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Cyclometalated organoplatinum(II) complex for yellow and white organic light-emitting devices

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1. INTRODUCTION

Phosphorescent white organic light-emitting device (WOLED) technology is a major focus of OLED area since the demonstration of devices with practical electroluminescence (*EL*) efficiency of over 30 cd A^{-1} has been reported. Utilization of a simplified WOLED structure with two-color emission, i.e. blue and yellow (BY), is preferential. However, the success for realizing efficient BY-based WOLEDs strongly relies on the development of high efficiency key emitters. Herein, a high efficiency WOLED incorporating a newly-synthesized yellow-emitting organoplatinum(II) complex, **HKU-Y-Pt**, and a modified composite host for blue FIrpic phosphor that can achieve current efficiency (η_C) of 46 cd A^{-1} is reported.

2. EXPERIMENTS

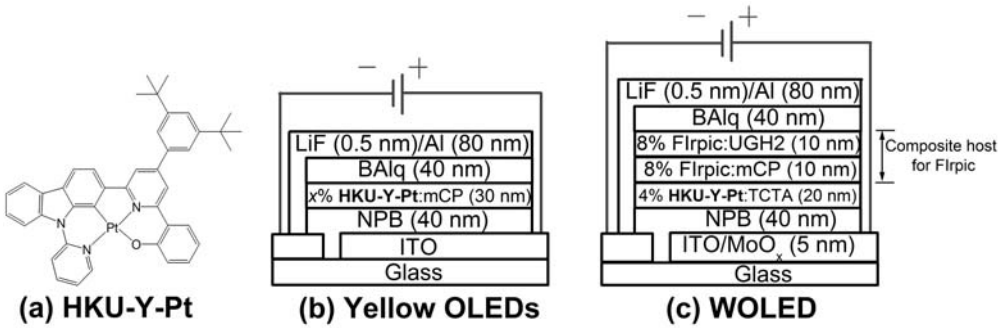

Fig. 1 Chemical structure of (a) **HKU-Y-Pt** and schematic device architectures of (b) yellow OLEDs (**HKU-Y-Pt** content, x = 2, 4, 6, 8) and (c) WOLED based on blue emission from FIrpic and yellow emission from **HKU-Y-Pt**.

Figure 1(a) shows the chemical structure of **HKU-Y-Pt** that contains a strong chelating tetradentate ligand having mixed C, O, and N donor atoms. The strong chelation effect of O^N^C^N ligand in **HKU-Y-Pt** contributes to excellent thermal stability with high decomposition temperature of 400 °C and good emission efficiency with high photoluminescence (*PL*) quantum yields of 0.82–0.86 in most of organic solvents. **HKU-Y-Pt** exhibits a saturated yellow emission with peak maximum at *ca.* 553 nm and emission lifetimes of 6.6–7.6 μs (shown in **Fig. 2**). To validate its *EL* performance, yellow OLEDs with **HKU-Y-Pt** as phosphorescent dopant at different concentrations were fabricated based on the configuration shown in **Fig. 1**(b). As shown in **Fig. 3**, a maximum η_C of 75 cd A^{-1} was achieved at an optimized concentration of 6%**HKU-Y-Pt**. In addition, the *EL* spectra for 6%**HKU-Y-Pt** device remain unchanged over a wide range of luminance, exhibiting same *EL* peak at 568 nm, as shown in

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the inset of **Fig. 3**. This corresponds to a saturated yellow emission with CIE of (0.52, 0.47).

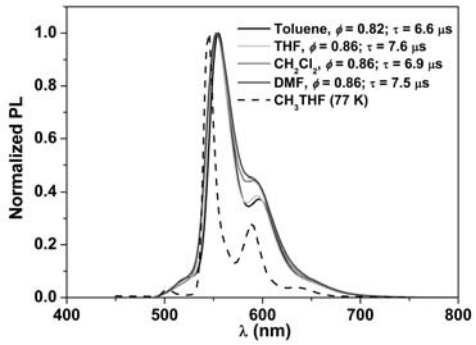

Fig. 2 *PL* spectra of **HKU-Y-Pt** in different solvents. Φ and τ are *PL* quantum yield and emission lifetime, respectively.

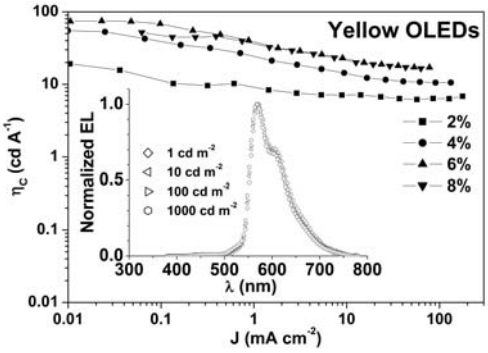

Fig. 3 η_c-*J* characteristics of yellow OLEDs. Inset: *EL* spectra of yellow OLED with 6%**HKU-Y-Pt** measured at various luminances.

Figure 4 depicts the *EL* spectrum of the optimized WOLED based on a modified structure (shown in **Fig. 1**(c)) incorporating a composite blue host of mCP and UGH2 both doped with 8%FIrpic and a single yellow emissive layer 4%**HKU-Y-Pt**:TCTA. *EL* spectrum of WOLED resembles to the summation of two monochromatic emissions from blue FIrpic and yellow **HKU-Y-Pt**, corresponding to CIE of (0.34, 0.44). **Figure 5** shows the η_C –current density (*J*) characteristic of WOLED, in which a high η_C of 46 cd A^{-1} could be realized, much higher than those obtained from conventional devices utilizing same emitters (~26 cd A^{-1}).

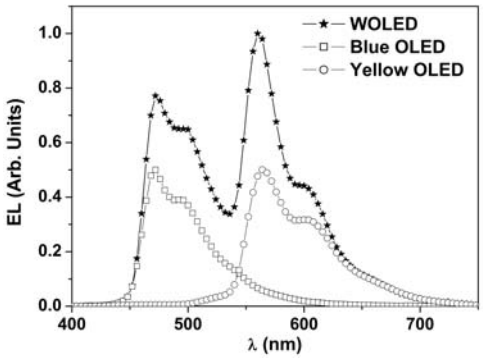

Fig. 4 *EL* spectra of WOLED, blue OLED and yellow OLED. Blue OLED: ITO / NPB / mCP / 8%FIrpic:UGH2 / BAlq / LiF / Al.

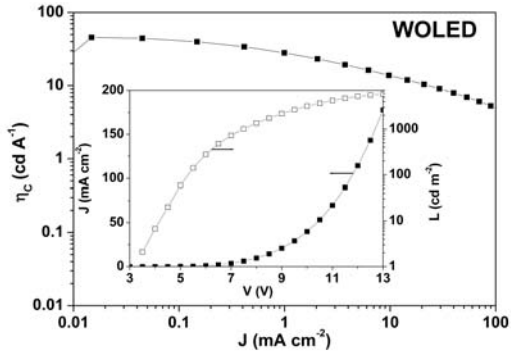

Fig. 5 η_c-*J* (Inset: Current density – voltage – luminance (*J-V-L*)) characteristic of WOLED.

3. SUMMARY

To conclude, the present work demonstrates WOLED incorporating a composite blue host and a highly robust yellow-emitting phosphor **HKU-Y-Pt**. This provides a simple means for achieving high efficiency of WOLED for lighting and can make advances to bring WOLED closer to practical applications.

ACKNOWLEDGEMENTS

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