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Electronic Supplementary Information Section

New Journal of Chemistry

Synthesis and characterisation of carbazole-based bipolar exciplex-forming compound for efficient and color-tunable OLEDs

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Data analyse of the fabricated devices.

The maximum theoretical external quantum efficiency for the single-layer device using DPNC as emitting layer can be described by the equation:

$$\eta_{ext}=\gamma\times\phi_{PL}\times\chi\times\eta_{out} \qquad \text{(Eq. 1)}$$

where γ corresponds to the charge-balance factor, ϕ_{PL} is the photoluminescence quantum efficiency, χ is the efficiency of exciton production (χ=0.25 in case of the fluorescence type devices), and η_{out} corresponds to the outcoupling efficiency (η_{out} is usually from 0.2 to 0.3). Indeed, the maximum theoretical external quantum efficiency for the single-layer device was only 0.23% since PLQY of solid layer of DPNC was only of 4.6 %. The obtained max. external quantum efficiency of 0.18 % for the single-layer device is in good agreement with this maximum theoretical external quantum efficiency (**Table 1**).

In the case of the bilayer device, exciplex type emitter formed on the interface between DPNC and BPhen layers was utilized (**Figure 10, main text**). To predict the maximum theoretical external quantum efficiency for the bilayer device, we additionally measured PLQY of the spin coated film of the blend DPNC (50%):Bphen (50%), which was found to be 9.31±2 %. This result is added to the main text of the manuscript. The exciplex type emitters allow harvesting of triplet excitons through intersystem crossing between triplet and singlet levels, resulting in χ values approaching unity (Nature Photonics 6, 253–258 (2012) doi:10.1038/nphoton.2012.31). The maximum theoretical external quantum efficiency of 2.8 % for the bilayer device was calculated using equation 1 and η_{out}=0.3. This value of the maximum theoretical external quantum efficiency is slightly lower than the experimentally obtained max. external quantum efficiency (3.3 %) for the bilayer device probably due to the interface effects (**Table 2**).

Characterization of the bilayer OLED in which TPBi was used as electron-transport interlayer.

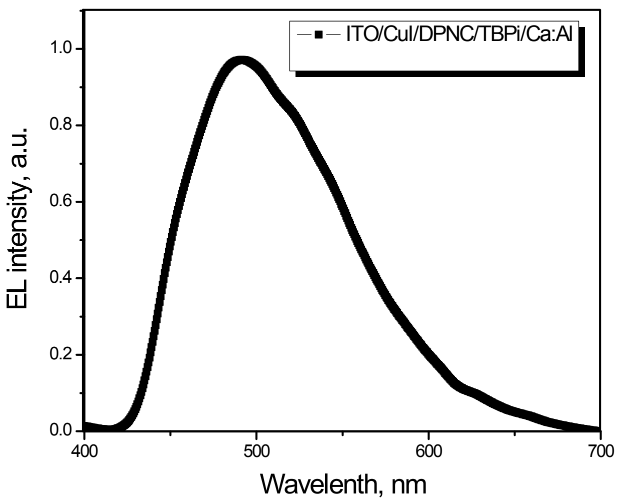

Figure S1. EL spectrum of ITO/CuI/DPNC/TPBi/Ca/Al device.

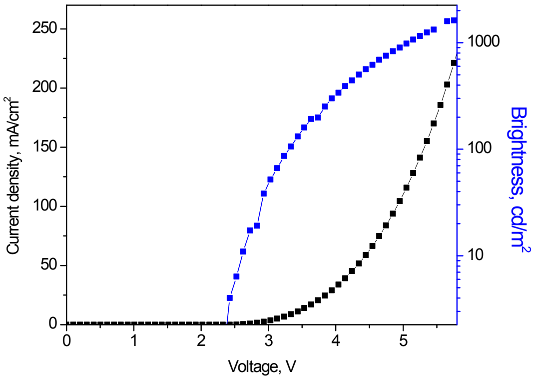

Figure S2. Current density *vs.* voltage (black curve) and brightness *vs.* voltage (blue curve) dependencies for the TPBi-containing OLED device.