側鏈取代液晶基之高分子液晶材料在偏極化電激發光元件的應用

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摘要

本研究之主要目的為合成五個系列液晶材料(liquid crystal)，並探討其在偏極化光電性質上的應用。第一系列為小分子液晶材料，核心為三苯基雙乙烯，兩邊末端為含有可進行紫外光聚合之 acrylate 基團，此系列材料皆不具有向列型液晶相，只有 **M2** 和 **M4** 具有層列型液晶相。從實驗結果的光譜可看出平行方向的強度大於垂直方向的強度，表示發光基團的排列方向皆與定向摩擦的方向相同。第二系列為具有 benzothiadiazole 基團的側鏈高分子液晶材料 polyacrylate，導入 benzothiadiazole 基團，除了可使光色紅位移，也可提升電激發光元件性質。此系列的液晶材料皆具有雙變型(enantiotropic)之向列型液晶相，因此可應用於偏極化電激發光元件上。第三系列為發紅、綠、藍光之主鏈型聚芴(polyfluorene）高分子液晶材料，經

由使用鈀當催化劑的 Suzuki coupling 聚合反應所得到，此系列高分子材料皆呈現良好的熱穩定性及向列型液晶相，並可製作成紅、綠、藍光之偏極化電激發光元件，再利用摻混的方法製作出偏極化白光元件。第四系列為連接兩種分別與主鏈垂直（cyclohexylphenyl）、平行(penta(*p*-phenylene))的液晶基團之聚芴高分子液晶材料，此系列高分子材料皆具有向列型液晶相以及在光學性質方面具有高極化值(polarized ratio)，**PF9** 具有最佳的偏極化元件性質，其極化值與元件亮度分別為 12.4 與 1855 cd/m^2 。在白光元件製作方面，可得到最大極化值為 11.8，最大亮度為 2454 cd/m^2 之偏極化白光元件。第五系列為具有平行液晶基團 (penta(*p*-phenylene)) 且主鏈為 poly(*p*-phenylene vinylene)之高分子液晶材料，此系列高分子材料皆具有向列型液晶相，高分子 **PPV1** 在紫外光吸收與螢光放射光譜的最大極化值分別為 5.2 與 4.7，此極化值在 PPVs 文獻中，為具有最佳的偏極化性質。

Synthesis of Laterally Attached Side-Chain Liquid Crystalline Polymers for the Application of Polarized Electroluminescence

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Abstract

The goal of this study is aimed to synthesize five series of liquid crystal (LC) materials for the application in polarized electroluminescence. The first series belongs to UV-curable rod-like diacrylates containing bis-stilbene as the mesogenic core. Most of them show no mesomorphic behavior except that **M2** and **M4** exhibit a S_A phase. The results indicate that the absorbance parallel to the rubbing direction is much higher than that perpendicular to the rubbing direction, which means that the mesogens are aligned parallel to the rubbing direction. In the second series, benzothiadiazole-based liquid crystalline polyacrylates were synthesized. The incorporation of benzothiodiazole moiety onto chromophores showed a red-shifted emission and improved device performance. These polymers reveal an enantiotropic nematic liquid crystal phase which can be applied for application in polarized electroluminescence. In the third series, three polyfluorene derivatives emitting red, green and blue

(RGB) colors were synthesized via a palladium-catalyzed Suzuki coupling reaction. All copolymers reveal good thermal stability and nematic liquid crystalline behavior. Polarized RGB electroluminescent devices were fabricated using these PF derivatives as active layers. Polarized white light emission was also obtained by blending approach. In the fourth series, polyfluorene derivatives containing two kinds of mesogens, cyclohexylphenyl and laterally attached penta(*p*-phenylene), were synthesized and characterized. These polymers show nematic liquid crystalline behavior and highly polarized ratio in optical properties. **PF9** offered the best polarized EL device performance with the polarized ratio of 12.4 and a maximum luminescence of 1855 cd/m^2. In the case of white light, a high polarized ratio of 11.8 and a pure white luminance of 2454 cd/m^2 were attained. In the fifth series, poly(*p*-phenylene vinylene) derivatives containing laterally attached penta(*p*-phenylene) mesogenes were also synthesized. These polymers show also nematic liquid crystalline behavior as well. The polymer **PPV1** showed a polarized ratio of 5.2 at 406 nm for UV-vis absorption and 4.7 at 572 nm for PL emission, which are superior to the side chain liquid crystalline PPVs reported so far.

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