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Synthesis and Properties of Light-Emitting Polymers Containing High Electron Attracting Groups

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Two light-emitting polymers containing high electron attracting groups have been synthesized and their luminescent properties have been investigated. The synthesized polymers showed their absorption maxima at about 310 nm and the photoluminescence emission maxima at about 470 nm and 488 nm depending on the substituents. Single layer electroluminescent (EL) devices using the polymers showed blue and blue-green light emission.

Keywords: light-emitting polymer; electron withdrawing group

INTRODUCTION

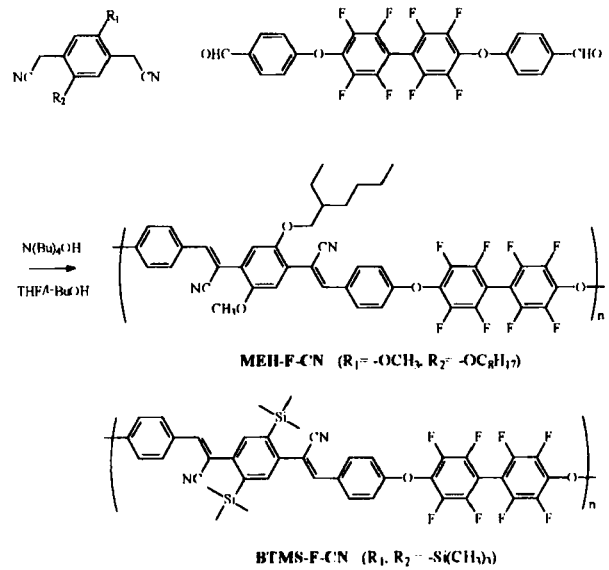
High electron affinity polymers have been extensively investigated to improve the quantum efficiency in the light-emitting devices.[1,2] High electron withdrawing groups lower the HOMO and LUMO energy levels and facilitate the electron injection from cathode due to the high electron affinity of the polymer, and thus improving the quantum efficiency of a polymer LED. Recently, we have successfully synthesized the light-emitting polymers containing high electron acceptors such as cyano and

perfluorobiphenyl moieties and have studied their luminescent properties. The synthetic scheme and chemical structures of the polymers are shown in Scheme 1.

EXPERIMENTAL

The polymers are synthesized by a Knoevenagel polycondensation reaction with 4,4'-bis(4-formylphenoxy)-octafluorobiphenyl and 2-methoxy-5-(2'-ethylhexyloxy)benzene-1,4-diacetonitrile or 2,5-bis(tri-methylsilyl)benzene-1,4-diacetonitrile. The condensation reaction takes place upon addition of excess tetrabutylammonium hydroxide in a tetra-hydrofuran/*t*-butanol mixture at 50 °C.[1,3] EL device fabrication, UV-visible, PL and EL measurements were performed in a similar way to the previously reported method.[4]

Scheme 1



MEH-F-CN (R_1= -OCH_3, R_2= -OC_8H_{17})

BTMS-F-CN (R_1, R_2 = -$Si(CH_3)_3$)

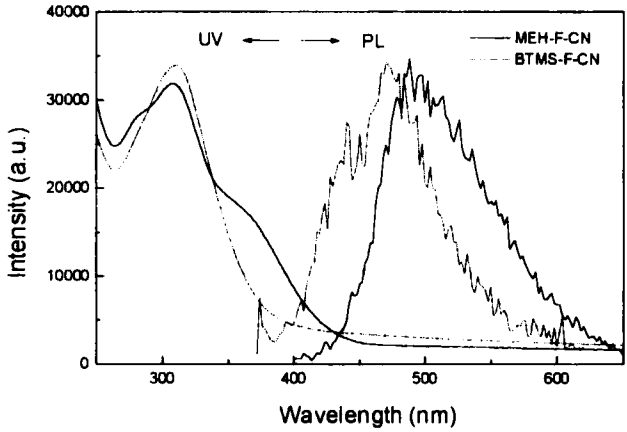


FIGURE 1. UV-visible and PL spectra of MEH-F-CN (solid line) and BTMS-F-CN (dot line) films.

RESULTS AND DISCUSSION

The synthesized MEH-F-CN and BTMS-F-CN are soluble in common organic solvents and the polymer solutions form smooth and uniform films by spin coating. Figure 1 shows the UV-visible and PL spectra of MEH-F-CN and BTMS-F-CN films. The MEH-F-CN film shows the absorption maximum at 310 nm and shoulder at 365 nm. The BTMS-F-CN films shows the absorption maximum at 310 nm without any shoulder absorption peak. PL emission maxima of MEH-F-CN and BTMS-F-CN films are at 470 nm and 488 nm, respectively. Single layer EL devices using these polymers as the emissive layer have been fabricated. Figure 2 shows the I-V and L-V characteristics of the single layer EL devices. The forward current increases with increasing the forward bias voltage and the curve shows a typical diode characteristics. The turn-on voltages of ITO/MEH-F-CN (100 nm)/Al and

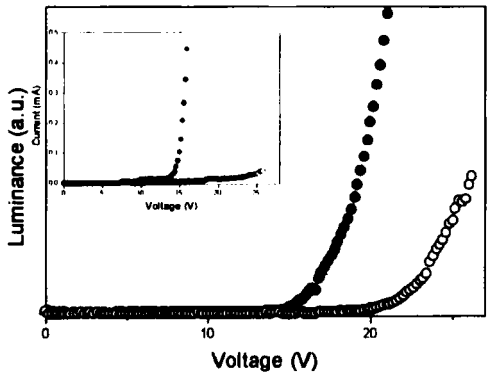


FIGURE 2. L-V and I-V (inset) curves of ITO/MEH-F-CN (filled circle) and ITO/BTMS-F-CN/Al (open circle) devices.

ITO/BTMS-F-CN (100 nm)/Al devices are about 15 V and 20 V, respectively.

We suppose that these polymers can be used as a good electron transporting layer (ETL) rather than an emissive layer (EML) in multilayered EL devices. Fabrication and characterization of the multilayered EL devices using the MEH-F-CN and BTMS-F-CN as the electron transporter layer are under investigation.

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