# Supporting information

## High Power Efficiency Solution-Processed Blue Phosphorescent OLEDs Using Exciplex-Type Host with a Turn-on Voltage Approaching the Theoretical Limit

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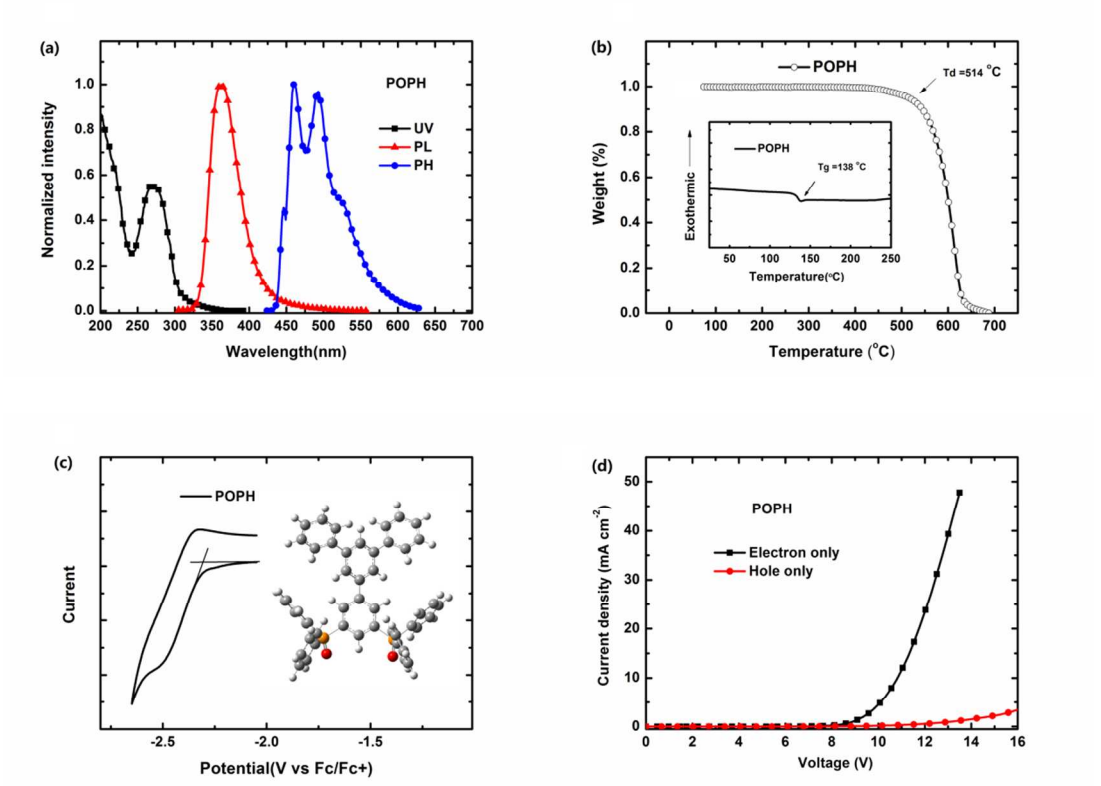


Figure S1. Physical properties of the electron-transporting material POPH. a) UV-Vis absorption, fluorescence and phosphorescence spectra of the spin-coated POPH film. b) TGA curve of POPH recorded at a heating rate of 10 °C $min^{-1}$. Inset: DSC trace recorded at a heating rate of 10 °C $min^{-1}$. c) Cyclic voltammogram of POPH in acetonitrile for reduction. Inset: Optimized space geometry for POPH. d) Current density-voltage (J−V) curves of hole- and electron-only devices based on POPH. The structure for hole-only device was ITO/PEDOT:PSS/POPH (60 nm)/Al, and the structure for electron-only device was ITO/POPH (60 nm)/TPBI (30 nm)/Ca (10nm)/Ag.

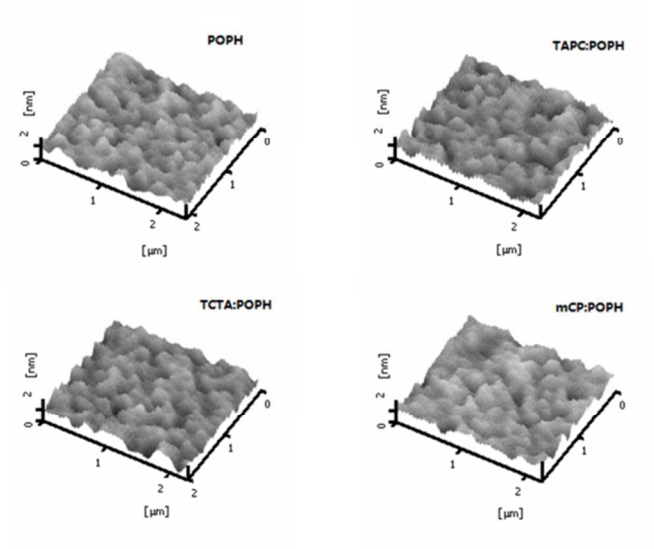


**Figure S2.** AFM topographic images of POPH, TAPC:POPH, TCTA:POPH and mCP:POPH**.**

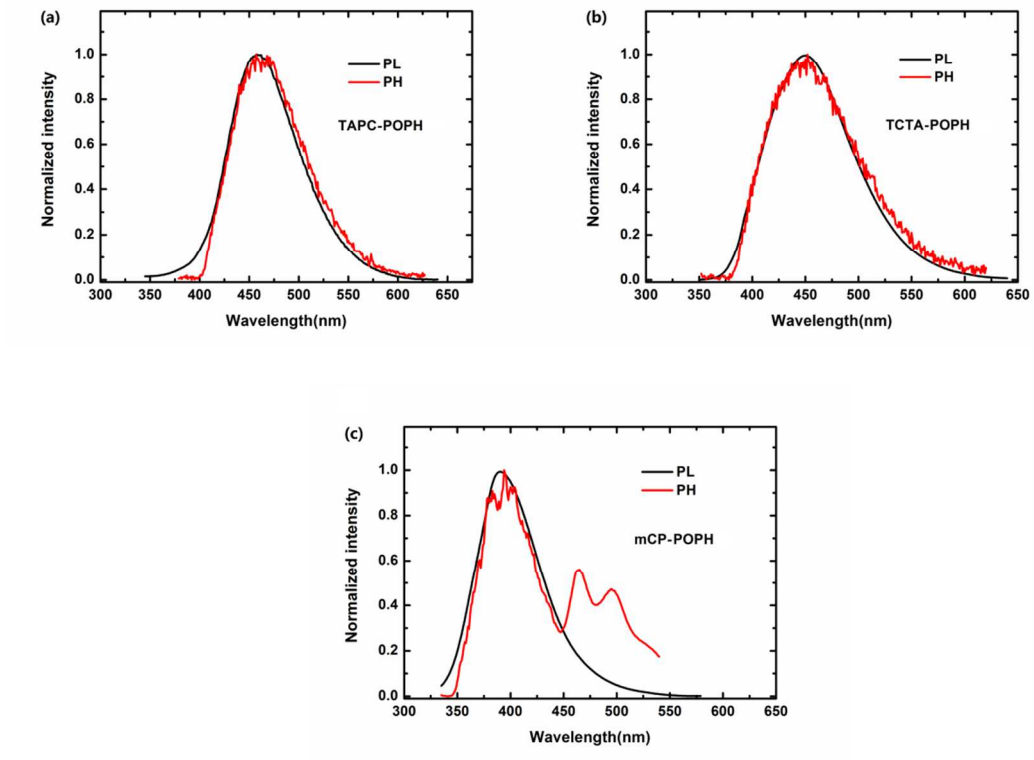


**Figure S3.** Fluorescence and phosphorescence spectra of mixed films at 77 K. (a)TAPC:POPH. (b) TCTA:POPH. (c) mCP:POPH.

**Table S1**. Photophysical properties of the exciplex emitters and their constituting molecules.

| | $\lambda_{max}$ [nm][a] | FWHM [nm][b] | $S_1$ [eV][c] | $T_1$ [eV][c] | $\Delta E_{ST}$ [eV][d] | HOMO/ LUMO [eV][e] | $\tau$ [ns][a] |
|---|---|---|---|---|---|---|---|
| TAPC | 375 | 43 | 3.59[e] | 2.98[e] | 0.61 | -5.6/-2.0 | 2.5 (53%), 6.3 (47%) |
| TCTA | 392 | 47 | 3.21[e] | 2.85[e] | 0.36 | -5.8/-2.4 | 2.3 (100%) |
| mCP | 365 | 54 | 3.49[e] | 3.00[e] | 0.49 | -6.1/-2.4 | 3.5 (100%) |
| POPH | 363 | 46 | 3.41[e] | 2.78[e] | 0.65 | -6.7/-2.5 | 20 (100%) |
| TAPC:POPH | 460 | 82 | 2.69 | 2.64 | 0.059 | -/- | 4.4 (12%), 135 (88%) |
| TCTA:POPH | 448 | 95 | 2.75 | 2.72 | 0.038 | -/- | 20 (23%), 150 (77%) |
| mCP:POPH | 392 | 72 | 3.15 | 3.10 | 0.051 | -/- | 16 (38%), 80 (62%) |

[a] Measured in deposited films at 300 K. [b] The full width at half maximum (FWHM) of the emission spectra. [c] Estimated from high-energy peaks of film-state fluorescence and phosphorescence spectra at 77 K. [d] The difference between $S_1$ and $T_1$. [e] Obtained from the reference.

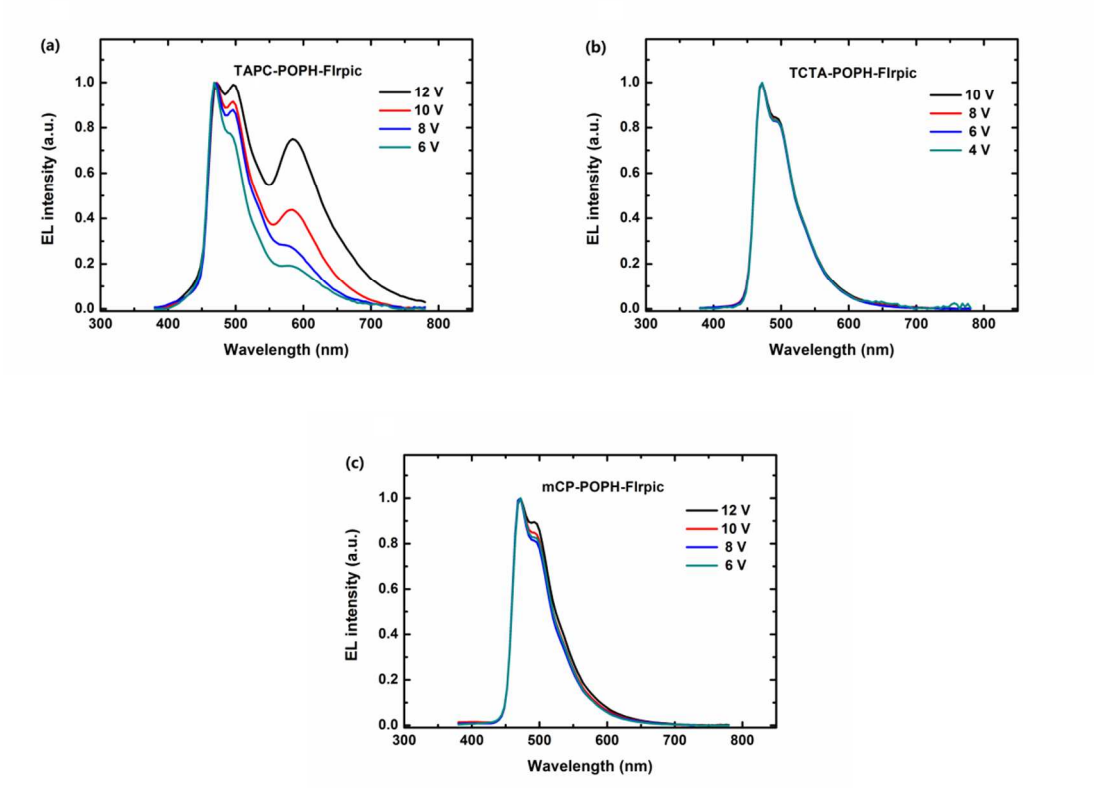


**Figure S4.** Electroluminescence spectra of the (a) TAPC-POPH-FIrpic, (b) TCTA-POPH- FIrpic and (c) mCP-POPH-FIrpic based devices at different voltages.