Molecular Crystals and Liquid Crystals
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gmcl20

Improvement in the Efficiency of Organic Light Emitting Diode Consisting of Copolymer having Hole and Electron Transporting Moieties and CsF as an Injection Material

Chang Ho Lee [a], Seung Wook Kim [a], Francisco Bloom [b], George Malliaras [b] & Se Young Oh [c]

[a] Department of Chemical Engineering, Sogang University, Seoul, 121-742, Korea

[b] Materials Science and Engineering, Cornell University, Ithaca, NY, 14853-2801

[c] Department of Chemical Engineering, Sogang University, Seoul, 121-742, Korea E-mail:

Version of record first published: 29 Oct 2010

To cite this article: Chang Ho Lee, Seung Wook Kim, Francisco Bloom, George Malliaras & Se Young Oh (2002): Improvement in the Efficiency of Organic Light Emitting Diode Consisting of Copolymer having Hole and Electron Transporting Moieties and CsF as an Injection Material, Molecular Crystals and Liquid Crystals, 377:1, 77-80

To link to this article: http://dx.doi.org/10.1080/713738542

Mol. Cryst. Liq. Cryst., Vol. 377, pp. 77-80

1058-725X/02 $12.00 + .00
DOI: 10.1080/10587250290088582

Improvement in the Efficiency of Organic Light Emitting Diode Consisting of Copolymer having Hole and Electron Transporting Moieties and CsF as an Injection Material

CHANG HO LEE[a], SEUNG WOOK KIM[a], FRANCISCO BLOOM[b], GEORGE MALLIARAS[b] and SE YOUNG OH[a]

[a]*Department of Chemical Engineering, Sogang University, Seoul, 121-742, Korea and*
[b]*Materials Science and Engineering, Cornell University, Ithaca NY 14853-2801*
E-mail : syoh@sogang.ac.kr

Organic light emitting diodes (OLEDs) with a novel carrier transporting copolymer having a triphenylamine moiety as hole transporting unit and a triazine moiety as electron transporting unit in the polymer side chain and a CsF as electron injection material were fabricated. The device consisting of ITO/copolymer and DCM emitting material (500 Å)/CsF (5 Å)/Al showed high quantum efficiency of 0.3% at a DC 12 V. Especially, the electroluminescence (EL) device emitted red light (720 nm) with high brightness corresponding to the emitting material.

Keywords: copolymer; DCM; CsF; quantum efficiency; red light

INTRODUCTION

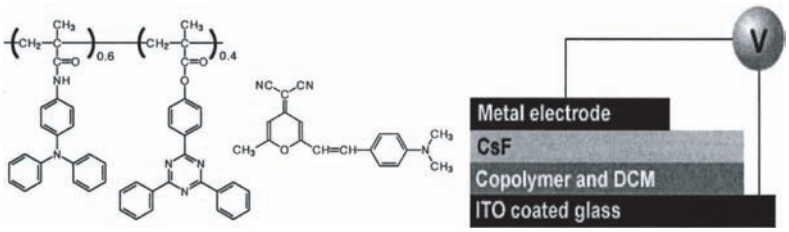
Single layer polymer based light emitting diodes have attracted much attention because of their application as flexible flat panel display as well as easiness of device fabrication. In order to improve the imbalance of carrier transport in the single-layered OLED using

conjugated polymer, copolymers which hole transporting unit and electron transporting unit are incorporated have been currently studied [1,2]. In the previous work, we have studied on the characteristics of single-layered OLED using blend of a novel carrier transporting copolymer and low molecular fluorescent dyes (DCM or Coumarin 6) as emitting material [2,3].

In this study, we have investigated the effects of CsF as an injection material on the performance of EL device consisting of ITO/copolymer and DCM /CsF/Al.

MATERIALS AND EXPERIMENTAL

Copolymer was synthesized by solution polymerization of *N*-(*p*-diphenylamine)phenylmethacrylamide and *N*-(2,4-diphenyl-1,3,5-triazine)phenylmethacrylate monomers with an AIBN initiator. DCM, Al and CsF of high purity were purchased from Aldrich. Copolymer and DCM were spin-cast from a monochlorobenzene solution onto ITO coated glass. The speed of spin casting was about 2000 rpm. The ITO substrate was cleaned by a deionized water bath, followed by a ultraviolet/ozone treatment prior to use. Al and CsF were deposited by vacuum sublimation at 10^{-6} mbar. EL spectra were obtained from the measurements of an Acton 300i spectrofluorometer. The current - voltage - radiance characteristics were measured with a Kiethley 236 source-measurement unit and the radiance with a calibrated UDT S370 optometer in a nitrogen glove box containing less than 1 ppm oxygen and moisture at Cornell university [4].



(a) (b)

FIGURE 1 Chemical structures of copolymer and DCM (a) and EL device configuration (b).

RESULTS AND DISCUSSION

Figure 2 showed the EL spectra of ITO/copolymer and DCM/Al devices with various DCM contents. A maximum EL intensity of the prepared devices was achieved at a DCM content of 30 wt%. As the dye concentration increases, the maximum peak was shifted from 620 nm to 720 nm and shoulder peak increased, which is mainly due to the strong dipole interaction between dye molecules.

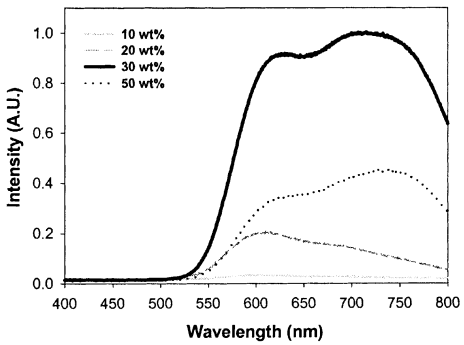
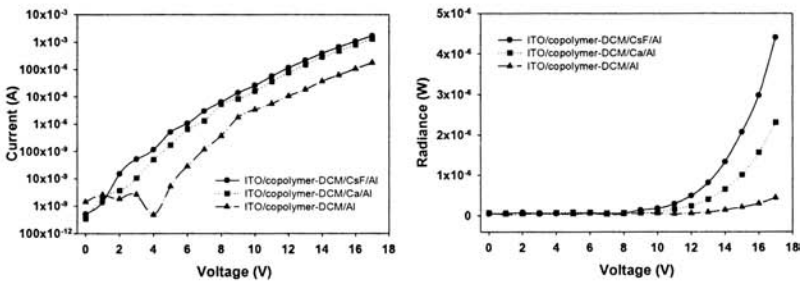


FIGURE 2 EL spectra of ITO/ copolymer and DCM/Al devices with various DCM contents.

The current and radiance of EL device with a CsF/Al cathode were higher than those of devices with Ca/Al and Al cathodes as shown in Figure 3, which is attributed to the enhancement of electron injection Also, the drive voltage decreased to 8 V. As a consequence, it should be emphasized that the introduction of a CsF thin layer between copolymer and Al cathode leads to a high EL efficiency.



(a) (b)

FIGURE 3 I-V (a) and R-V (b) characteristics of EL devices with different cathodes.

Acknowledgement

This work was supported by Brain Korea 21 program.

References

1. S. Y. Oh, C. H. Lee, E. Kim. *J. of Korean Ind. & Eng. Chem*. **11(4)**, 408 (2000).
2. S. Y. Oh, C. H. Lee, H. M. Kim, J. W. Choi, H. W. Rhee. *Synth. Metals*. **117**, 195 (2001).
3. S. Y. Oh, C. H. Lee, S. W. Kim. *Optical Materials*. in press.
4. P. Piromreun, H. S. Oh, Y. Shen, G. G. Malliaras. *Appl. Phys. Lett*., **77(15)**, 2000.