All-phosphorescent three-peak two-stack tandem white organic light emitting diodes

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The tandem stack structure is the most widely used technique to make high efficiency white organic light emitting diodes (WOLEDs) for lighting application. Recently, hybrid three stack tandem WOLEDs with fluorescent blue and phosphorescent yellow-red emitters show almost 100 lm/W(with additional out-coupling layer) efficiency and very good lifetime. However, this approach have a limitation to increase the efficiency because of 25% theoretical limitation value of singlet exciton generation. Whereas all-phosphorescent WOLEDs can break out this limit of efficiency, hence, over 120 lm/W efficiency are expected by the use of phosphorescent blue emitter.

In this paper, we report two-stacked three-peak all-phosphorescent tandem WOLEDs using phosphorescent red (608 nm) and yellow (550nm), blue (470nm) emitters. For high color rendering index (CRI), red emitter is applied as a single emissive layer (EML) and blue: yellow emitters are applied as blended EML. In order to find optimum location of each EMLs, optical simulation is conducted. After that, we fabricate red monochromatic device and blue: yellow blended device. From each device's *J/V*, *L/V*, *E.Q.E.*, *lm/*W and spectrum data, we can predict two-stack tandem OLED's performance (see Figure 1). We also investigate charge generation layer (CGL) by using ITO/ETL/n-ETL/p-type/HTL/Al structure for getting optimum n-dopant concentration, p-type materials thickness. Although there is a little optical losses because of metal dopant and non-perfectly matched p-n junction condition, we can achieve 60lm/W efficiency at 1,000 cd/m^2 with CRI 86.4. With internal and external out-coupling in this device, over 120 lm/W efficiency is expected at 1000nit.

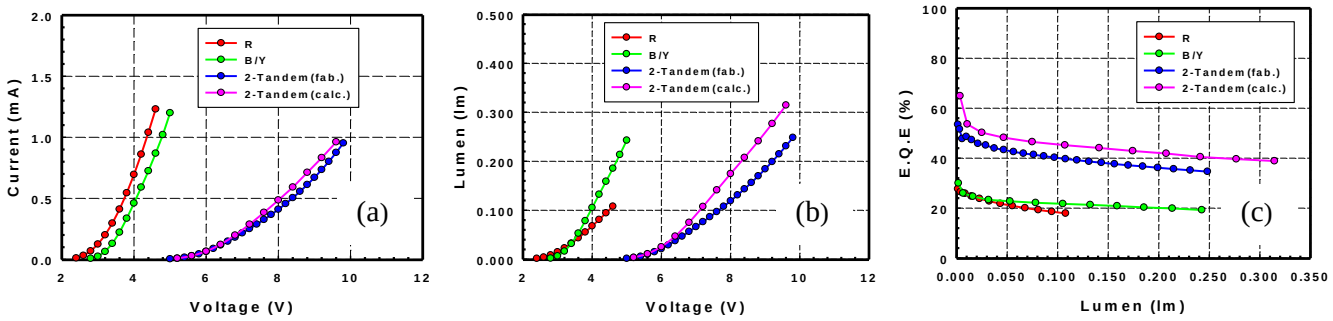

Fig. 1. (a) *J/V* (b) *L/V* (c) E.Q.E. graphs of unit red, blue/yellow blended OLEDs, calculated and fabricated two stacked tandem OLEDs.

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References

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