Electroluminescence Characteristics of Novel Phenylamine Derivatives for Organic Electroluminescent Devices

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Abstract

We reported the optical and electrical characteristics of organic electroluminescent phenylamine derivatives. The maximum EL peak of organic electroluminescent devices(OELDs) with PDV-DMI and PDV-AQ are at 615nm and at 592nm which are corresponding to red and orange emission, respectively.

1. Introduction

Since the pioneering work of Tang and VanSlyke on organic electroluminescent devices(OELDs), many efforts have been devoted to prepare OELDs for enhancing performance [1]. OELDs have been widely investigated for their potential applications in a wide visible region and for applications in flat-panel displays driven at low voltage. In order to realize full-color flat-panel displays, it is necessary to develop efficient red-light-emitting devices. A few red-light-emitting devices have been reported [2-5], but all of them contains an organic layer doped with small amount of a red fluorescent dye, and most of these devices have very broad peaks because of the varying circumstances of the dopant molecules.

In this paper, we report the emission characteristics of the OELDs for enhanced red light emission.

2.Experiment

Figure 1 lists the molecular structures of the organic materials used in the OELDs. The novel hetero-cyclic bis-styryl dyes, 2,2'-(1,4-phenylene-divinylene)bis-3,3'-dimethylindoline (PDV-DMI) and 2,2'-(1,4-phenylenedivinylene)bis-8-acetoxyuinoline acetoxyquinoline (PDV-AQ) were synthesized according to the method in reference [6, 7].

The schematic cross-sectional view of the fabricated device is shown in Fig. 2. The emissive materials are PDV-DMI and PDV-AQ, the hole conducting buffer polymer is polyethylene dioxythiophene(PEDOT) and the hole transport agent is N,N'-diphenyl-N,N'-bis(3-methylphenyl)1,1'-bi-phenyl-4,4'diamine(TPD). The cell structure is an ITO anode / PEDOT / TPD(50nm) / PDV-DMI or PDV-AQ(50nm) / Al cathode(150nm). The patterned ITO-coated glass(30Ω /sq.) was sonicated in a detergent solution followed by a de-ionized water rinse, dipped into acetone, trichloroethylene and isopropyl alcohol.

After drying, the PEDOT was formed on the ITO-coated glass substrate by spin-cast technique.

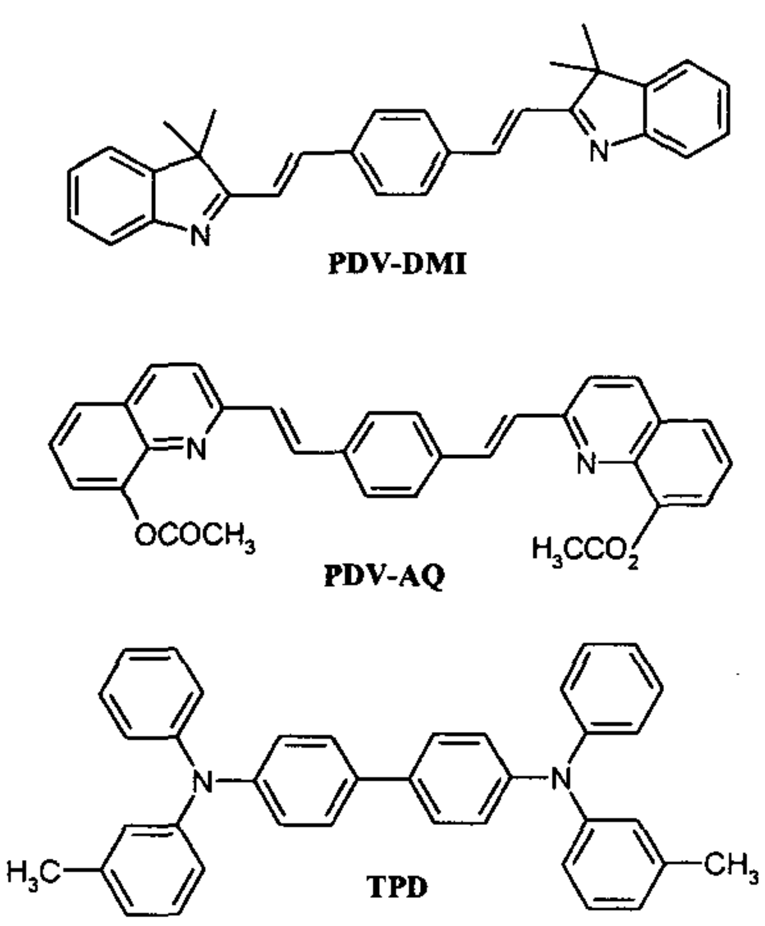

Figure 1 Molecular structures of the materials used in this study

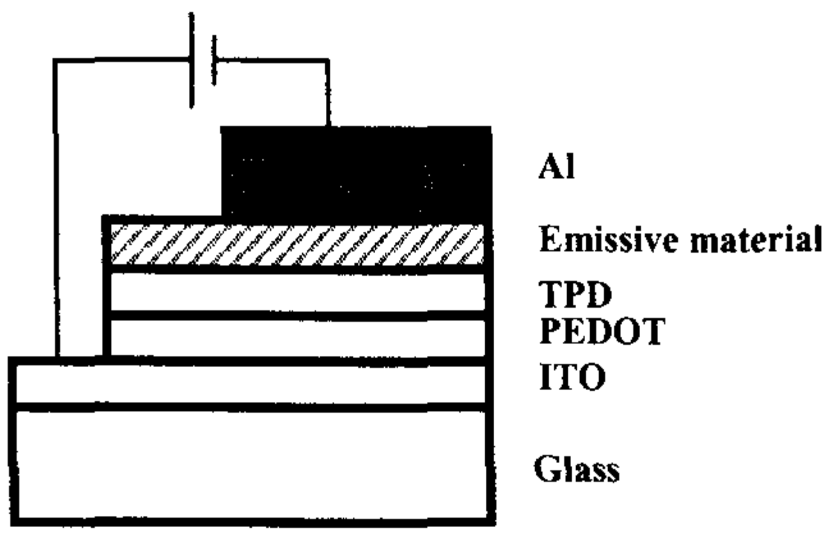

Figure 2 Configuration of the OELD with PDV-DMI or PDV-AQ as an emissive material

And then TPD, PDV-DMI or PDV-AQ, and Al were deposited by vacuum thermal evaporation under a vacuum of about 2×10^{-6} torr.

The electroluminescence (EL) and photoluminescence (PL) spectra were taken with a monochrometer (PI instrument Spectra-pro 300i). The Commission International De L'Eclairage (CIE) coordinates were measured with Spectroradiometer (Minolta CS-1000). Electrical and optical output measurements were made using a Keithley 2400 Source meter and Newport-1830C Optical power meter.

3. Results and discussion

The UV-vis absorption and normalized PL spectra of PDV-DMI and PDV-AQ thin films on glass substrates are shown in Fig. 3. In the PDV-DMI and the PDV-AQ thin film, the maximum peaks of UV-vis absorption are at 389nm and 380nm, and PL spectra are at 503nm and 516nm, respectively.

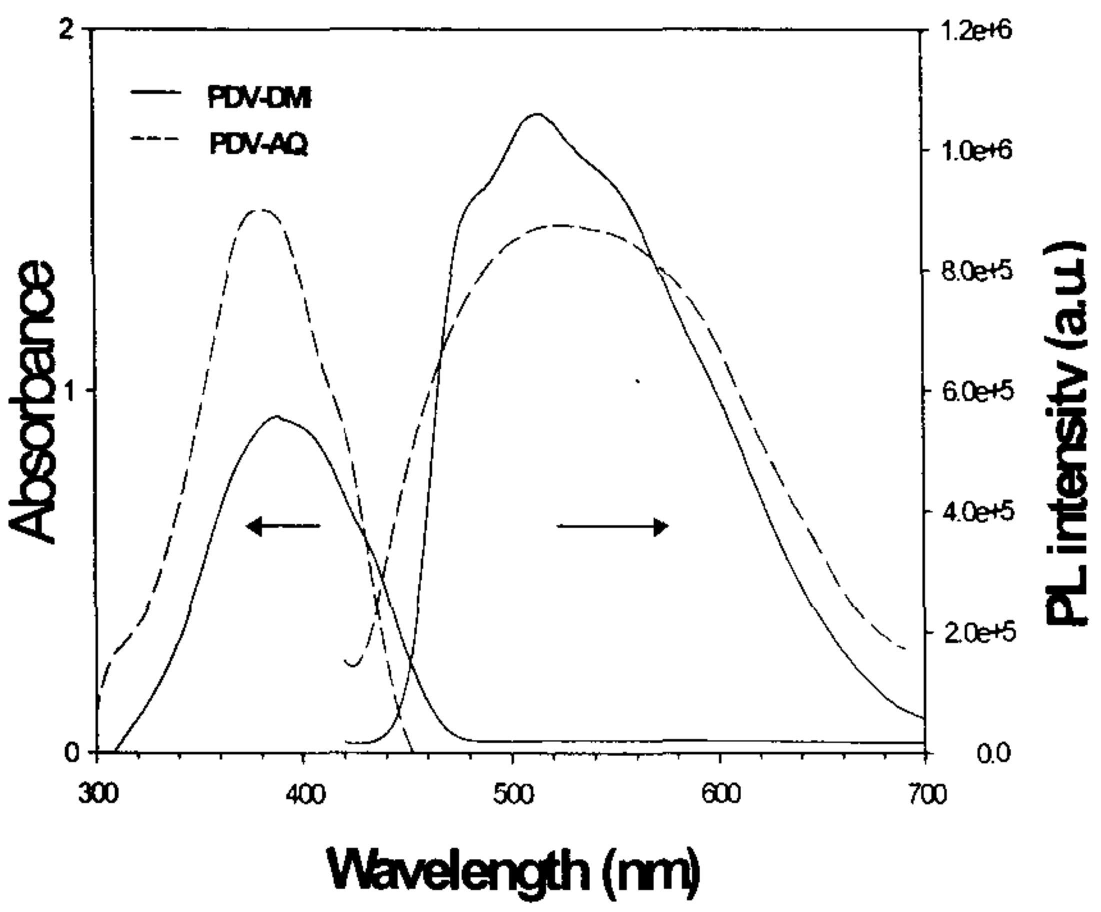

Figure 3 UV-vis absorption and PL spectra of PDV-DMI and PDV-AQ thin films on glass substrates

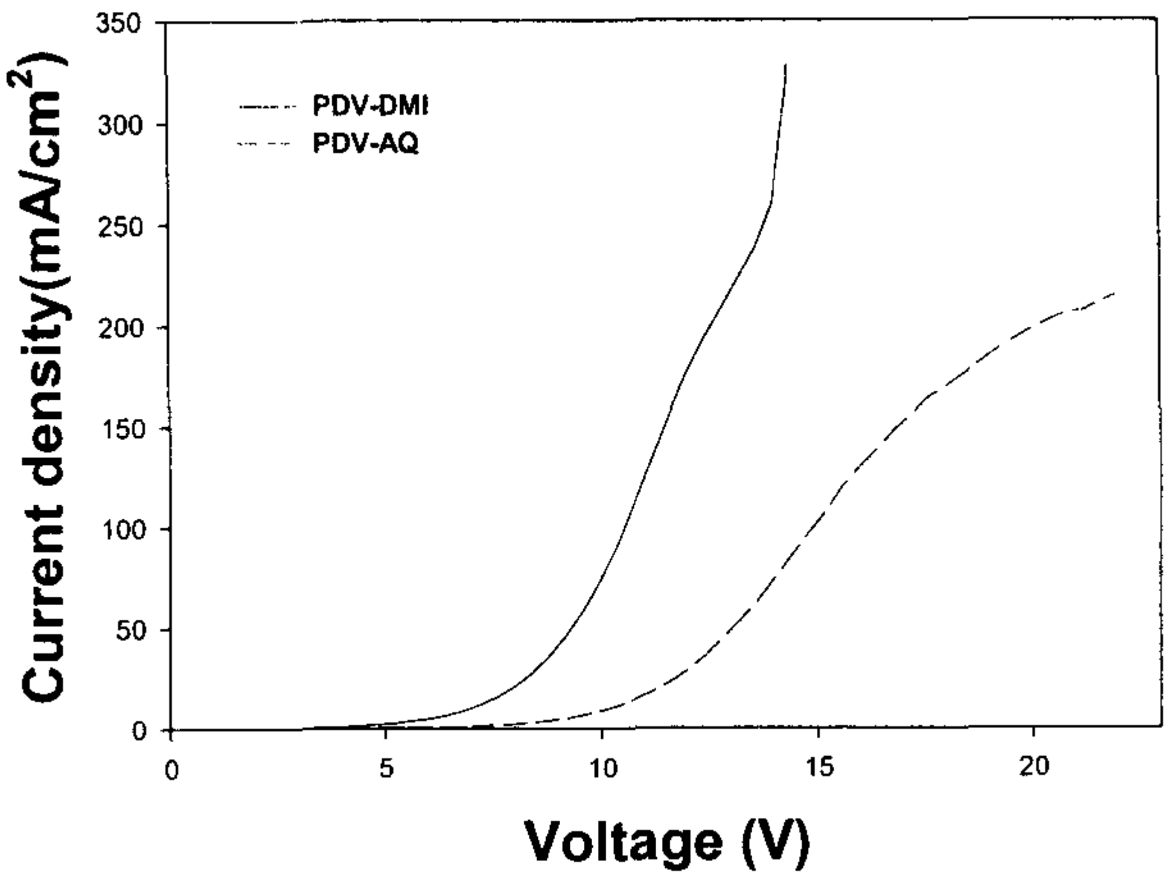

Figure 4 Applied voltage - current density characteristics of the EL devices with PDV-DMI and PDV-AQ

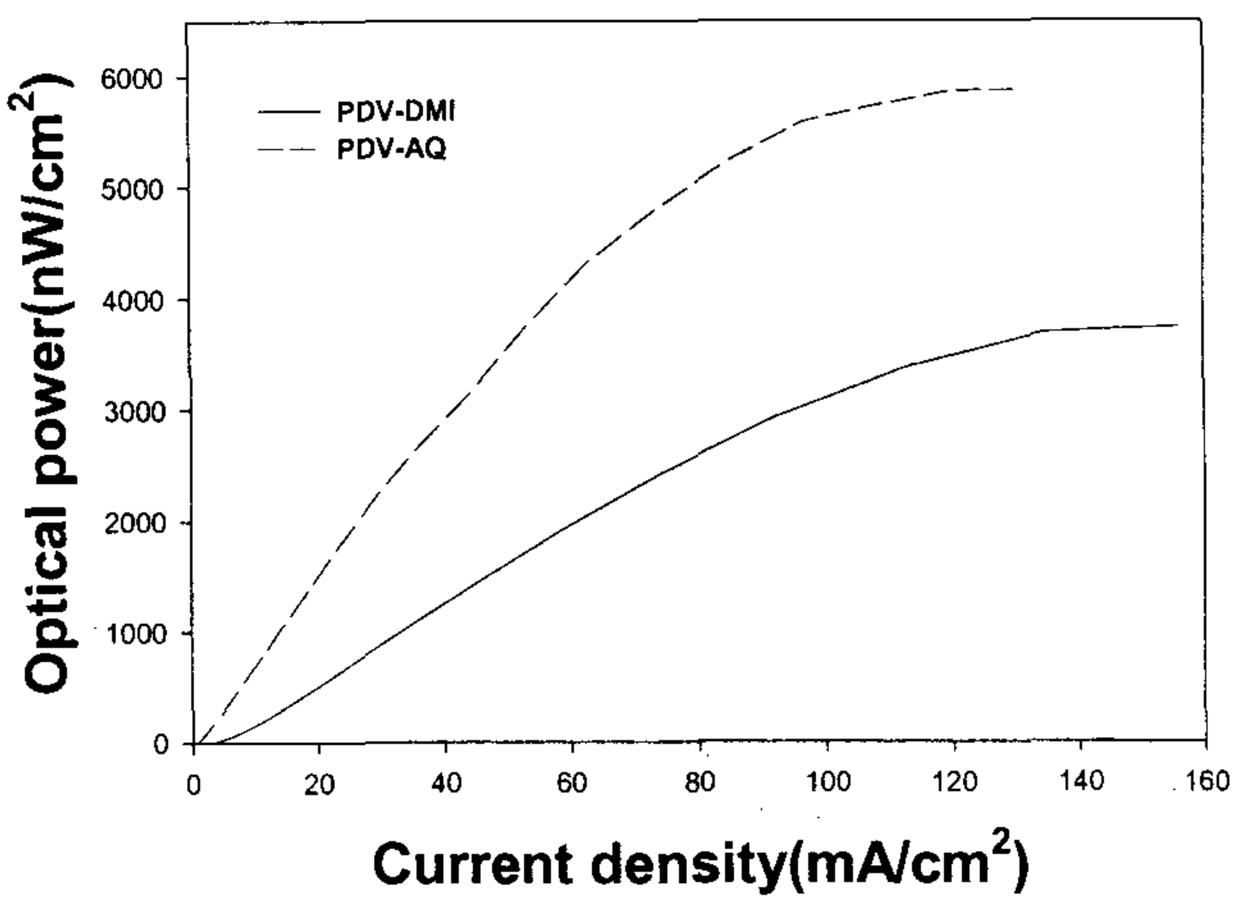

Figure 5 Luminance - current density characteristics of the EL devices with PDV-DMI and PDV-AQ

Figure 4 shows the characteristics of applied voltage- current density of the devices with PDV-DMI and PDV-AQ. Turn-on voltages of the OELDs with PDV-DMI and PDV-AQ are about 4V and 7V, respectively.

The characteristics of luminance-current density of the OELDs with PDV-DMI and PDV-AQ are shown in Fig. 5. The brightness of PDV-DMI and PDV-AQ reaches a maximum peak about 3700 nW/cm^2 at

156mA/cm^2 and 6000 nW/cm^2 at 130mA/cm^2, respectively.

Figure 6 shows the normalized EL spectra of the OELDs with a PDV-DMI(solid line) and a PDV-AQ(dashed line), which maximum emission located at 615nm and 592nm, respectively.

The CIE coordinates of the devices with PDV-DMI and PDV-AQ are shown in Fig. 7. The CIE coordinates of PDV-DMI and PDV-AQ are x = 0.5636, y = 0.4277 and x = 0.4725, y = 0.4640, respectively.

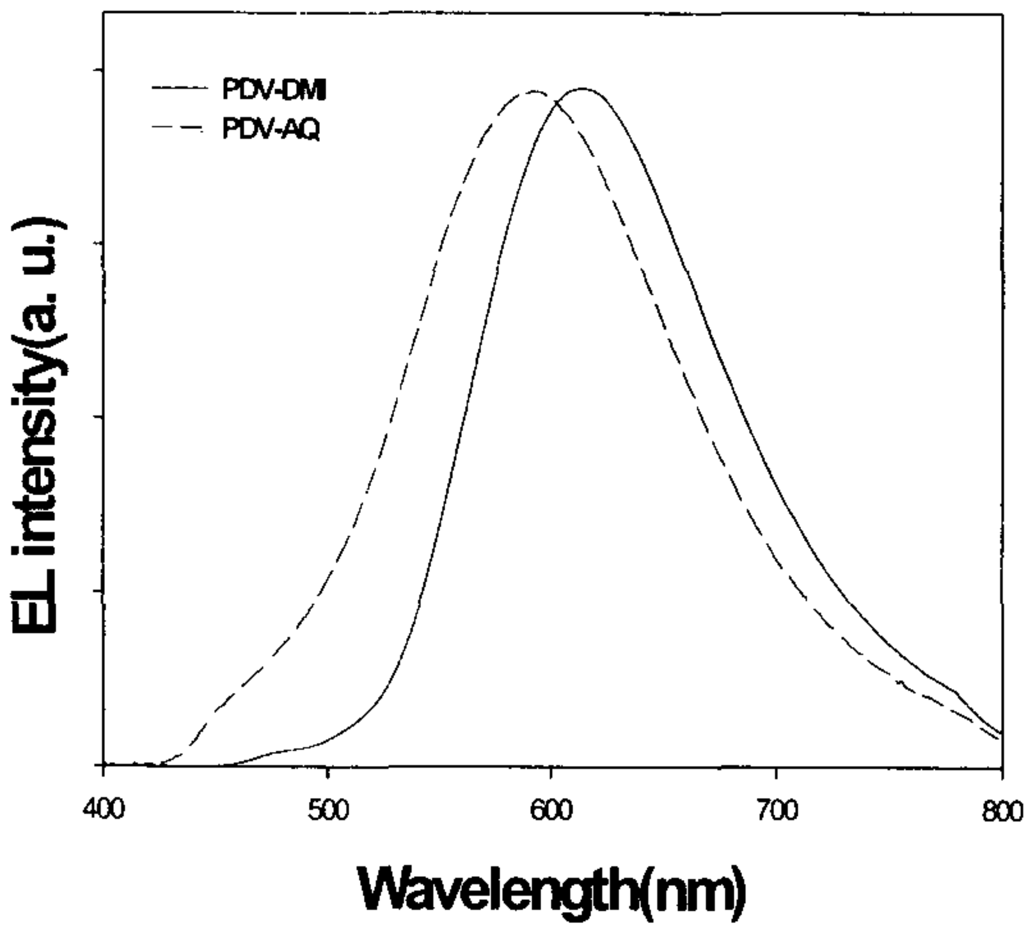

Figure 6 Elecroluminescence spectra of devices with PDV-DMI and PDV-AQ

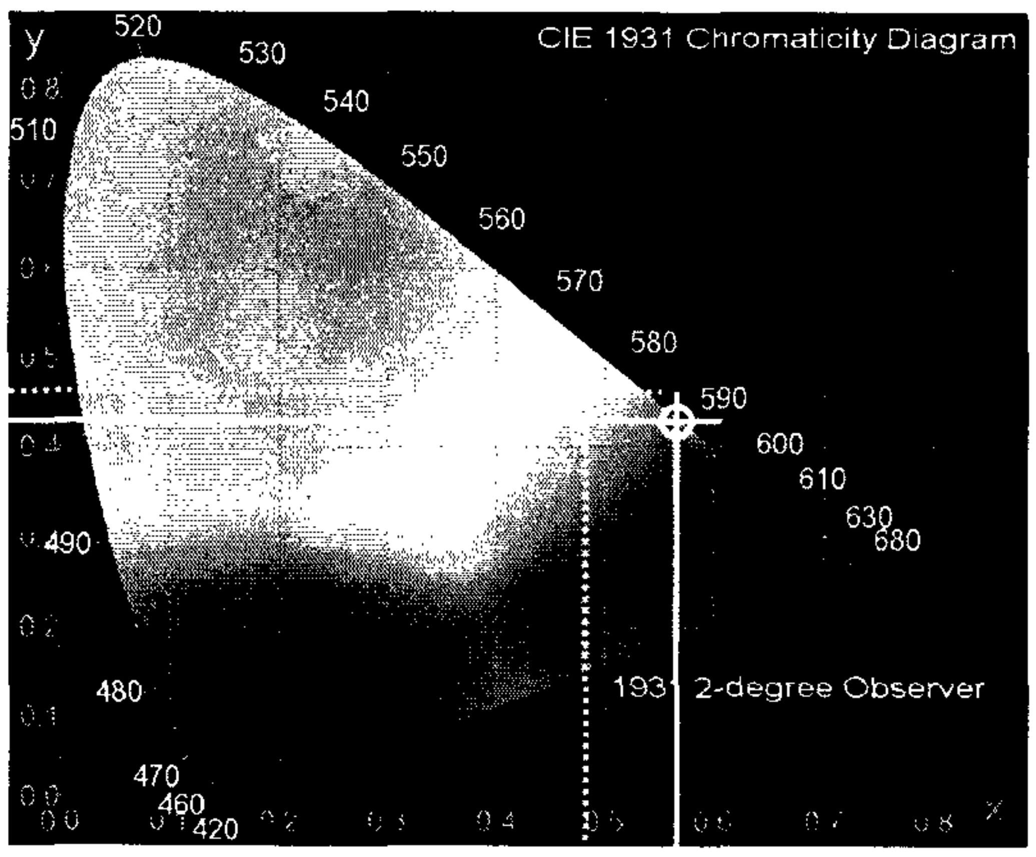

Figure 7 The CIE coordinates of devices with PDV-DMI (solid line) and PDV-AQ (dashed line)

4. Conclusion

We reported the optical and electrical characteristics of novel phenylamine derivatives, PDV-DMI and PDV-AQ, as an emitting layer for OELDs. The maximum peaks in the EL spectra of PDV-DMI and PDV-AQ were at 615nm and 592nm, which are corresponding to red and orange-red emission, respectively.

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5. References

[1] C. W. Tang, S. A. Van Slyke, Appl. Plys. Lett., 51, 913-915 (1987).
[2] S. Toguchi, Y. morioka, Synthetic metals, 111-112, (2000)57-61.
[3] J. Kido, M. Kohda, Cryst. Liq. Cryst. 227, 277(1993).
[4] H. Sugiura, R, Inaba, Jpn. Soc. Appl. Phys, 3, 1073(1994).
[5] C. C. Wu, J. C. Sturm, Appl. Phys. Lett. 69, 3117(1996).
[6] S. B. Lokhande and D. W. Rangnekar, Indian J. Chem., 1986, 25B, 485.
[7] C. D. Diskoumakos, J. Mikroyannideis, J. Polymer Sci.: Part A : Polymer Chem., 31, 2333(1993).