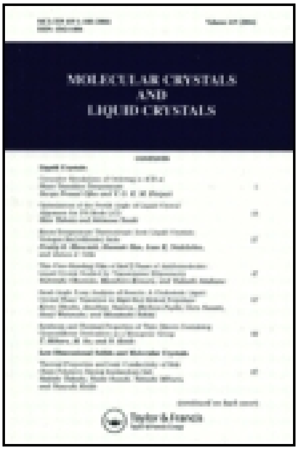

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Light-Emitting Properties of Side-Chain Polymer (EH-PMA) and its Blend with MEH-PPV

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Light-Emitting Properties of Side-Chain Polymer (EH-PMA) and its Blend with MEH-PPV

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A side chain polymer, alkoxy-ethylhexyloxystilbene substituted PMA derivative (EH-PMA), was synthesized through radical polymerization route. EH-PMA was blended with MEH-PPV by changing their weight ratios. The EL emission peakes of the polymer blends showed at the region of 570–580 nm which corresponds to MEH-PPV only, indicating that the energy transfer from the high energy state EH-PMA to the low energy state MEH-PPV exists in EL devices.

INTRODUCTION

The light-emitting diode (LED) using conjugated or non-conjugated polymer as the active luminescent layers is a promising application for semiconducting polymer.[1-2] The EL efficiency could be greatly enhanced by blending a polyconjugated polymer and a conjugation regulated polymer.[3-4] The efficiencies of these polymer blends were also improved owing to a decrease in energy barriers between the electrodes and the luminescent polymers. In the research of new materials for polymer LED, we prepared a novel polymer blend as the emitting layer; the blend is composed of an organic soluble, non-conjugated polymer, poly{6-[4-(2-(4-ethylhexyloxy-phenyl) vinyl)phenoxy]hexyl 2-methylacrylate} (EH-PMA) and a fully conjugated poly[2-methoxy-5-(2-ethylhexyloxy)-1,4-phenylenevinylene] (MEH-PPV). The initial devices utilized aluminum as an electron-injecting and ITO as a hole-injecting electrode.

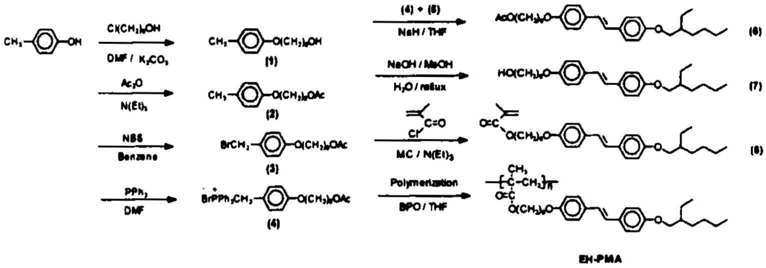
EXPERIMENTAL

Synthesis of monomer (8). *p*-Cresol was reacted with 1-chloro-6-

hydroxyhexane, protected hydroxyl group with acetic anhydride, bromination of methyl group, and then reacted with triphenylphosphine to give the compound (4). The phosphonium salts (4) reacted with compound (5) to form the stilbene compound (6). After deprotection of the compound (6), compound (7) reacted with methacryloyl chloride and then finally we could obtain the monomer (8)

Synthesis of EH-PMA. A solution of 1 g of the monomer (8) in 8 mL of anhydrous THF was prepared, and then 5 mg of benzoyl peroxide (BPO) was added as a catalyst and reacted at 70 °C for 2 days under a N_2 atmosphere. After 2 days, the reaction mixture was added dropwise into the large amount of methanol. The crude product was precipitated, filtrated and then purified by Soxhlet extraction in methanol for 3 days. The polymer yield was 0.87 g (87 %). The synthetic procedures for EH-PMA are shown in SCHEME 1.

SCHEME 1



RESULTS AND DISCUSSION

MEH-PPV and EH-PMA were blended by changing the weight ratio of two polymers. Thin film of the polymer blends could be obtained by spin-coating from the 1,2-dichloroethane solution with excellent reproducibility.

Figure 1 shows the emission properties of EH-PMA, MEH-PPV and their polymer blend. The MEH-PPV/EH-PMA (1/5) polymer blend showed two isolated PL emission peaks at 380 and 580 nm corresponding to the component polymers. Electroluminescence (EL) spectra of EH-PMA, MEH-

PPV and their polymer blends are shown in Figure 2. The EL emission peaks of all the blended polymers are ranged from 570 nm to 580 nm as changing blend ratios, corresponding to that of MEH-PPV only.

The polymer blends exhibited no emission at around 390 nm corresponding to EH-PMA. Regardless of the composition of the polymer blends, they showed strong emission maxima at around 570-580 nm. From these results, we can guess that the singlet excitons generated in high energy state EH-PMA are transferred into the low energy state MEH-PPV polymer.

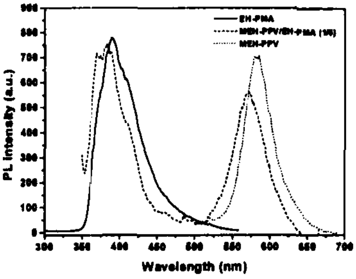


FIGURE 1 Photoluminescence spectra of EH-PMA, MEH-PPV and MEH-PPV/EH-PMA (1/5) polymer blend.

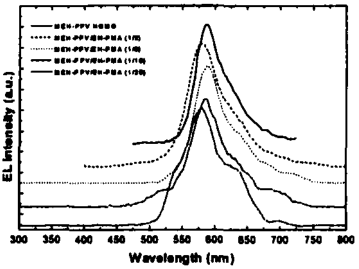


FIGURE 2 Electroluminescence spectra of MEH-PPV and its EH-PMA polymer blends.

Figure 3 shows the turn-on voltages of the blended polymer devices increased as the content of EH-PMA increased due to the difficulty of carrier's injection and mobility for EH-PMA polymer. The relative quantum efficiencies of the polymer blends increased with increasing EH-PMA content as shown in Figure 4. MEH-PPV/EH-PMA (1/20) blended polymer showed the highest luminescence at the same current. The blended polymer devices emitted orange-light at about 570-580 nm wavelength region and their EL efficiencies were also highly improved. The improvement on quantum efficiencies of the polymer blend compared with MEH-PPV may be explained by following factors. Firstly, the excited EH-PMA polymers transfer their energies to MEH-PPV, thereby enhancing the luminescent intensities of the blended polymers. Secondly, the dilution effect influences

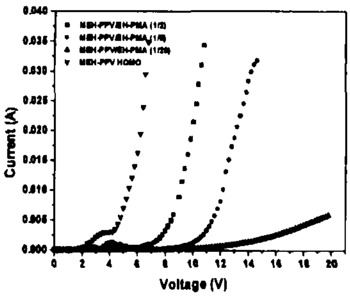


FIGURE 3 Voltage-current (*I-V*) characteristics MEH-PPV and its EH-PMA polymer blends.

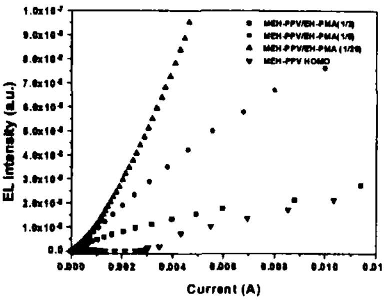


FIGURE 4 EL intensity-current (*L-I*) characteristics of MEH-PPV and its EH-PMA polymer blends.

the quantum efficiencies of blended polymer devices. As the EL active MEH-PPV is diluted by EH-PMA, the intermolecular nonradiative decay is diminished by blocking of the charge carriers. Therefore, the luminescent intensity is increased by increasing of the EH-PMA portion in blended polymer. Conclusively, we propose that the EH-PMA polymer acts as an EL enhancing materials rather than an EL active polymer.

ACKNOWLEDGEMENT

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