

## Supporting Information

### Highly efficient deep-red organic light-emitting diodes using exciplex-forming co-hosts and thermally activated delayed fluorescent sensitizers with extended lifetime

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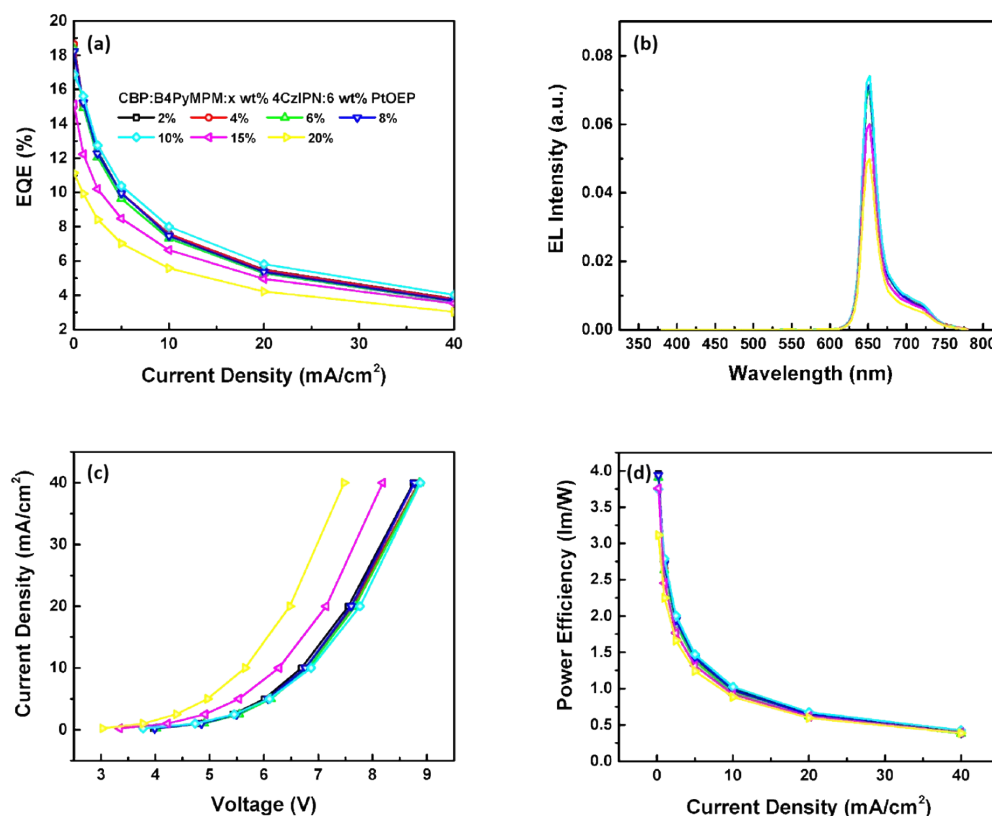


Figure S1 (a) External quantum efficiencies (EQEs) vs. current densities, (b) electroluminescence (EL) spectra, (c) current densities vs. voltage, and (d) power efficiencies (PEs) vs. current densities curves of the novel-design PtOEP-based deep-red PhOLEDs with various 4CzIPN concentrations from 2 wt% to 20 wt% at the doping concentration 6 wt% of the guest PtOEP.

(ITO/HAT-CN (10 nm)/TAPC (55 nm)/TCTA (10 nm)/ CBP:B4PyMPM: x wt% 4CzIPN: 6 wt% PtOEP (30 nm)/B4PyMPM (55 nm)/ Liq (2 nm)/Al (110 nm))

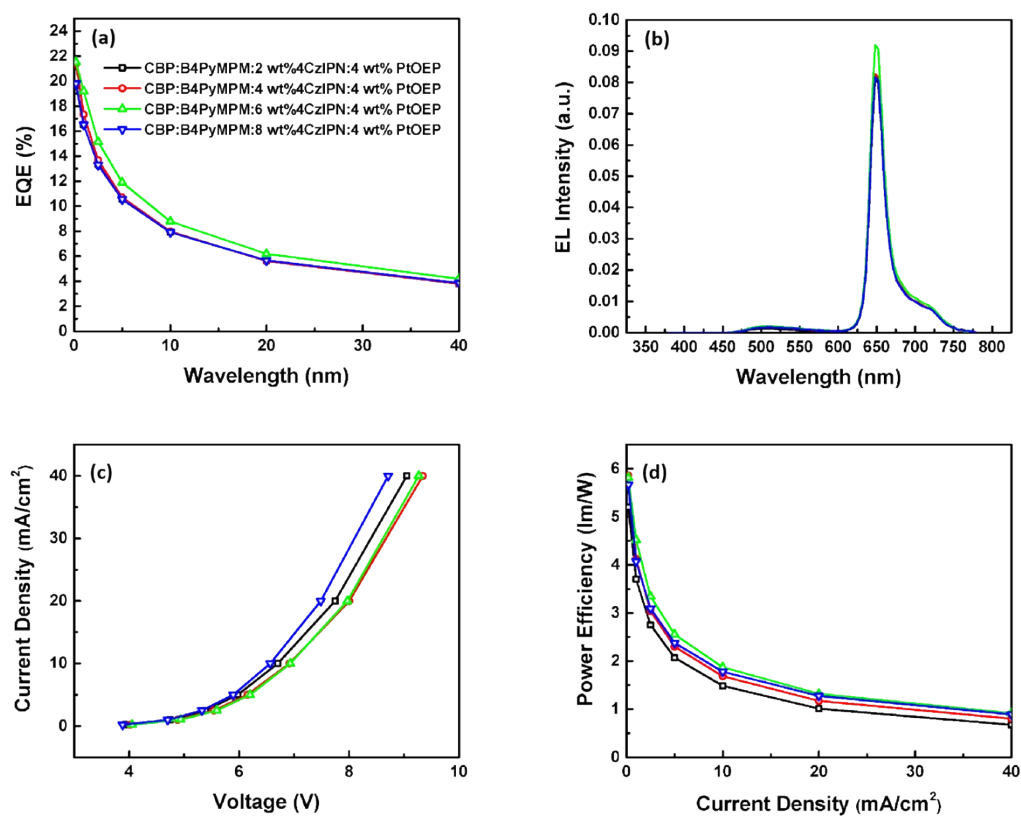


Figure S2 (a) External quantum efficiencies (EQEs) vs. current densities, (b) electroluminescence (EL) spectra, (c) current densities vs. voltage, and (d) power efficiencies (PEs) vs. current densities curves of novel-design PtOEP-based deep-red PhOLEDs with various 4CzIPN concentrations from 2 wt% to 8 wt% at the doping concentration 4 wt% of the guest PtOEP.

(ITO/HAT-CN (10 nm)/TAPC (55 nm)/TCTA (10 nm)/ CBP:B4PyMPM: x wt% 4CzIPN: 4 wt% PtOEP (30 nm)/B4PyMPM (55 nm)/ Liq (2 nm)/Al (110 nm))

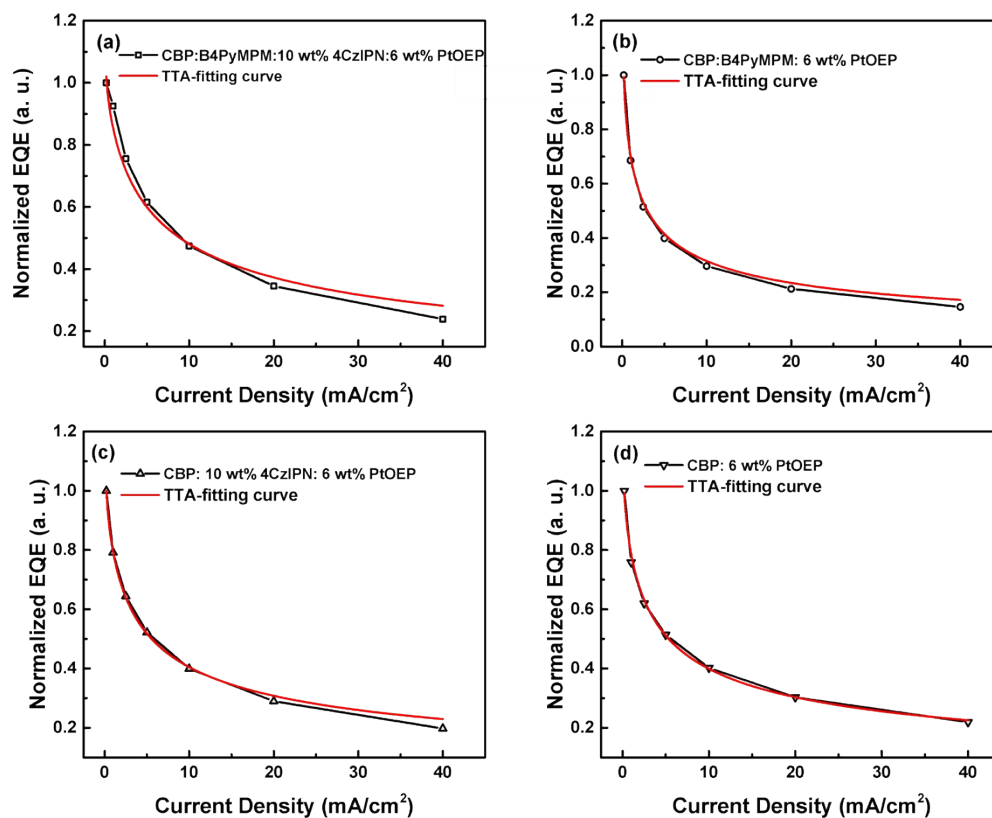


Figure S3 Images of TTA-fitting stimulation for PtOEP-based deep-red PhOLEDs using different emitting layers of (a) CBP:B4PyMPM: 10 wt% 4CzIPN: 6 wt% PtOEP, (b) CBP:B4PyMPM: 6 wt% PtOEP, (c) CBP:10 wt% 4CzIPN: 6 wt% PtOEP and (d) CBP:6 wt% PtOEP.

Table S1. The photoluminescence quantum yields (PLQYs) of emitting layers.

Emitting layer	Photoluminescence quantum yield (PLQY)
CBP: B4PyMPM: 6 wt% 4CzIPN: 4 wt% PtOEP	50
CBP: B4PyMPM: 10 wt% 4CzIPN: 6 wt% PtOEP	43
CBP: B4PyMPM: 6 wt% PtOEP	40
CBP: 10 wt% 4CzIPN: 6 wt% PtOEP	36
CBP: 6 wt% PtOEP	35

(The PLQYs were tested by HORIBA, Fluorolog-3.)