BECCP/Alq3 이중층을 이용한 전기 발광 소자의 특성 연구

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Electroluminescent Properties of BECCP/Alq3 Organic Light-emitting Diode

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Abstract

Many organic materials have been synthesized and extended efforts have been made to obtain high performance electroluminescence(EL) devices, since the first report of the light-emitting diodes based on Alq3. BECCP[bis(3-N-ethylcarbazolyl)cyanoterephthalidene] is a new luminescent material having cyano as an electron acceptor part and carbazole moiety as an electron donor part. The BECCP material shows blue PL and EL spectra of the device at about 480nm and in the ITO/BECCP/Al device shows typical rectifying diode characteristics. We have introduced Alq3 between the electrode and BECCP, and obtained more intensive rectifying diode characteristics in forward and reverse bias.

Key Words : OLED, BECCP, Electroluminescent

1. Introduction

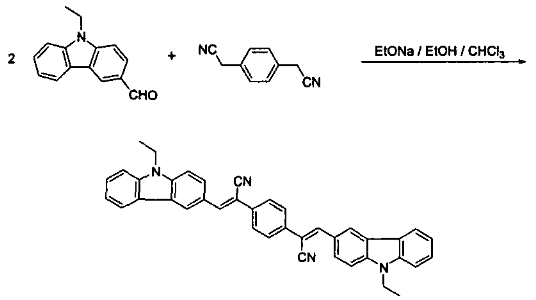
Since the first report of the light-emitting diodes based on Alq_3, many organic materials have been synthesized and extended efforts have been made to obtain high performance electroluminescent(EL) device[1-3].

Recently, many researchers reported several bipolar emitting molecules. In the EL device, one important approach to enhance the EL performance, escpecially life time of device, is to incorporate vinylene linkages between the aromatic rings. In this paper, we have studied photoluminescent and electroluminescent properties of new bipolar emitting molecule, bis(3-N-ethycarbazoly)cyanotere phthalidene(BECCP).

2. Experimental

Figure 1 shows synthesized process using well-known Knoevenagel condensation reaction of the BECCP. The BECCP was identified by

UV/visible absorption spectroscopy and it is slightly soluble in chloroform or THF.



Bis(3-N-ethylcarbazolyl)cyanoterephthalidene

Fig. 1. Synthesis and structure of the BECCP.

The optical absorption spectra were measured by HP8452A spectrometer. A Perkin Elmer LS50B spectrophotometer was used for photoluminescent and electroluminescent spectrum. To make a device, the BECCP was vacuum deposited on the ITO-glass at 10^{-6} torr with a deposition rate of 0.5 Å/s. An active area of device is 3mm×5mm and Al was also vacuum deposited at the same vacuum condition for the electrode[4].

Current-voltage characteristics of the electroluminescent device was measured using Keithley 238 electrometer with source-measure unit(SMU) system.

3. Results and discussion

Figure 2 shows the UV/visible absorption and photoluminescent(PL) spectrum of the BECCP film on a quartz substrate. The absorption peak was at 385nm and a PL spectrum gives a blue emission with a peak wavelength at 480nm. The absorption band at 385nm, which is originated from the π-π^* transition of partially conjugated double bond due to the nitrogen atom, was newly. A typical organic light-emitting diodes was fabricated using a vacuum deposition at 10^{-6} torr. Figure 3(a) shows typical rectifying diode characteristics. As is seen in the figure, the turn-on voltage was at 8V and the current density was reached to about 300mA/cm^2. observed.

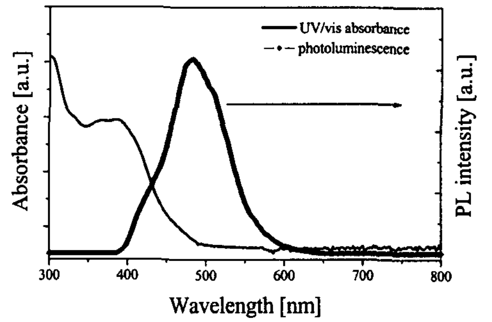


Fig. 2. UV/visible absorption and photplumine-scent spectrum of the BECCP.

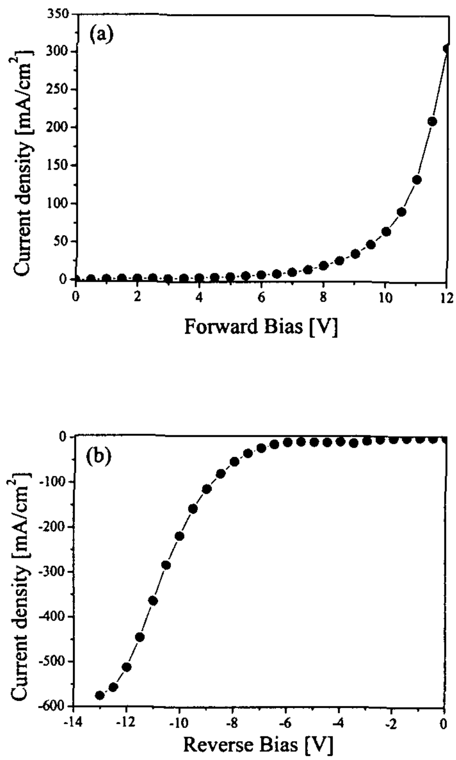


Fig.3. Current-voltage characteristics of the ITO/BECCP/Al device with forward and reverse bias.

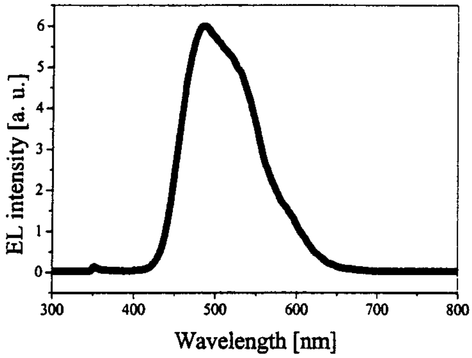


Fig. 4. Electroluminescent spectrum of the ITO/BECCP/Al device.

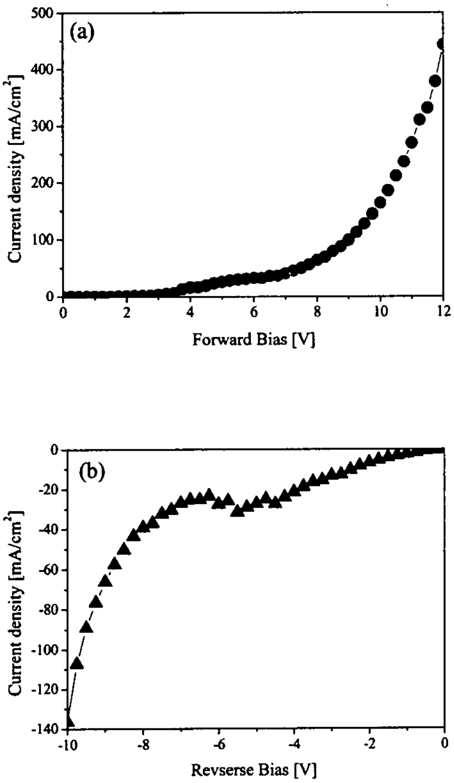


Fig. 5. Current-voltage characteristics of the ITO/BECCP/Alq3/Al device with forward and reverse bias.

However, when the reverse bias is applied, the light emission from the organic light-emitting diodes is quite low compare to the forward bias, so we introduced the other emitting material Alq3 between the BECCP and cathode eletrode. When the reverse bias is applied to the device, the turn-on voltage was at the same voltage as the forward bias and the current density was reached to about 600mA/cm^2(Fig 3(b)).

Figure 4 shows the electroluminescent spectrum of the ITO/BECCP/Al device. We observed that the electroluminescent peak is at 480nm, and it is blue light emission. It is almost the same as that of photoluminescent of the BECCP. This implies that the photoluminescent and electroluminescent come from the same origin.

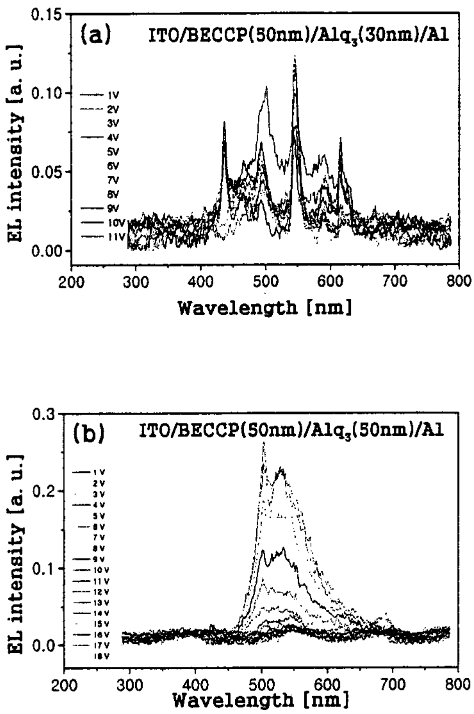


Fig. 6. Electroluminescent spectrum of the ITO/BECCP/Alq3/Al device.

Figure 5 shows the current-voltage characteristics of the ITO/BECCP/Alq3/Al device. Figure 5 shows that a turn-on voltage is about 3.5V, and the current density is about

450mA/cm^2 at 12V. Luminance of the device was about several hundred of cd/m^2 at 12V. And when the reverse bias is applied to the device, the luminance of the device is very low. These results imply that the energy band is quite different between the metal electrode and organic layer.

Fig. 6 shows the the electroluminescent spectrum of the ITO/BECCP/Alq_3/Al device. The BECCP thickness was a 50nm and Alq_3 thickness was a 30nm and 50nm. We observed that the electroluminescent peak is at 480nm(Fig. 6(a)), and it is blue light emission. Also we observed the EL peak is at 530nm(Fig. 6(b)), and it is green light emission. So we thought that the EL emission peak was some shift, and the recombination zone was shift from BECCP layer to Alq_3 layer.

4. Conclusion

A new bipolar electriluminescent material BECCP, which is the small molecule, was synthesized. A BECCP film was made using thermal vacuum deposition. The BECCP shows blue photoluminescent and electroluminescent spectrum at around 480nm. The ITO/BECCP/Al devie shows a typical diode characteristics. An insertion of Alq_3 in between BECCP and Al gives a more enhanced emission and rectifying diode characteristics.

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