Synthesis of Water-Soluble 1,3,4-Oxadiazole-Based Electron Transporting / Hole Blocking Materials for the Applications of Multilayer Polymer Light Emitting Devices

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Abstract

The goal of this research is aimed to synthesize polyoxiranes containing 1,3,4,-oxadiazole side groups for the application in multi-layer polymer light-emitting diodes as an electron transporting and hole blocking layers. In the first part, the monomer 2-phenyl-5-[4-(9-oxiranyl nonyloxy)phenyl]-1,3,4-oxadiazole **(M1)** was synthesized. The homopolymer (P1) was synthesized via cationic ring-opening polymerization, using $BF_3 \cdot OEt_2$ as the initiator. By copolymerizing with different amounts of 1,2-hexyl epoxide, three copolymers P2, P3 and P4 were obtained. The maximum UV-Vis absorption bands were located from 300 to 307 nm in thin film state, while their maximum PL emission bands were located from 365 nm to 371 nm. The highest-occupied molecular orbital (HOMO) and lowest un-occupied molecular orbital (LUMO) ranged from -6.13 to -6.16 eV and from -2.56 to -2.74 eV, respectively.

In the second part of this research, a series of multi-layer light-emitting diodes with the configuration of ITO / PEDOT / EML / P1 ~ P4 /

Ca / Al were fabricated. The synthesized P1 ~ P4 materials were used as the electron-transporting / hole-blocking layer (ETL / HBL) to evaluate the device performance. In this part, an inorganic salt lithium triflate ($LiCF_3SO_3$) were also added into P1 ~ P4 materials to evaluate its effect on device performance. The results showed that the luminance of devices were effectively increased using P1 ~ P4 as ETL / HBL, and the efficiency of devices showed high stability under high current density. By adding $LiCF_3SO_3$ into P1 ~ P4, the luminance and efficiency of devices were further improved. The multi-layer with P2 : $LiCF_3SO_3$ as ETL / HBL was increased from 6208 to 10540 cd/m^2, and max current efficiency was enhanced from 1.36 cd/A to 2.16 cd/A as comparison with a double- layer device without this layer.