ABSTRACT

In recent years, three types of single-layer, mixed-host organic light emitting diode (OLED), namely the uniformly mixed (UM), step-wise graded mixed (SGM) and continuously graded mixed (CGM) OLEDs have shown to improve the device efficiency and stability over those of a conventional, bi-layer heterojunction (HJ) OLED. To the best of our literature search, while some numerical simulations have been performed on SGM- and UM-OLEDs, CGM-OLED has not been reported. Thus, it may warrant a comprehensive study via numerical simulations of these four OLEDs and comparison of their spatial profiles of electric field, carriers densities, recombination zones and rates in the mixed-host, light emitting layer.

In this work, a commercially available software, the "SimOLED' simulator is used to predict the current-voltage and luminance characteristic, current and power efficiencies of these OLEDs and compare with conventional, bi-layer heterojunction (HJ) OLED. Comparison is also carried out between the simulated and published experimental results of UM-, SGM-, CGM- and HJ-OLEDs. Reasonable good agreements are obtained on current and power efficiencies for OLED operations with and without the ultrathin electron injection layer. In order to enable the 'SimOLED', input parameters are required, these include the electron and hole mobilities in the electron-transport and hole-transport materials, respectively. Half-cell devices are fabricated so that electron-only and hole-only currents are measured, which profiles are simulated to extract the electron and hole mobiliities by using the Poole-Frenkel Mobility (PFM) Model, the Extended Gaussian Disorder Model (EGDM) and the Extended Correlated Disorder Model (ECDM); which are compared and discussed.