*Electronic Supporting Information*

# Red Emissive AIE Luminogens with High Hole-Transporting Properties for Efficient Non-doped OLEDs

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**Fig. S6** Energy level diagrams and device configurations of (A) device II and (B) device IV.

## Experimental section

### Materials and Instrumentations

TTB and TNB were prepared according to the reported experimental procedures.[1] All the solvents and chemicals were purchased from Aldrich and used as received without further purification. UV spectra were measured on a Milton Roy 5 Spectronic 3000 Array spectrophotometer. Photoluminescence spectra were recorded on a Perkin-Elmer LS 55 spectrofluorometer. Time-resolved fluorescence decay curves of TTB and TNB were measured using an Edinburgh FLSP920 spectrophotometer equipped with a 450 nm picosecond pulsed diode laser (EPL-450, 5 mW) at room temperature. Their thermal stabilities were evaluated on TGA Q5000 and DSC Q1000 instruments under nitrogen at a heating rate of 10 ℃/min. Cyclic voltammetry (CV) experiments were carried out in dichloromethane solution with 0.1 M tetrabutylammonium hexafluorophosphate (*n*-$Bu_4NPF_6$) as the supporting electrolyte at a scan rate of 100 mV/s by using $Ag/AgNO_3$ as the working electrode and saturated calomel electrode (SCE) as the reference electrode.

### Device fabrication

The devices were fabricated on 80 nm ITO-coated glass with a sheet resistance of 25 Ω per square. Before loading into the pretreatment chamber, the ITO-coated glasses were soaked in ultrasonic detergent for 0.5 h, followed by spraying with deionized water for 10 min, soaking in ultrasonic deionized water for 0.5 h, and oven-baking for 1 h. The cleaned samples were treated by fluoroform plasma with a power of 10 W, gas flow of 50 sccm, and pressure of 0.2 Torr for 10 s in the pretreatment chamber. The samples were transferred to the organic chamber with a base pressure of $5 \times 10^{-7}$ Torr for the deposition of NPB, AIE emitters (TTB and TNB), and TPBi. The samples were then transferred to the metal chamber for the deposition of cathode, which was composed of lithium fluoride (LiF) capped with aluminum (Al). The light-emitting

area was 4 $mm^2$ as defined by the overlap of the anode and cathode. The current density–voltage–luminance characteristics of the devices were measured by a HP4145B semiconductor parameter analyzer and a calibrated UDT PIN-25D silicon photodiode. The luminance and external quantum efficiencies of the devices were inferred from the photocurrent of the photodiode. The EL spectra were determined by a PR650 spectrophotometer. All the measurements were performed at room temperature under air without device encapsulation.

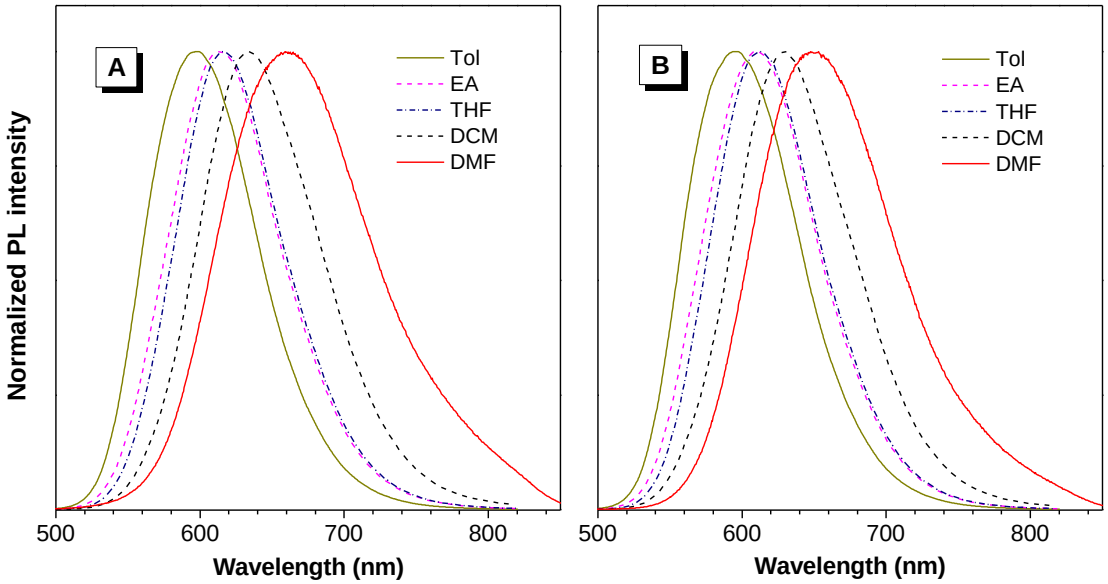



**Fig. S1** Emission spectra of (A) TTB and (B) TNB in solvents with different polarities. Excitation wavelength: 470 nm.

**Table S1.** Absorption and emission of TTB and TNB in different solvents[a]

| Solvent | TTB | | TNB | |
|---|---|---|---|---|
| | $\lambda_{ab}$ (nm) | $\lambda_{em}$ (nm) | $\lambda_{ab}$ (nm) | $\lambda_{em}$ (nm) |
| Tol | 473 | 598 | 470 | 595 |
| EA | 463 | 614 | 464 | 610 |
| THF | 471 | 616 | 470 | 613 |
| DCM | 467 | 635 | 470 | 629 |
| DMF | 466 | 659 | 465 | 649 |

[a] Abbreviation: $\lambda_{ab}$ = absorption maximum, $\lambda_{em}$ = emission maximum.

**Table S2** Optical, electronic and thermal properties of TTB and TNB.

| | | $\lambda_{em}$ (nm)[b] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $\lambda_{ab}$ (nm)[a] | soln | aggr | film ($\Phi_{F's}$)[c] | $\tau$ (ns)[d] | $E_g$ (eV)[e] | HOMO/LUMO (eV)[f] | $T_d/T_g$ (℃)[g] |
| TTB | 471 | 616 | 609 | 617 (48.8%) | 4.93 | 2.26 | −5.23/−2.97 | 456/nd[h] |
| TNB | 470 | 613 | 604 | 617 (63.0%) | 3.19 | 2.27 | −5.21 /−2.94 | 535/169 |

[a] Absorption maximum ($\lambda_{ab}$) in THF. [b] Emission maximum ($\lambda_{em}$) in THF solutions (soln, 10 μM), THF/water mixtures (aggr; 1:9 v/v; 10 μM), and solid thin films spin-coated from THF solution. [c] $\Phi_{F's}$ are the fluorescence quantum efficiencies in the solid state measured by a calibrated integrating sphere. [d] τ = fluorescence lifetime of solid powders. [e] $E_g$ = energy gap calculated from the onset of the absorption spectrum. [f] HOMO = the highest occupied molecular orbital determined from cyclic voltammetry by the equation: HOMO = –($E_{onset}$ –$E_{ferrocene}$ + 4.8); LUMO = the lowest unoccupied molecular orbital calculated by the equation: LUMO = HOMO + $E_g$. [g] $T_d$ = temperature for 5% weight loss, $T_g$ = glass transition temperature. [h] nd = not detected.

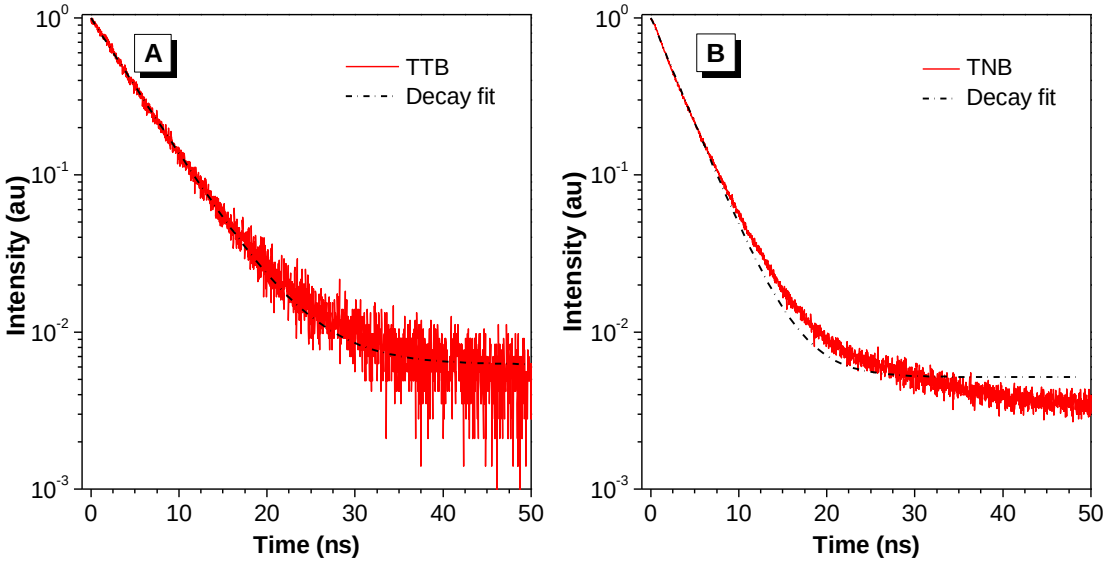



**Fig. S2** Time-resolved fluorescence decay curves of (A) TTB and (B) TNB in the solid state at room temperature.

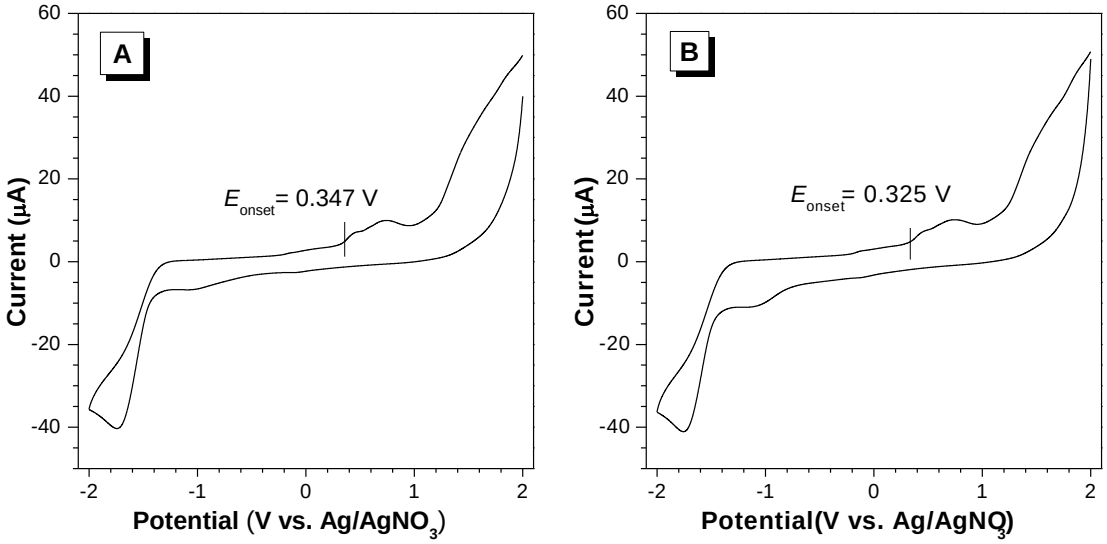



**Fig. S3** Cyclic voltammograms of (A) TTB and (B) TNB measured in dichloromethane containing 0.1 M tetra-*n*-butylammonium hexafluorophosphate. Scan rate = 100 mV/s.

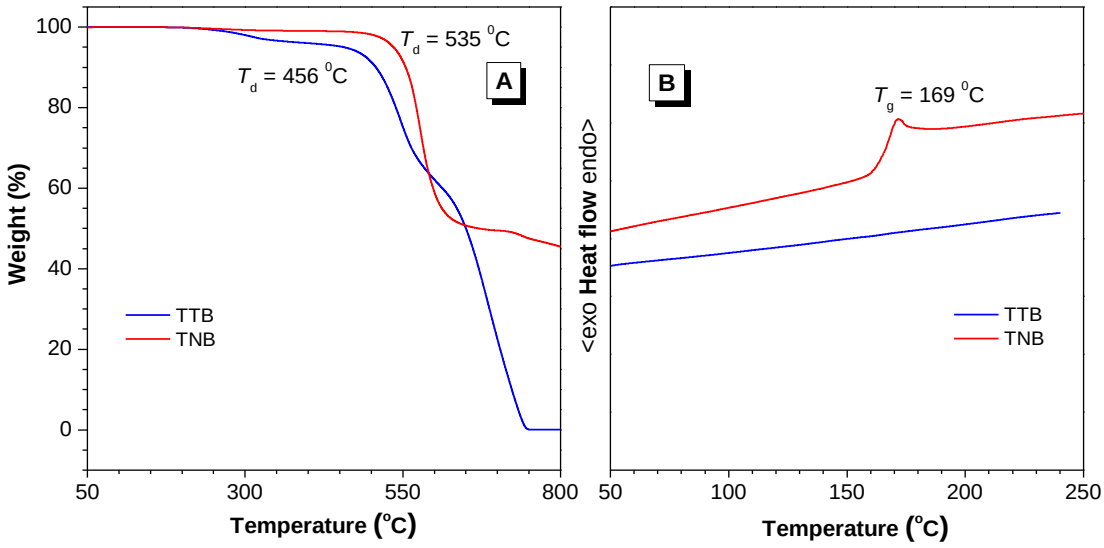
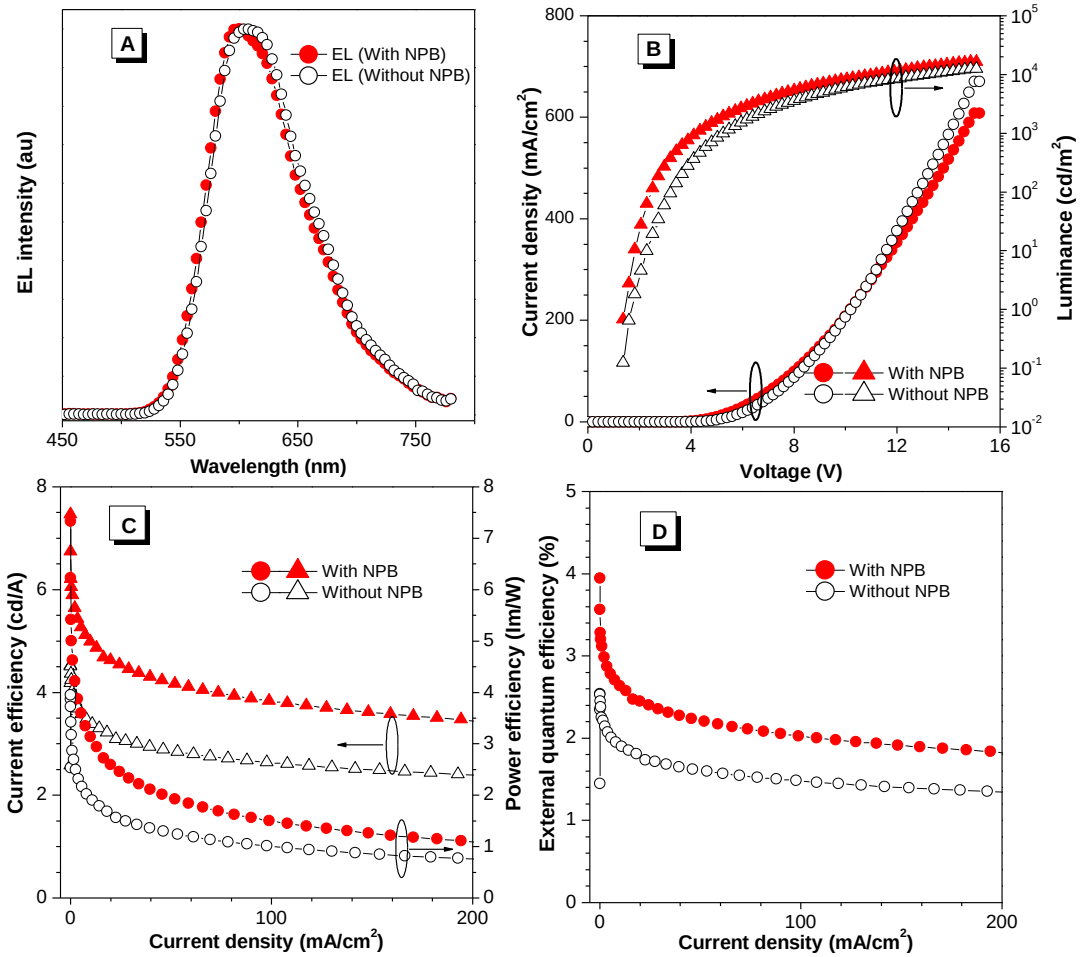



**Fig. S4** (A) TGA thermograms and (B) DSC curves recorded during the second heating cycle of TTB and TNB measured under $N_2$ at a heating rate of 10 ℃ /min.

**Table S3** EL performances of TTB and TNB[a]

| Dye | Device | EL (nm) | $V_{on}$ (V) | $L_{max}$ (cd/m$^2$) | $\eta_{C,max}$ (cd/A) | $\eta_{P,max}$ (lm/W) | $\eta_{ext,max}$ (%) |
|---|---|---|---|---|---|---|---|
| TTB | I | 604 | 3.2 | 15584 | 6.4 (4.4) | 6.3 (2.6) | 3.5 (2.3) |
| TTB | III | 604 | 3.5 | 13459 | 5.7 (4.0) | 5.4 (2.1) | 3.2 (2.2) |
| TNB | II | 604 | 3.2 | 16396 | 7.5 (4.6) | 7.3 (2.6) | 3.9 (2.4) |
| TNB | IV | 610 | 3.2 | 12468 | 4.5 (3.0) | 3.9 (1.4) | 2.5 (1.7) |

[a] Device configuration: ITO/NPB(80 nm)/luminogen(20 nm)/TPBi(40 nm)/LiF(1 nm)/Al(100 nm) (device I and II); ITO/luminogen(100 nm)/TPBi(40 nm)/LiF(1 nm)/Al(100 nm) (device III and IV). Abbreviation: $\lambda_{EL}$ = maximum emission wavelength, $V_{on}$ = turn-on voltage at 1 cd/m$^2$, $L_{max}$ = maximum luminance, $\eta_{P,max}$ = maximum power efficiency, $\eta_{C,max}$ = maximum current efficiency, and $\eta_{ext,max}$ = maximum external quantum efficiency. The values in the parentheses are taken at a luminance of 1000 cd/m$^2$.

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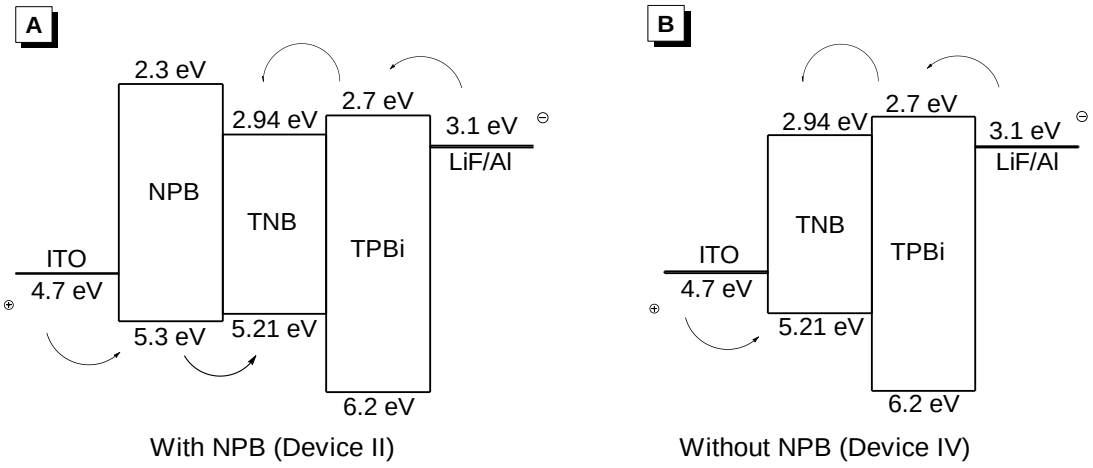


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## Reference

1 W. Qin, K. Li, G. Feng, M. Li, Z. Yang, B. Liu and B. Z. Tang, *Adv*. *Funct*. *Mater*., 2014, **24**, 635.