**New Solution Processable Small Molecular Host Materials for Blue Phosphorescence Organic Light-Emitting Diodes**

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**Abstract**
A new series of CzPX small-molecule host materials for blue phosphorescence OLEDs have been characterized. These CzPX materials are truly amorphous and their triplet state energy are high in the range of 2.58~2.73 eV, estimated from the time-gated low temperature photoluminescence spectra of the neat film. Corresponding solution processed active single layer in blue phosphorescence OLEDs has been achieved. These devices have shown peak current efficiency at 7~11 cd/A, surpassing ~6 cd/A acquired for SimCP2-based device with same fabrication condition.

**Keyword**: Solution process, small molecule, host material, blue phosphorescence.

1. **INTRODUCTION**

Previously we have successfully developed small-molecule SimCP and SimCP2 (Fig. 1) for high performance blue phosphorescence (Flrpic dopant) organic light-emitting diodes (OLEDs).

Fig. 1 Chemical structure of mCP, SimCP, and SimCP2.

Whereas SimCP is best suitable for vacuum thermal deposition process in the fabrication of high performance blue phosphorescence OLEDs, SimCP2 is a truly amorphous small-molecule material and viable for solution process in the fabrication of OLEDs, which are constructed with single active layer containing Flrpic blue phosphorescence dopant and OXD-7 as electron transporting material. Very recently, we have demonstrated that such SimCP2 hosted Flrpic Blue phosphorescence OLEDs outperform the same device except the host material PVK, which is one of the few known polymeric material with high enough triplet state energy (Eₜ) for Flrpic blue phosphorescence dopant.

As part of ongoing research effort, here we report a new series of solution processable small molecular material with high enough Eₜ for hosting Flrpic blue phosphorescence dopant in single active layer OLEDs. The new small-molecule host material CzPX share a common feature of SimCP and SimCP2, i.e., mCP, where X can be AMe, APm, or PO (see Figure 2 for the chemical structure of CzPX). As shown in the structure, previously reported SimCP2 can be considered as one member of CzPX family, where X denotes diphenylsilane (SiPh₂).

Fig. 2 Chemical structure of high Eₜ solution processable small-molecule CzPX.

We report physical and spectroscopic characterization of CzPX host materials. A series of blue phosphorescence OLEDs were fabricated with solution process of a single active layer containing CzPX host, Flrpic blue phosphorescence dopant, and OXD-7 electron transporting material (see Figure 3 for the sketch of device structures).

Fig. 3 CzPX hosted blue phosphorescence OLED.

2. **EXPERIMENTAL AND RESULTS**

Amorphous feature of CzPX material was characterized by differential scanning calorimetry (DSC) and X-ray diffraction (XRD). Whereas all spin-coated thin films of CzPX display featureless halo in XRD spectra,
DSC thermograms identify clear glass transition temperatures ($T_g$) of the materials around 155-175 °C (Figure 4), which are all higher than 144 °C of truly amorphous SimCP2 reported previously. Low temperature (~10 k), time-gated, photoluminescence (PL) spectra were acquired for CzPX host materials (Figure 5). Solid state (thin film) $E_T$ values are estimated in the range of 2.58-2.73 eV, which are close to or higher than 2.64 eV (470 nm) of Flrpic blue phosphorescence dopant.

Solution process in fabricating single active layer of CzPX:OXD-7:Flrpic OLED was successful. All devices show typical Flrpic electroluminescence (EL) (Figure 6a). Brightness of the devices is in the order of CzPAMe > CzPPO > SimCP2 > CzPAPm (Figure 6b). However, above ~6 V, the current density of devices has the order of CzPAMe > CzPPO > SimCP2 > CzPAPm (Figure 6c), of which CzPAPm device is significantly smaller than that of SimCP2 device. Therefore, combing the brightness and current density results, EL efficiency of the devices follows the order of CzPAMe > CzPAPm > CzPPO > SimCP2 (Figure 6d).

3. SUMMARY

We have developed new series of solution processable small-molecule, high $E_T$ host materials CzPX for blue phosphorescence Flrpic OLEDs. EL efficiency (cd/A) of these devices are better than that of previously known SimCP2 OLEDs.

4. REFERENCES