

Influence of an electron transport layer of a White Polymer Light Emitting Diode

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Abstract – A new White Polymer Light Emitting Diode for white emission is fabricated and characterized. In order to searches for the white emission, different structures with two distinct electron transport layers (to allow charge confinement) are tested. The best result is obtained when butyl-PBD is used, although a small blue shift appears, which response can be interpreted as a superimposed of the electroluminescent emission from the blue polymer of the blend. When the Alq3 is used as electron transport layer, a systematic green shift is observed, that corresponds to a small emission of the Alq3 itself. This late result suggests a poor charge confinement. The physical model is proposed and discussed.

Conjugated polymers have attracted much research interest in science and technology. In the past years as electro-active materials for many applications like organic transistors, solar cells and polymer light-emitting diodes (PLED). One of the most important light-emitting fields is the white emission, due to their application in full color displays, backlights and other devices. Usually, depending on the organic layer composition, the emission can be chosen either to be confined to a relatively narrow band in the optical spectrum, leading to a monochrome wavelength, or to be distributed over the entire visible part of the electromagnetic spectrum, leading to a white emission. Some methods have been used to generating white emission since doping and / or making polymeric blends.

In this work, we present a successful three layer PLED with an emissive layer formed by a blend with MEH-PPV / Lapps 16 Poly(9,9 di n-dihexyl 2,7fluorenyldivinylene-alt-1,4 phenylenevinylene) / (PMMA/PMMant) with a host matrix of Poly(9,9 n-dihexyl 2,7 fluorene), used as received (not commercial). PEDOT:PSS is used for hole transport / injection layer.

In order to optimize the white emission, two distinct electron transport layers were tested: Alq3 and butyl-PBD. The results show that although the Alq3 enhances the electroluminescence, the butyl-PBD allows the emission to be more closed to the white emission. This must be due to the fact that, the Alq3 also emits suggesting that the use of this electron transport material cannot guarantee the correct charge confinement inside the active layer (it is clear due a green shift). By other side, the use of butyl-PBD a small blue shift occurs at more high applied voltage, indicating that the blue emitter from the blend tends to superimpose its emission. The best result obtained (with butyl-PBD) shows a driving voltage near 7 V and a luminance of 6 cd/m² at 15 V (current density of 220 A/m²). At low driving voltages the emission is near white with CIE (x,y) color coordinates of (0.3, 0.3) moving towards blue emission at high applied voltages with CIE color coordinates of (0.21, 0.20).

The physical discussion of results, taking into account the electronic properties and HOMO / LUMO levels of different materials is made.

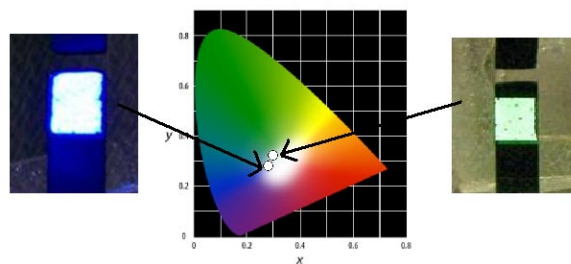


Figure 1: PLED at 10 V, where a) with Alq3 as electron transport layer and b) with butyl-PBD as electron transport layer

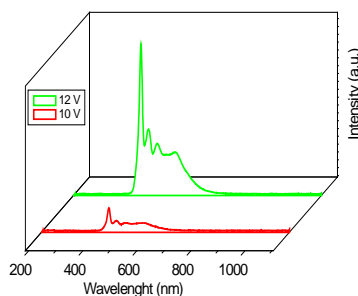


Figure 2: PLED EL-spectra with butyl-PBD as electron transport layer