

Electronic Supplementary Information (ESI)

Towards ideal electrophosphorescent devices with low dopant concentrations: the key role of triplet up-conversion

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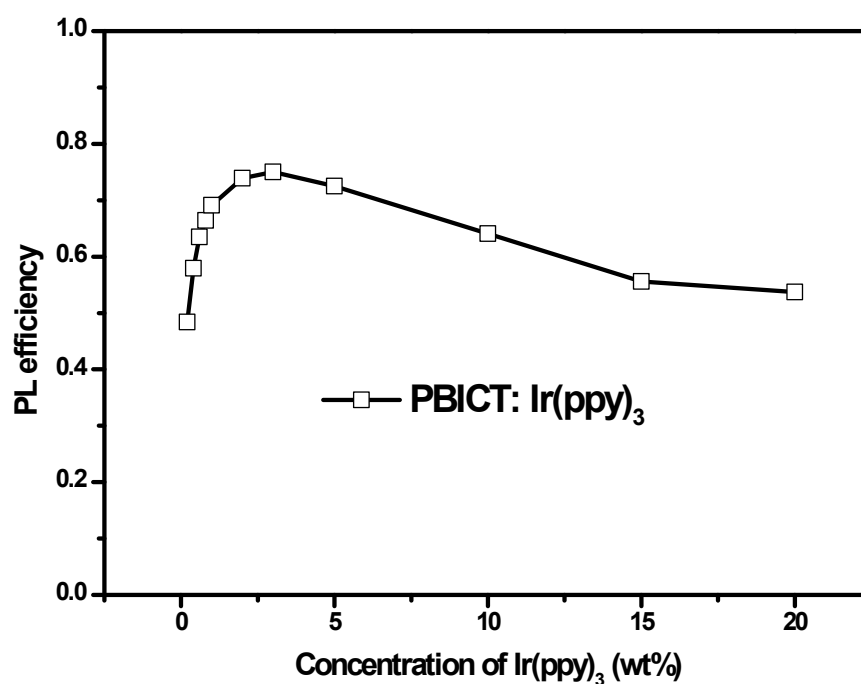


Figure S1: The PL efficiency of PBICT: Ir(ppy)₃ films.

Table S1. The transient decay characteristics of films.

	τ_{S1} (ns)	k_{S1} (s ⁻¹)	k_{ET} (s ⁻¹)
CBP	1.4	7.14×10^8	
CBP: 0.2% Ir(ppy) ₃	1.02	9.80×10^8	2.66×10^8
CBP: 0.4% Ir(ppy) ₃	0.92	10.9×10^8	3.76×10^8

CBP: 0.6% Ir(ppy) ₃	0.85	11.9×10^8	4.76×10^8
PBICT	19	5.26×10^7	
PBICT: 0.2% Ir(ppy) ₃	16	6.25×10^7	0.99×10^7
PBICT: 0.4% Ir(ppy) ₃	13	7.69×10^7	2.43×10^7
PBICT: 0.6% Ir(ppy) ₃	12	8.33×10^7	3.07×10^7
PBICT: 0.8% Ir(ppy) ₃	11	9.09×10^7	3.83×10^7
PBICT: 1.0% Ir(ppy) ₃	10	10.0×10^7	4.74×10^7

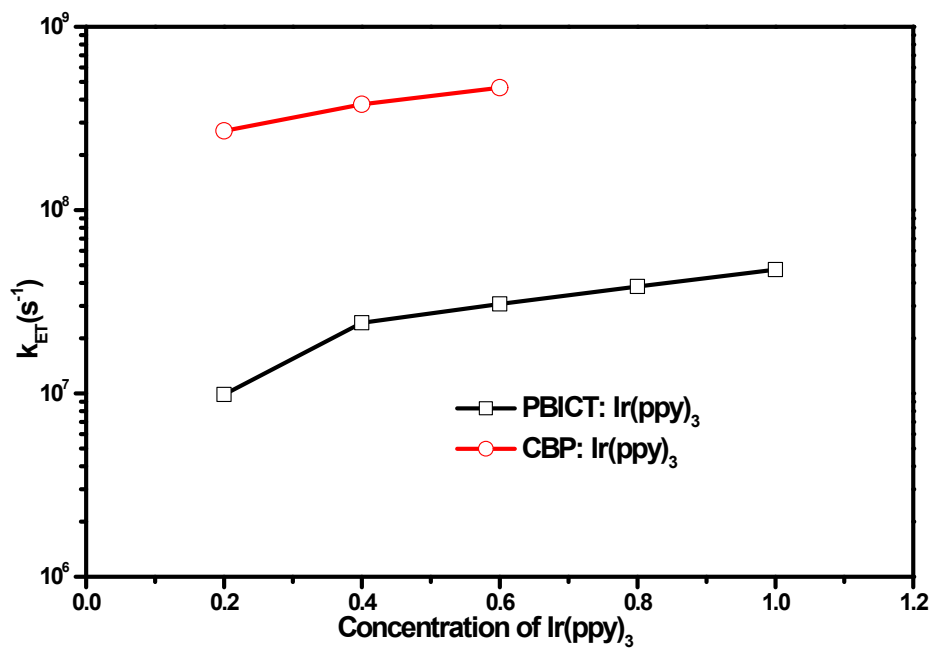


Figure S2: The k_{FET} of the host: guest films.

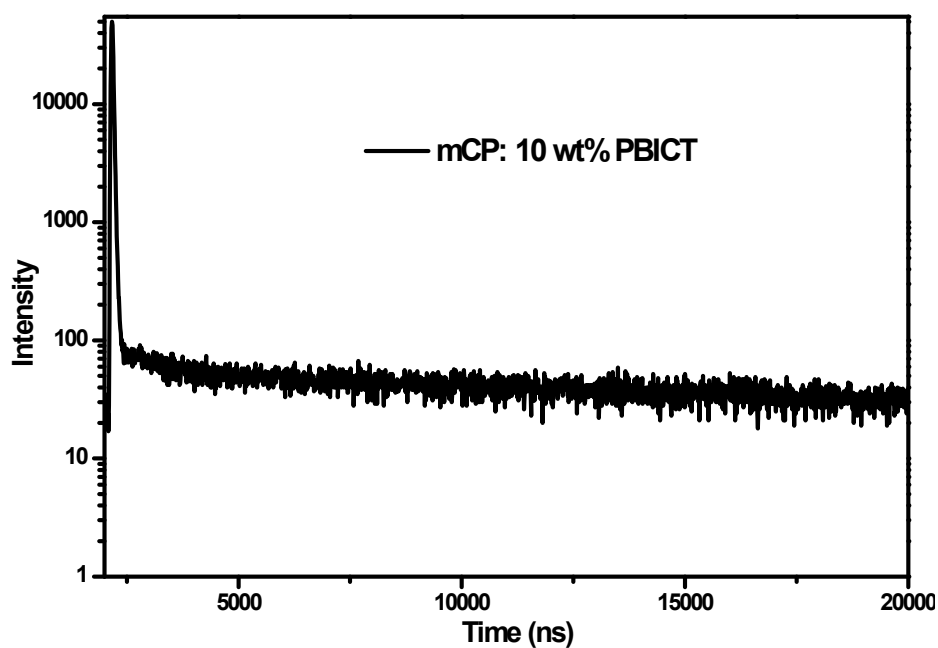
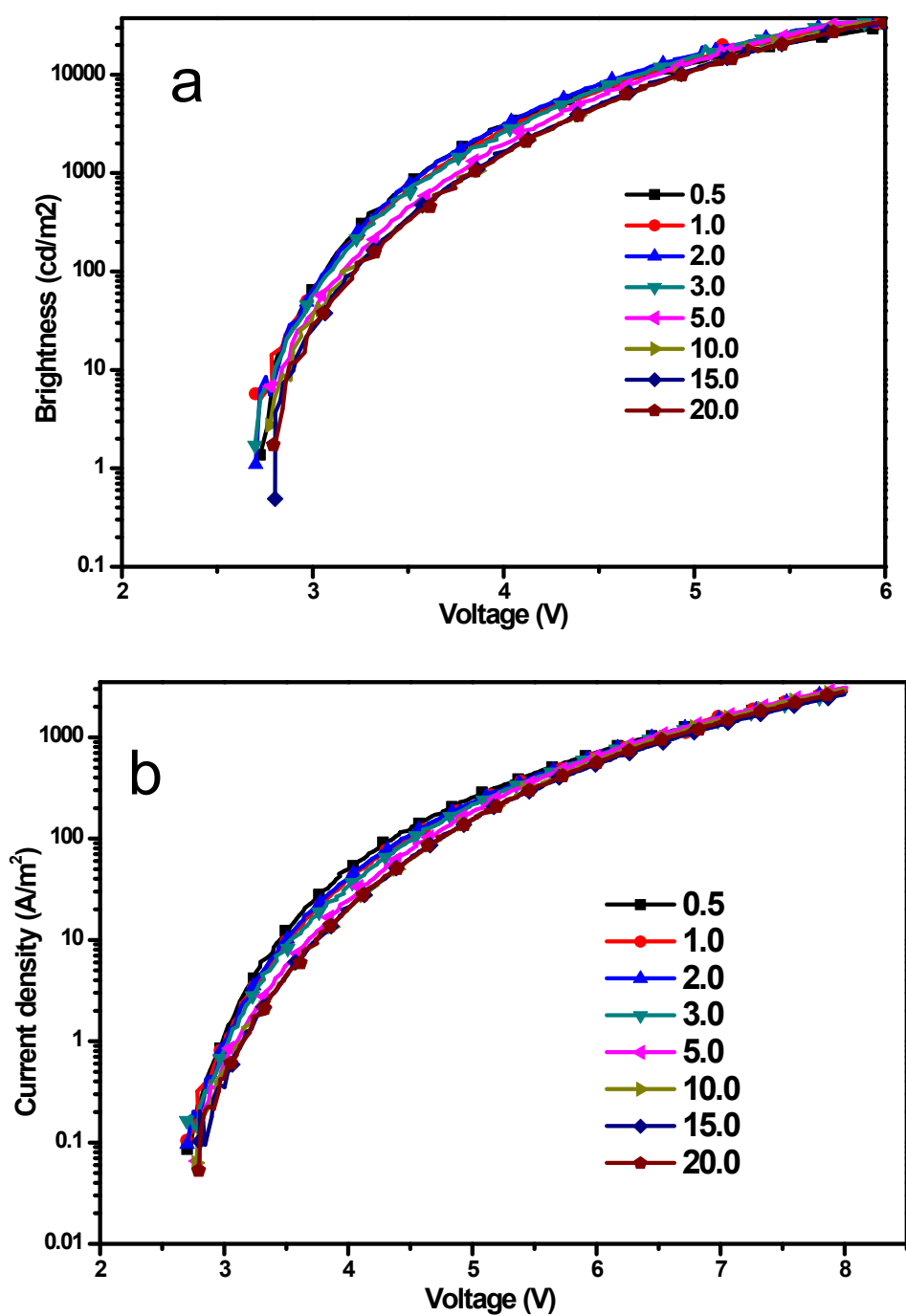


Figure S3: The PL transient decay curves of mCP: 10% PBICT.



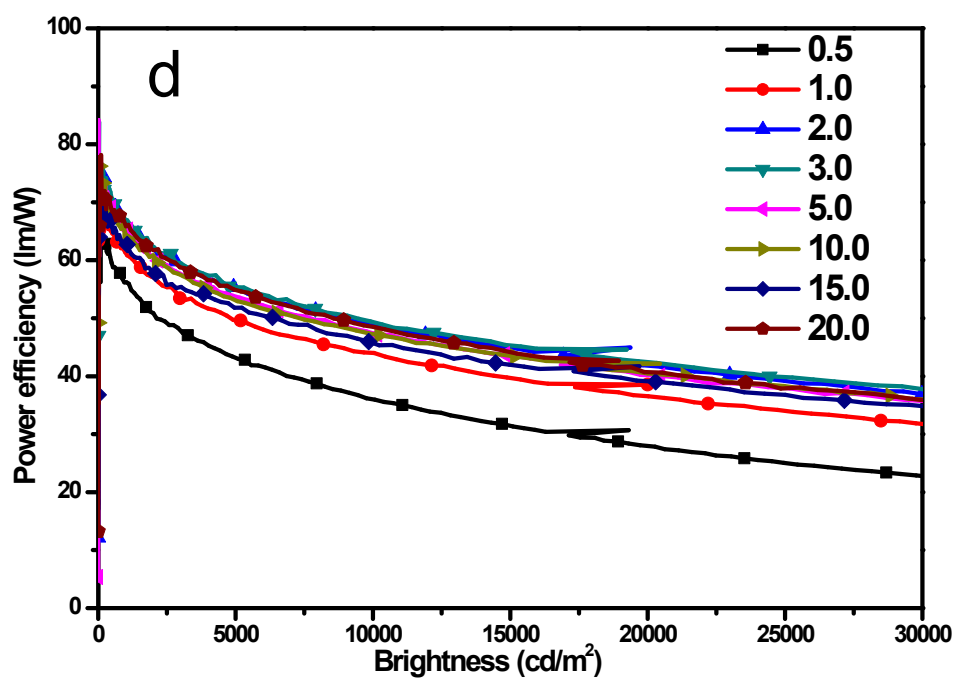
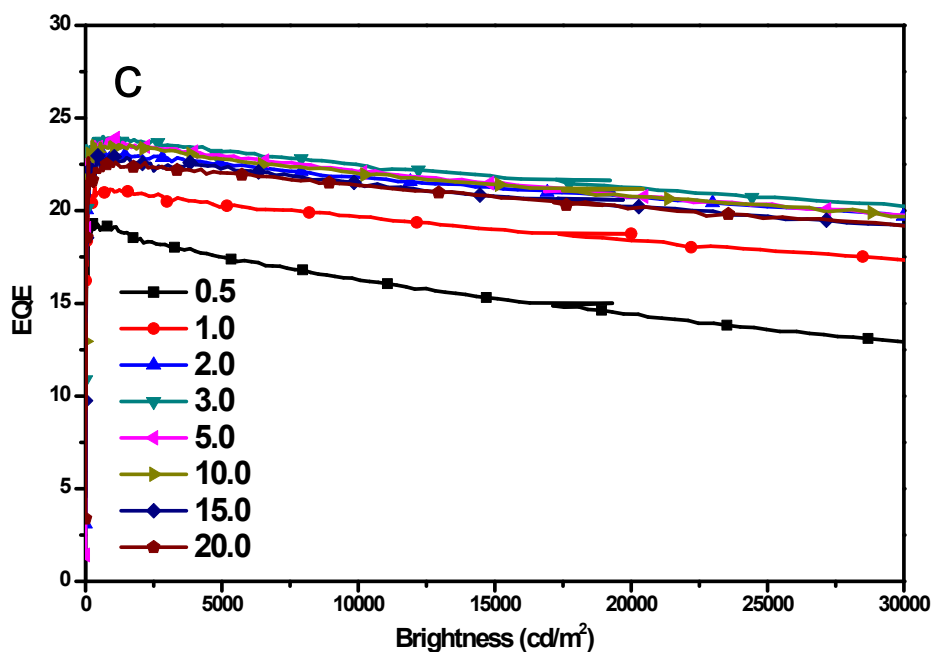
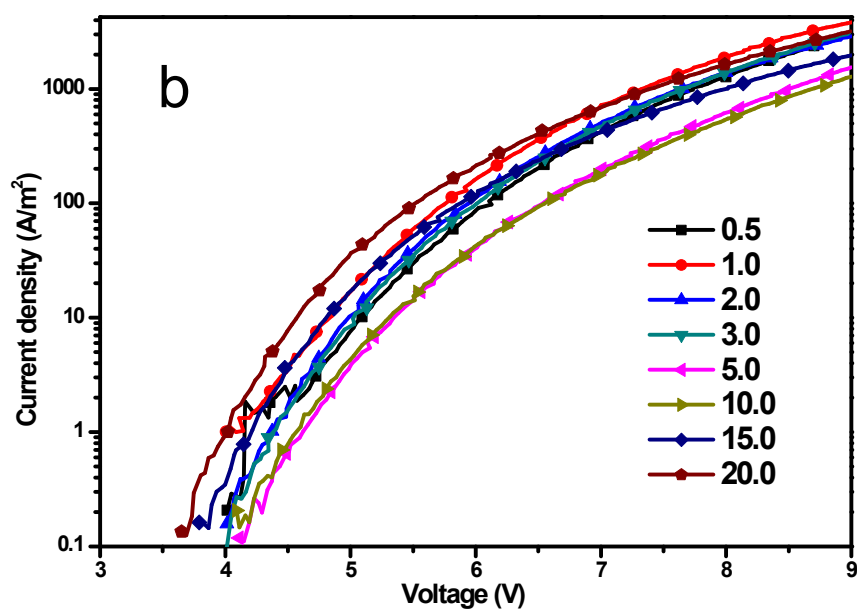
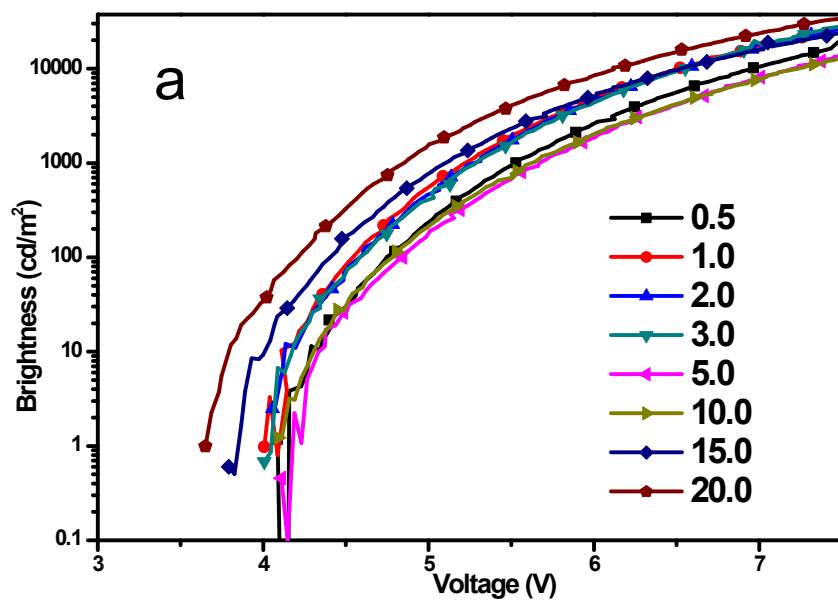


Figure S4. (a) The brightness-voltage characteristics of devices with PBICT as the host. (b) The current density-voltage characteristics of devices with PBICT as the host. (c) The EQE-brightness characteristics of devices with PBICT as the host. (d) The power efficiency-brightness characteristics of devices with PBICT as the host.

Table S2. The performances of devices with PBICT as the host.

Devices	$\text{EQE}_{x \text{ wt}\% \text{ max}}$	$\text{EQE}_{10000 \text{ cd/m}^2}$	$\text{EQE}_{x \text{ wt}\% \text{ max}} / \text{EQE}_{\text{max}}$
PBICT:0.5 wt% Ir(ppy) ₃	19.1	16.3	0.799
PBICT:1.0 wt% Ir(ppy) ₃	21.1	19.7	0.883
PBICT:2.0 wt% Ir(ppy) ₃	23.1	21.8	0.967

PBICT:3.0 wt% Ir(ppy) ₃	23.9	22.5	1.00
PBICT:5.0 wt% Ir(ppy) ₃	23.7	22.2	0.992
PBICT:10.0 wt% Ir(ppy) ₃	23.5	22.1	0.983
PBICT:15.0 wt% Ir(ppy) ₃	22.9	21.5	0.958
PBICT:20.0 wt% Ir(ppy) ₃	22.5	21.4	0.941



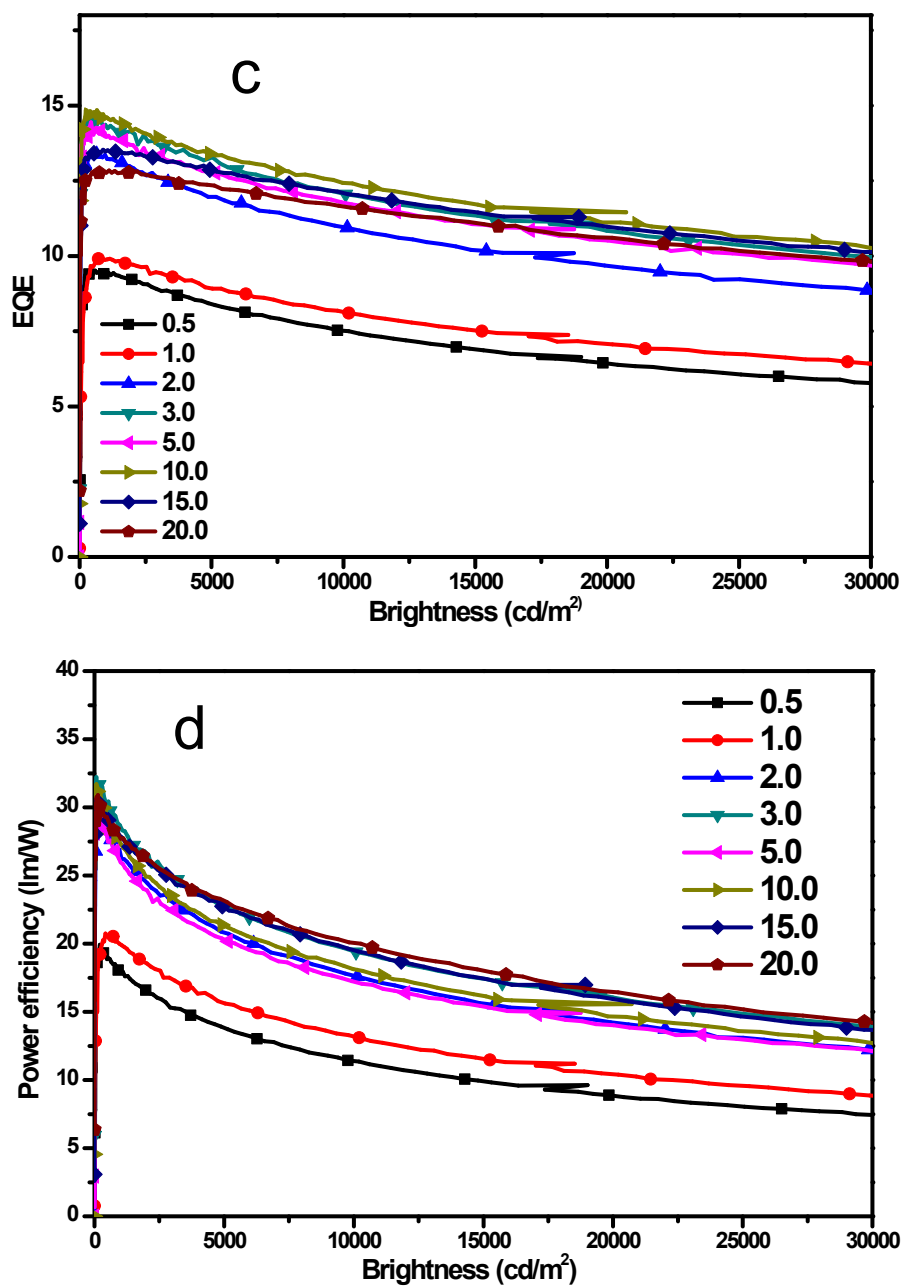
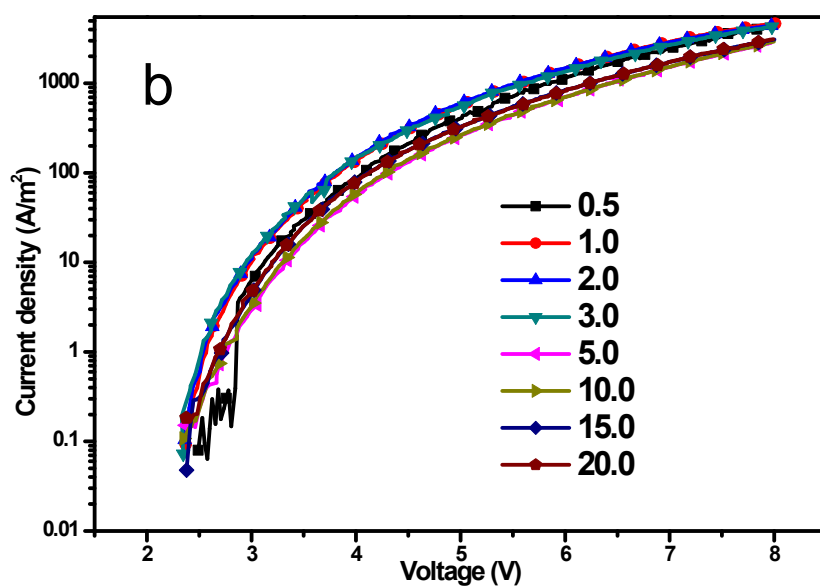
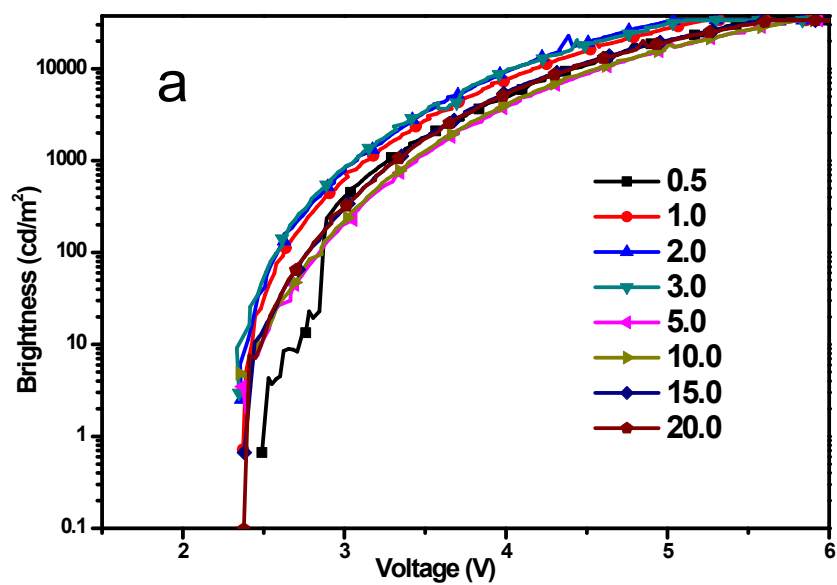


Figure S5. (a) The brightness-voltage characteristics of devices with CBP as the host. (b) The current density-voltage characteristics of devices with CBP as the host. (c) The EQE-brightness characteristics of devices with CBP as the host. (d) The power efficiency-brightness characteristics of devices with CBP as the host.

Table S3. The performances of devices with CBP as the host.

Devices	EQE _{max}	EQE _{10000 cd/m²}	EQE _{x wt%max} / EQE _{max}
CBP:0.5 wt% Ir(ppy) ₃	9.46	7.55	0.641
CBP:1.0 wt% Ir(ppy) ₃	9.96	8.19	0.674
CBP:2.0 wt% Ir(ppy) ₃	13.45	10.92	0.911

CBP:3.0 wt% Ir(ppy) ₃	14.46	12.11	0.979
CBP:5.0 wt% Ir(ppy) ₃	14.21	11.76	0.962
CBP:10.0 wt% Ir(ppy) ₃	14.76	12.47	1.00
CBP:15.0 wt% Ir(ppy) ₃	13.39	12.16	0.907
CBP:20.0 wt% Ir(ppy) ₃	12.79	11.66	0.867



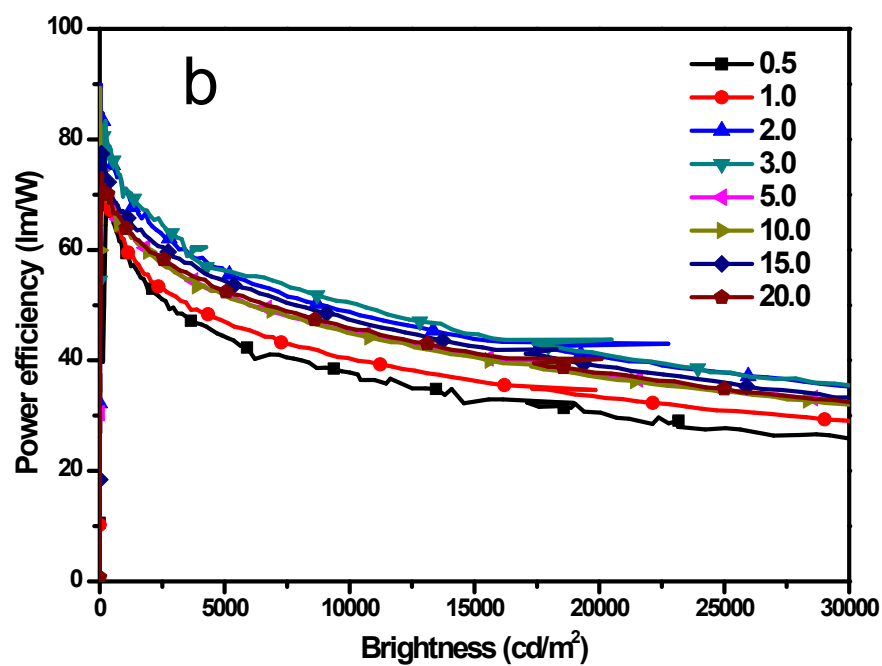
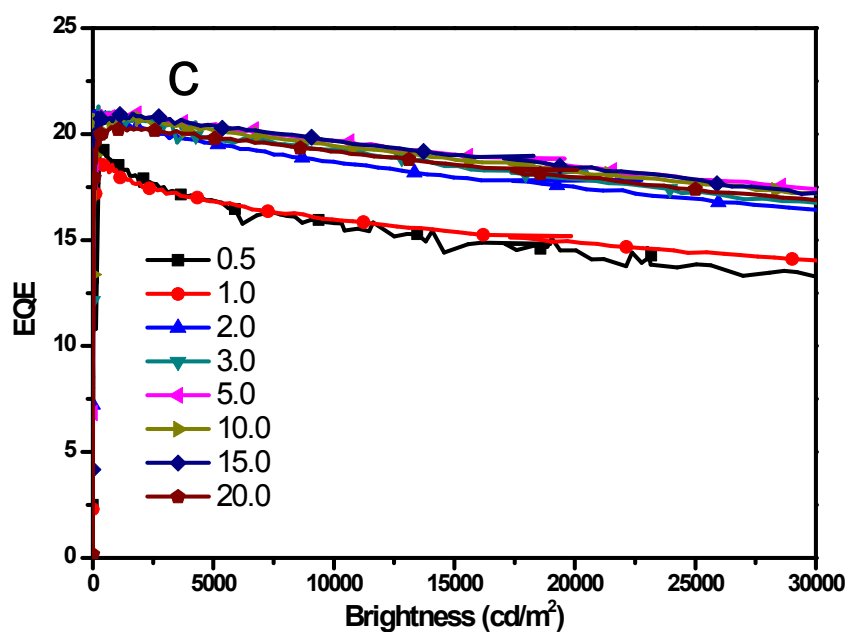


Figure S6. (a) The brightness-voltage characteristics of devices with DIC-TRZ as the host. (b) The current density-voltage characteristics of devices with DIC-TRZ as the host. (c) The EQE-brightness characteristics of devices with DIC-TRZ as the host. (d) The power efficiency-brightness characteristics of devices with DIC-TRZ as the host.

Table S4. The performances of devices with DIC-TRZ as the host.

Devices	EQE _{maximum}	EQE _{10000 cd/m²}	EQE _{x wt%max} / EQE _{max}
DIC-TRZ: 0.5 wt%Ir(ppy) ₃	19.20	15.81	0.916
DIC-TRZ: 1.0 wt%Ir(ppy) ₃	19.22	16.01	0.917
DIC-TRZ: 2.0 wt%Ir(ppy) ₃	20.90	18.68	0.998
DIC-TRZ: 3.0 wt%Ir(ppy) ₃	20.93	19.29	0.999
DIC-TRZ: 5.0 wt%Ir(ppy) ₃	20.95	19.69	1.00
DIC-TRZ: 10.0 wt%Ir(ppy) ₃	20.78	19.46	0.992
DIC-TRZ: 15.0 wt%Ir(ppy) ₃	20.91	19.72	0.998
DIC-TRZ: 20.0 wt%Ir(ppy) ₃	20.27	19.18	0.968