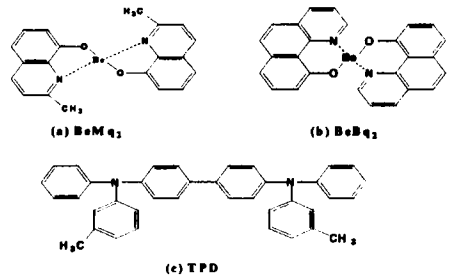
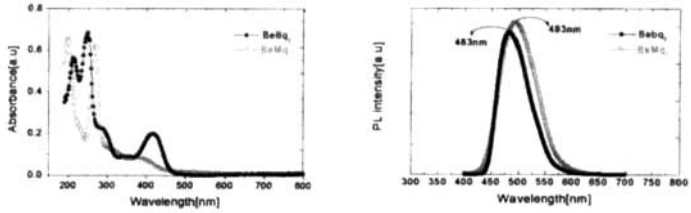


FIGURE 1. Molecular structures of the $BeMq_2$, $BeBq_2$,and TPD used in this study.

RESULTS AND DISCUSSION

The UV/Visible absorption and PL spectra of the Beryllium complexes are shown in FIGURE 2 (a) and 2 (b), respectively. It was found that the UV/Visible absorption spectrum of $BeBq_2$ was almost the same as that of $BeMq_2$, but the intensity of edge peak(λ_{max}=417nm) of UV/Visible absorption spectrum of $BeBq_2$ was not, which seems to be due to the different ligand.

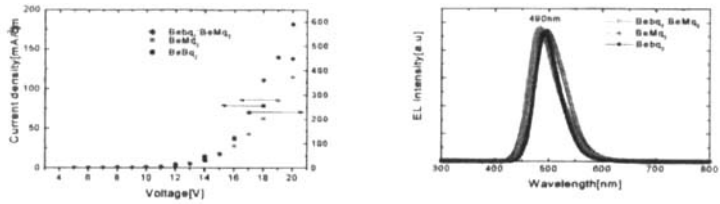
FIGURE 2 (b) show the PL spectra of beryllium complexes. They show the strongest peak at the wavelength of about 483($BeBq_2$) to 493($BeMq_2$)nm which coincides with a general observation that beryllium complexes are known as green-light emitting materials.



(a) (b)

FIGURE 2. The UV/visible spectra (a) and PL spectra (b) of the beryllium complexes, $BeBq_2$ and $BeMq_2$

FIGURE 3 (a) shows the EL spectra of the OELDs for ITO/TPD/$BeBq_2$/Al, ITO/TPD/$BeMq_2$/Al, ITO/TPD/$BeBq_2$:$BeMq_2$/Al at 12 volt, where the three EL spectra from the device structures show a maximum peak at the same wavelength of 490 nm. FIGURE 3 (b) shows the J-V characteristics of these three OELDs, where the total thickness of the three OELDs were the same.

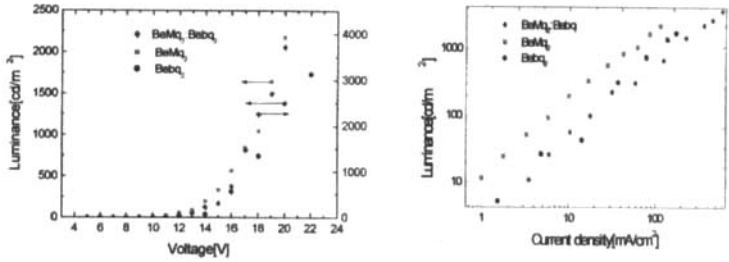


(a) (b)

FIGURE 3. The EL spectra (a) and Current density (J)-bias voltage (V) characteristics of the OELDs with structures of ITO/TPD/$BeBq_2$/Al, ITO/TPD/$BeMq_2$/Al, and ITO/TPD/ $BeBq_2$:$BeMq_2$ /Al.

FIGURE 4 (a) shows the L-V characteristics of the OELDs with structures of ITO/TPD/$BeBq_2$/Al, ITO/TPD/$BeMq_2$/Al, and ITO/TPD/$BeBq_2$:$BeMq_2$ /Al. It was found in FIGURE 4 (a) that the luminance of the OELD with structure of ITO/TPD/$BeBq_2$:$BeMq_2$/Al was 3720cd/m^2 at 20V. The brightness and luminance of the OELD using the co-deposited films of $BeBq_2$ and $BeMq_2$ as an emitting materials was improved by a factor of 1.5~2 in comparison with the OELD using single films of $BeBq_2$ or $BeMq_2$ as an emitting material. FIGURE 4 (b) shows the L-J for the three OELDs The luminance of OELD using the co-deposited films of $BeBq_2$ and $BeMq_2$ as an emitting material was lower at the same current density in comparison

with the OELD using single films of $BeBq_2$ or $BeMq_2$ as an emitting material, which indicates that the OELD using the co-deposited films has more power consumption in spite of higher brightness at the same voltage.



(a) (b)

FIGURE 4.Luminance (L)-voltage (V) characteristics (a) and luminance(L)-current density(J) (b) for the OELDs with structures of ITO/TPD/$BeBq_2$/Al, ITO/TPD/$BeMq_2$/Al, and ITO/TPD/$BeBq_2$:$BeMq_2$/Al .

CONCLUSIONS

The EL characteristics of the co-deposited films of $BeBq_2$ and $BeMq_2$ was investigated using a device structure of ITO/TPD/$BeBq_2$:$BeMq_2$/Al. and compared with those of single film of $BeBq_2$ and $BeMq_2$ using a device structure of ITO/TPD/$BeBq_2$ or $BeMq_2$/Al. The brightness and luminescence of co-deposited film was improved by a factor of 1.5~2 in comparison with a device structure of ITO/TPD/$BeBq_2$ or $BeMq_2$/Al even though the power consumption of the co-deposited films of $BeBq_2$ and $BeMq_2$ was higher than that of the single films of $BeBq_2$ and $BeMq_2$.

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