Superluminescent Organic Light-Emitting Diodes based on Fullerene-based Charge Injection Materials

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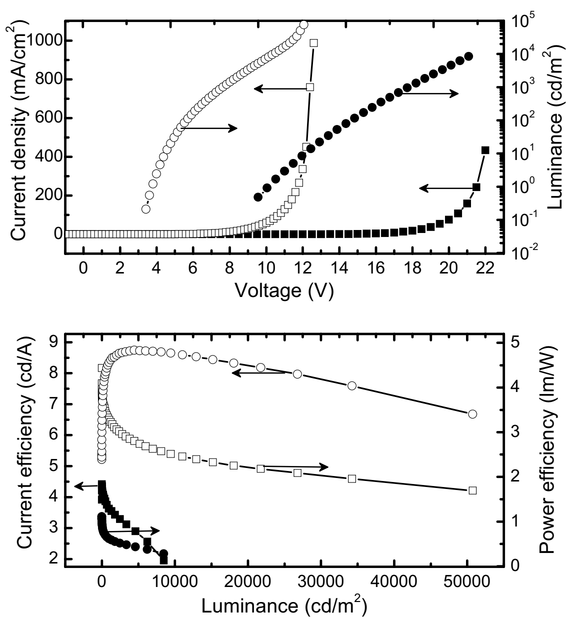
Fullerene-based materials have been found to form universal hole injection structures on several anode materials. A significant increase (~ 2 times) in current efficiency and thermal stability have been observed in OLEDs when the nanocomposite anode structures are used to replace the conventional CuPc/ITO hole injection structure (shown in Figure 1). Moreover, the composite anode structures enable the use of simple metal electrodes for efficient and stable OLEDs. The composite provides, through a controlled variation in the C_{60} concentration, a flexible material platform in regulating the hole injection and transport through the various layers in an OLED. On the electron injection side, fullerene-LiF system provide excellent Ohmic contact to several low work function metals (shown in Figure 2) and reduce the OLED's driving voltage significantly.



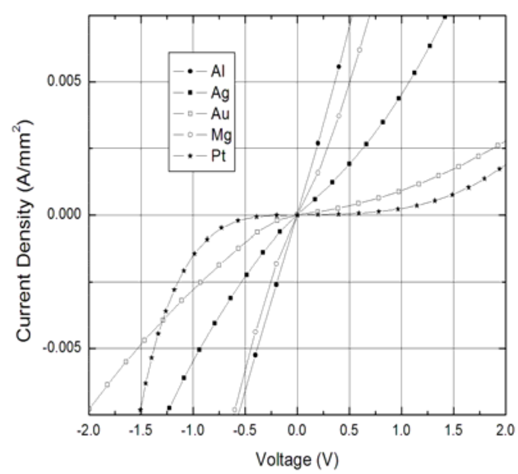


Figure 1. Current-voltage-luminance characteristics (top panel) and efficiency-luminance characteristics (bottom panel) of OLEDs with Au/CuPc anode structure (solid circles and squares) and Au/CuPc:30 wt.%C_{60} anode structure (open circles and circles). The test structure are: CuPc:C_{60}(25nm)/NPB(45nm)/Alq3(40nm)/LiF(1nm)/Al (open circles are squares) and CuPc(25nm)/NPB(45nm)/Alq3(40nm)/LiF(1nm)/Al, respectively.

Figure 2. Current-voltage characteristics of several test device structured as: Substrate/Metal(Al, Ag, Au, Mg, Pt)(60nm)-/C60(200nm)/LiF(1nm)/Al(100nm), respectively as labeled.