# Supporting information

## *n*-Doping-Induced Efficient Electron-Injection for High Efficiency Inverted Organic Light-Emitting Diodes Based on Thermally Activated Delayed Fluorescence Emitter

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Each layer of the cathode structure is studied by AFM. As shown in **Fig. S1**, ITO has a rougher surface with a RMS value of 2.60 nm. After depositing a 20-nm-thickness ZnO film, the surface becomes much more smooth. This indicates that the ZnO film can remedy the surface defect of ITO and facilitate efficient charge injection by reducing leakage current. When spin-coating a blend film of BPhen:$Cs_2CO_3$, the RMS roughness decreases to 0.373 nm, which is comparable to the film prepared by vacuum evaporation.

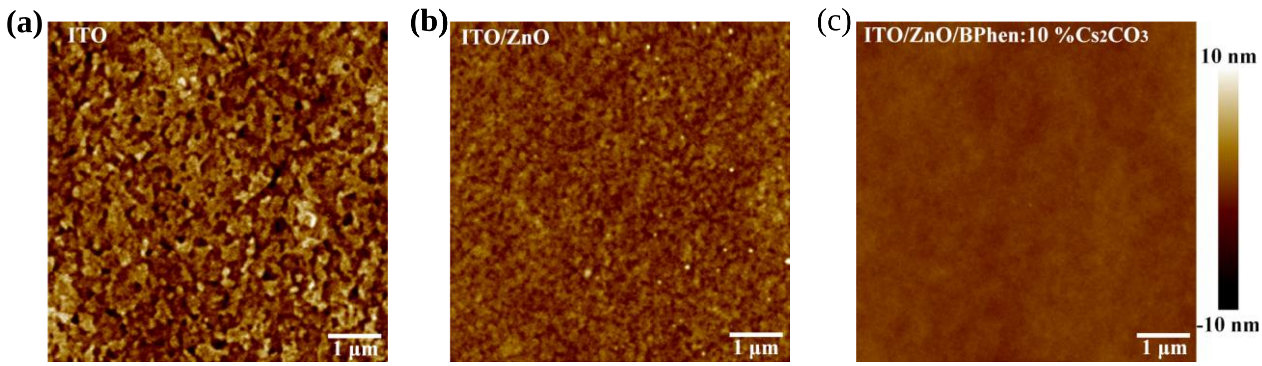


**Fig. S1** Comparison of AFM images (5 µm × 5 µm) of bare ITO, ITO/ZnO (20 nm) and ITO/ZnO (20 nm)/BPhen:10 wt% $Cs_2CO_3$(20 nm). The RMS values are 2.60 nm, 1.30 nm, 0.373 nm, respectively.

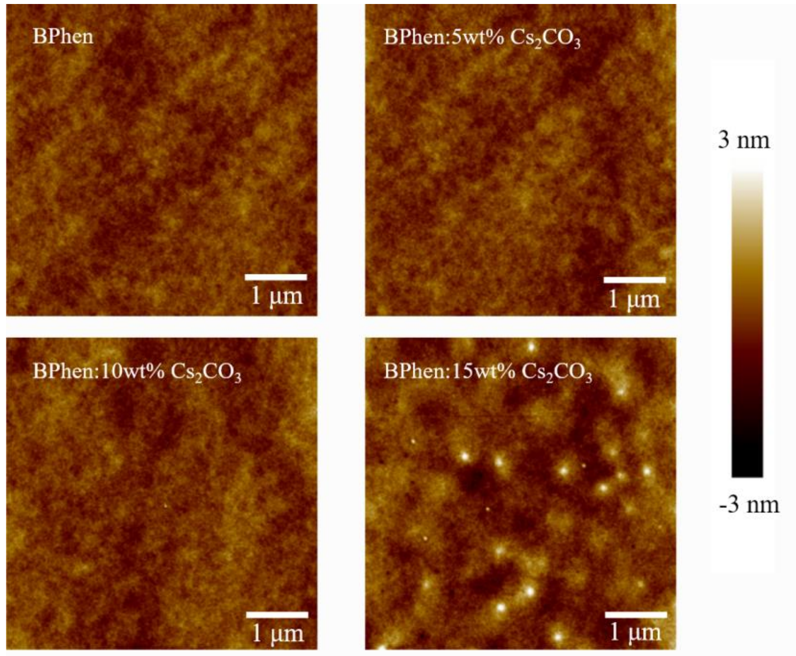


**Fig. S2** Comparison of AFM images (5 μm × 5 μm) of ITO/ZnO (20 nm)/BPhen: $Cs_2CO_3$ (20 nm, *x* wt%). *x* is 0 wt%, 5 wt%, 10 wt%, and 15 wt%, respectively.

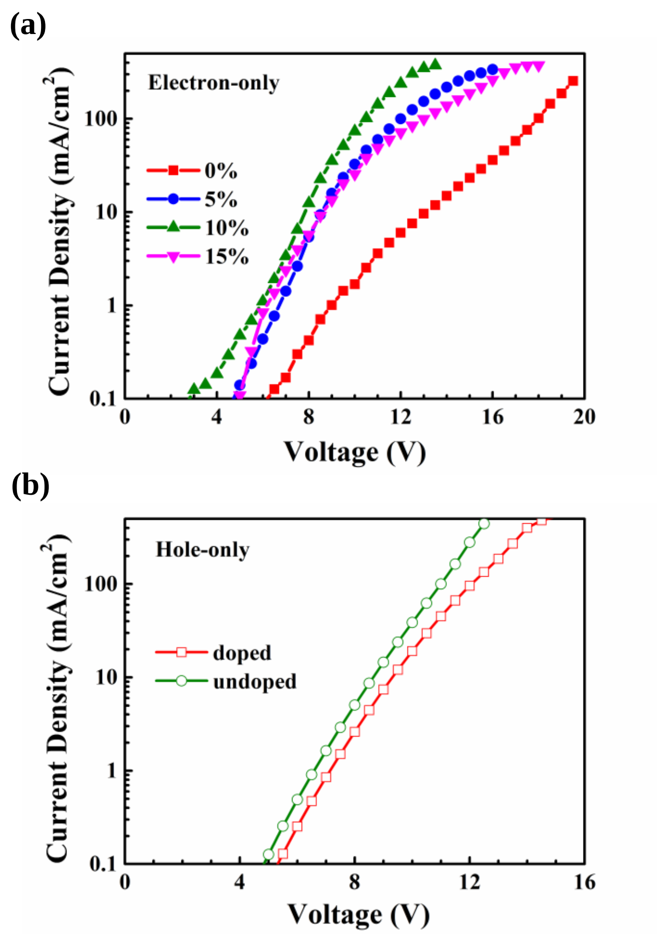


**Fig. S3** J−V characteristics of (a) electron-only and (b) hole-only devices. The structure of electron-only device is ITO/ZnO (20 nm)/BPhen:x wt% $Cs_2CO_3$ (20 nm)/BPhen (20 nm)/mCBP (30 nm)/BPhen (30 nm)/LiF (0.9 nm)/Al, and hole-only device is ITO/PEDOT:PSS (30 nm)/TAPC (20 nm)/mCBP (un-) doped with TXO-PhCz (30 nm)/TAPC (40 nm)/$MoO_3$ (10 nm)/Al.

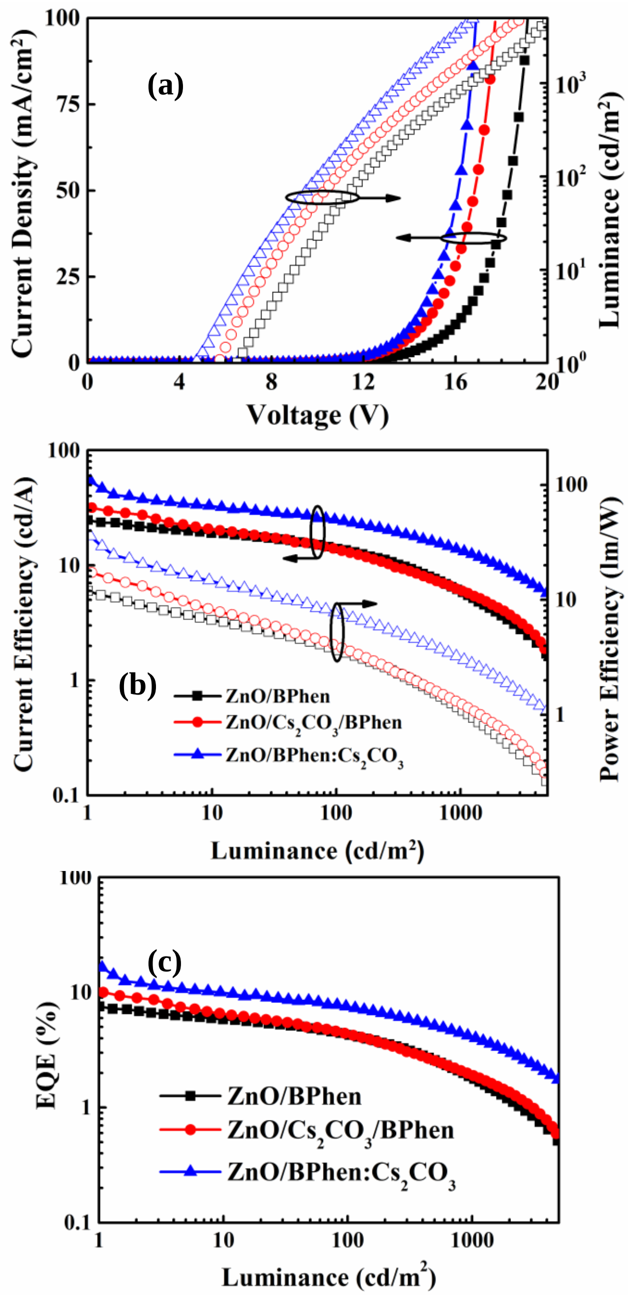


**Fig. S4** The performance comparison of devices without interlayer, with a pure $Cs_2CO_3$ layer and with a BPhen:$Cs_2CO_3$ doped layer: (a) Current density-Voltage-Luminance curves; (b) Current efficiency-Luminance-Power efficiency curves; and (c) EQE-Luminance curves. The structure of the device with $Cs_2CO_3$ interlayer is: ITO/ZnO (20 nm)/$Cs_2CO_3$ (5 nm)/BPhen (40 nm)/mCBP:10 wt% TXO-PhCz (30 nm)/TAPC (40 nm)/$MoO_3$ (10 nm)/Al (90 nm).

**Table S1.** Summary of device performance for inverted OLEDs with different ZnO thicknesses.

| ZnO | $V_{on}$ [V][a] | $EQE_{max}$ [%] | $CE_{max}$ [cd/A] | $PE_{max}$ [lm/W] |
|---|---|---|---|---|
| 30 nm | 6.2 | 7.5 | 24.3 | 12.2 |
| 25 nm | 5.8 | 10.7 | 33.7 | 18.4 |
| 20 nm | 4.7 | 16.4 | 53.9 | 35.6 |
| 15 nm | 5.2 | 10.3 | 32.3 | 19.3 |

[a]Turn-on voltage (at brightness of 1 cd/$m^2$).

**Table S2.** Summary of device performance for inverted OLEDs with different interlayer.

| Interlayer | Doping concentration [wt%] | $V_{on}$ [a] [V] | $EQE_{max}$ [%] | $CE_{max}$ [cd/A] | $PE_{max}$ [lm/W] |
|---|---|---|---|---|---|
| BPhen: $Cs_2CO_3$ | 0 | 6.5 | 7.5 | 24.6 | 11.9 |
| BPhen: $Cs_2CO_3$ | 5 | 5.5 | 11.3 | 37.6 | 21.5 |
| BPhen: $Cs_2CO_3$ | 10 | 4.7 | 16.4 | 53.9 | 35.6 |
| BPhen: $Cs_2CO_3$ | 15 | 5.5 | 13.4 | 42.3 | 24.2 |
| $Cs_2CO_3$ | – | 5.7 | 10.0 | 31.6 | 17.3 |
| BPhen: $Cs_2CO_3$ [b] | 10 | 4.4 | 9.9 | 29.3 | 19.4 |
| $Cs_2CO_3$ [b] | – | 5.4 | 9.1 | 27.9 | 16.0 |

[a]Turn-on voltage (at brightness of 1 $cd/m^2$). [b]Prepared by vacuum-deposited method.