Injection Characteristics of Transport Layers in PIN OLED

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ABSTRACT

Efficient injection of current into OLED is one of the critical factor for high performance OLED. It can be achieved by doping, which is a commonly adopted method to tune the energy level in the transport layer. Cs₂CO₃ is one of the more widely used dopants in electron injection material. However there is ambiguity in its function once it is doped into the material. In this work, the function of Cs₂CO₃ and also its chemical status when it is doped into four electron transport materials has been examined. It is found that Cs₂CO₃ can decompose into its oxide and hydroxide form when doped. They were found to occupy different energy levels with respect to the LUMO and HOMO of the host materials. The finding clarifies the role of Cs₂CO₃ in enhancement of OLED emission efficiency and the impact of metal cathodes on the Cs₂CO₃ doped electron transport layer (ETL) has been investigated. As balance of charge transport is also an important factor to get a high performance OLED, the mobility of Cs₂CO₃ doped ETL has been estimated by studying the movement of recombination zone.

White light organic light emitting devices (WOLED) can be contributed to solid-state lighting application. High power efficiency of WOLED can be achieved by incorporating p-i-n structure. By inserting PEDOT: PSS as a hole injection layer combining with the use of Cs₂CO₃ doped ETL, the barrier for carrier injection would be reduced, leading to the effective injection of holes and electrons. The optimum p-i-n WOLED structure of ITO/ PEDOT: PSS (60nm)/ NPB (40nm)/ mADN: EY53 (4.5nm)/ mADN: BUBD-1 (40.5nm)/ Bphen (5nm)/ Bphen: Cs₂CO₃ (25nm)/ Al achieves a maximum power efficiency of 15.2 lm/W.
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