Control of Polarization States of Light by Thermal Evaporation of Chiral Dopant

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Abstract— **We propose a method to generate multi-polarized light in a single substrate by spatially patterned deposition of chiral dopant on conjugated polymer. The deposited chiral dopant generates a twisted configuration of the conjugated polymer. By controlling thickness of the deposited chiral dopant, linearly polarized light as well as circularly polarized light are simultaneously emitted.**

I. Introduction

Circularly polarized (CP) light, which has considerable potential applications in displays and sensers,[1,2] is generated by twisted stacking of birefringent materials.[3] Although high degree of CP emission have been reported by doping chiral dopant into conjugated polymer,[3] complicated surface treatment was required to achieve patterned polarization in a single substrate.[4] Here, we demonstrated CP emission by thermal deposition of chiral dopant on polymeric mesogenic luminophore. By spatially patterned deposition of the chiral dopant, multi-polarized emissions including linear polarization and circular polarization were implemented in a single substrate.

II. Result and Discussion

The Poly(9,9-di-n-octylfluorenyl-2,7-diyl)-alt-(benzo [2,1,3]thiadiazol-4,8-diyl) (F8BT) as a emitting layer was spin-coated on a unidirectionally rubbed alignment layer. The right-handed chiral dopant (R5011) was deposited on the F8BT layer using shadow mask by thermal evaporation to pattern the polarization states. Sequentially, through annealing at 160 °C for 15 min, the twisted configuration at the dopant-deposited region and the unidirectional alignment at the non-deposited region were achieved as shown in Fig. 1.

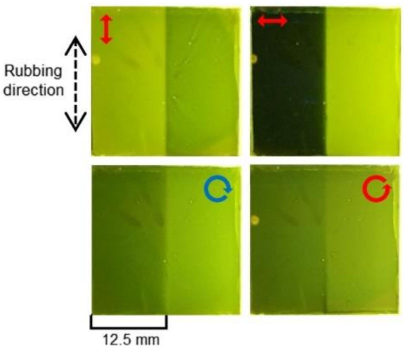

Fig.1 PL textures taken under linear polarizer (upper) and circular polarizer (lower).

Left region of microscopic textures in Fig. 1 shows completely dark state under polarizer perpendicular to rubbing direction. Under circular polarizers, however, the intensities of the transmittance are identical with both left-handed (LH) and right-handed (RH) circular polarizers. Therefore, the linearly polarized light was emitted and its ratio of linear polarization was measured to be 13. Right region of the textures shows different transmittance under LH and RH circular polarizers. As a result, circularly polarized light was emitted. The degree of the circular polarization is defined as the dissymmetry factor $g = 2(I_L - I_R) / (I_L + I_R)$, where I_L and I_R are the intensities of LH and RH CP lights, respectively. Here, the g factor was estimated to be -0.43 at 543 nm as shown in Fig. 2.

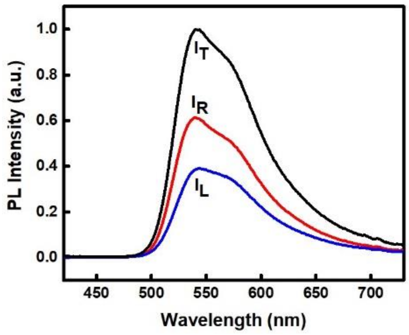

Fig.2 CP photoluminescence spectra of right region where chiral dopant was deposited.

In conclusion, through spatially patterned deposition of the chiral dopant, we demonstrated the light source with multi-polarization in the single substrate. The polarization states could be precisely controlled by deposition thickness of the chiral dopant.

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