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

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Version of record first published: 29 Oct 2010

To cite this article: Ki-Wook Yi, Kyoung-Hoon Jung, Sung-Taek Lim, Gweon-Young Ryu & Dong-Myung Shin (2002): Synthesis and Characterization of DCM Derivatives for Red Light Emitting OLEDs, Molecular Crystals and Liquid Crystals, 377:1, 97-100

To link to this article: http://dx.doi.org/10.1080/713738536

Mol. Cryst. Liq. Cryst., Vol. 377, pp. 97-100

1058-725X/02 $12.00 + .00
DOI: 10.1080/10587250290088636

Synthesis and Characterization of DCM Derivatives for Red Light Emitting OLEDs

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A novel red light emitting material, 2,6-dimethyl-4H-pyran-4'-ylidene)malononitrile (d-DCM) was synthesized and characterized. UV/visible absorption maximum is observed at 488 nm and emission maximum at 658 nm in solid film state, respectively. The organic light emitting diodes (OLEDs) with structure of indium tin oxide (ITO)/ buffer layer/ hole transporting layer/ emitting layer/ electron transporting layer/ LiF/ Al. The hole transporting layer was composed of TPD and the electron transporting layer, which consists of Alq_3, and emitting layer was composed of d-DCM. We investigated the characteristics of electroluminescence (EL) for OLEDs with red light emitting d-DCM.

Keywords Organic light-emitting diodes (OLEDs); d-DCM

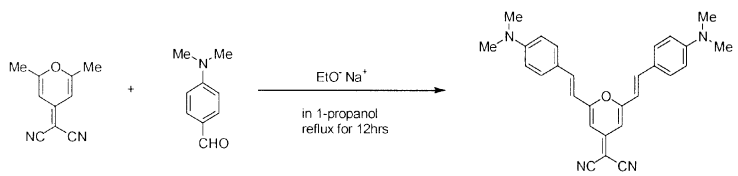
INTRODUCTION

Organic electroluminescent (EL) devices are of great interest because of their efficient emission in the visible region and their possible application to a new type of flat panel full color display, these devices show a low driving voltage of < 10 V. DCM-derivatives are known as

a good red-emitting material. However, they can be used with only doping system and have wide full width half maximum (FWHM, about 100 nm). To supplement these shortcomings, d-DCM was synthesized and advanced emitting property was investigated.

EXPERIMENTS

We have synthesized red-light emitting dyes (REDs) based on 2,6-dimethyl-4H-pyran-4'-ylidene)malononitrile moiety (Scheme 1). REDs show a strong absorption in the range of 410 ~ 550 nm in solid film state. All layers in EL devices were fabricated under 6 x 10^{-6} torr using ultra high vacuum system. As the hole transporting layer, N,N'-diphenyl-N,N'-bis(3-methylphenyl)1,1-biphenyl-4,4'-diamine (TPD), and electron transporting layer, tris(8-hydroxyquinoline) aluminum (Alq_3), were selected, respectively. ITO coated glasses were used as substrates. In this study, two types of EL devices were fabricated. Device 1 have structures of ITO/ α-septithiophene (α-7T) (5 nm)/ TPD (40 nm)/ Alq_3:d-DCM (0.1 w%) (20 nm)/ Alq_3 (50 nm)/ LiF (0.5 nm)/ Al (200 nm). Device 2 has structures of ITO/ α-7T (5 nm)/ TPD (40 nm)/ d-DCM (10 nm)/ Alq_3 (60 nm)/ LiF (0.5 nm)/ Al (200 nm).



Scheme 1. Synthesis of d-DCM

RESULTS AND DISCUSSION

The UV/visible absorption spectra showed absorption maximum at 488 nm in solid film state and 486 nm in solution state. PL spectra showed emission maximum at 658 nm in solid film and 602 nm in solution state

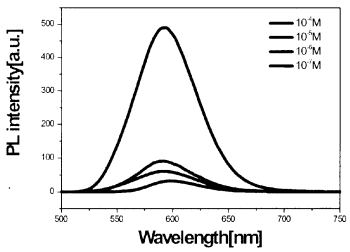


FIGURE 1. PL spectra in solution

FIGURE 1 shows the PL spectra in solution ($CHCl_3$). FWHM is 65nm. The narrow PL spectra of d-DCM shows that the resolution of d-DCM is improved

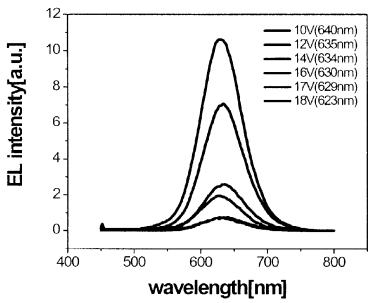


FIGURE 2. EL spectra of device 1

FIGURE 2 shows EL spectra of device 1. With changing driving voltage, the maximum wavelength in EL spectra was changed in range

from 640 to 623 nm, and it indicates that the device1 have the narrow FWHM. In addition, light emitting was observed in the single layer composed of d-DCM without any other host materials. Thus, the device shows the advanced emitting property as compared with an old DCM system. In this system, the characteristics of current density-applied voltage were a typical one of that of diodes

ACKNOWLEDGMENT

This work was supported by a grant from the Ministry of Education of Korea (BK 21).

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