Thickness-Dependent Polarized Emission in a Liquid Crystalline Light Emitting Polymer

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The control of orientational ordering in liquid crystalline (LC) conjugated polymers for organic light emitting diodes (OLEDs) has been of interest as a means to generating polarized light. In addition, the orientational ordering and its direction in the LC conjugated polymers are easily controlled by conventional alignment techniques used in LC displays [1]. A high polarization ratio, defined as the ratio of luminous intesities of parallel and perpendicularly polarized components, was observed in the LC conjugated polymer on the rubbed alignment layer [1,2]. Here, the rubbed alignment layer was acted as a hole injection/transport layer. The polarization ratio in electroluminescence (EL) and/or photoluminescence (PL) devices was directly correlated to the dipole orientation of the conjugated polymers and strongly governed by thermal annealing condition or anchoring strength of the alignment layer [2,3]. However, the EL and PL polarization ratios correlated to the order parameter of the conjugated polymers have not been theoretically discussed yet.

In this work, we theoretically analyzed both EL and PL polarized emissions of poly(9,9-dioctyl-2,7-fluorene) (PFO) based on the mean optical birefringence corresponding to the order parameter and the polarization ratio [2]. In such model, the effective optical birefringence is inversely proportional to a distance from the alignment layer, and thus the EL and PL polarization ratios are also reduced with increasing thickness of the PFO layer. The polarized light in the EL process is emitted at a certain region within the PFO layer but in the PL process the polarized light is emitted throughout the whole PFO layer. Our proposed birefringence model can account for the thickness-dependent polarization ratios in both EL and PL processes and the fitting results coincide with the previously reported literature.

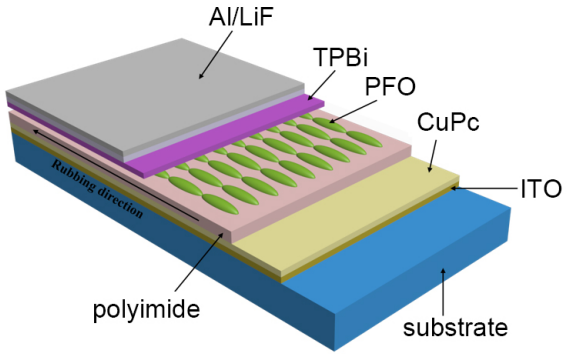

Fig. 1. Schematic structure of the linearly polarized emission

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References

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