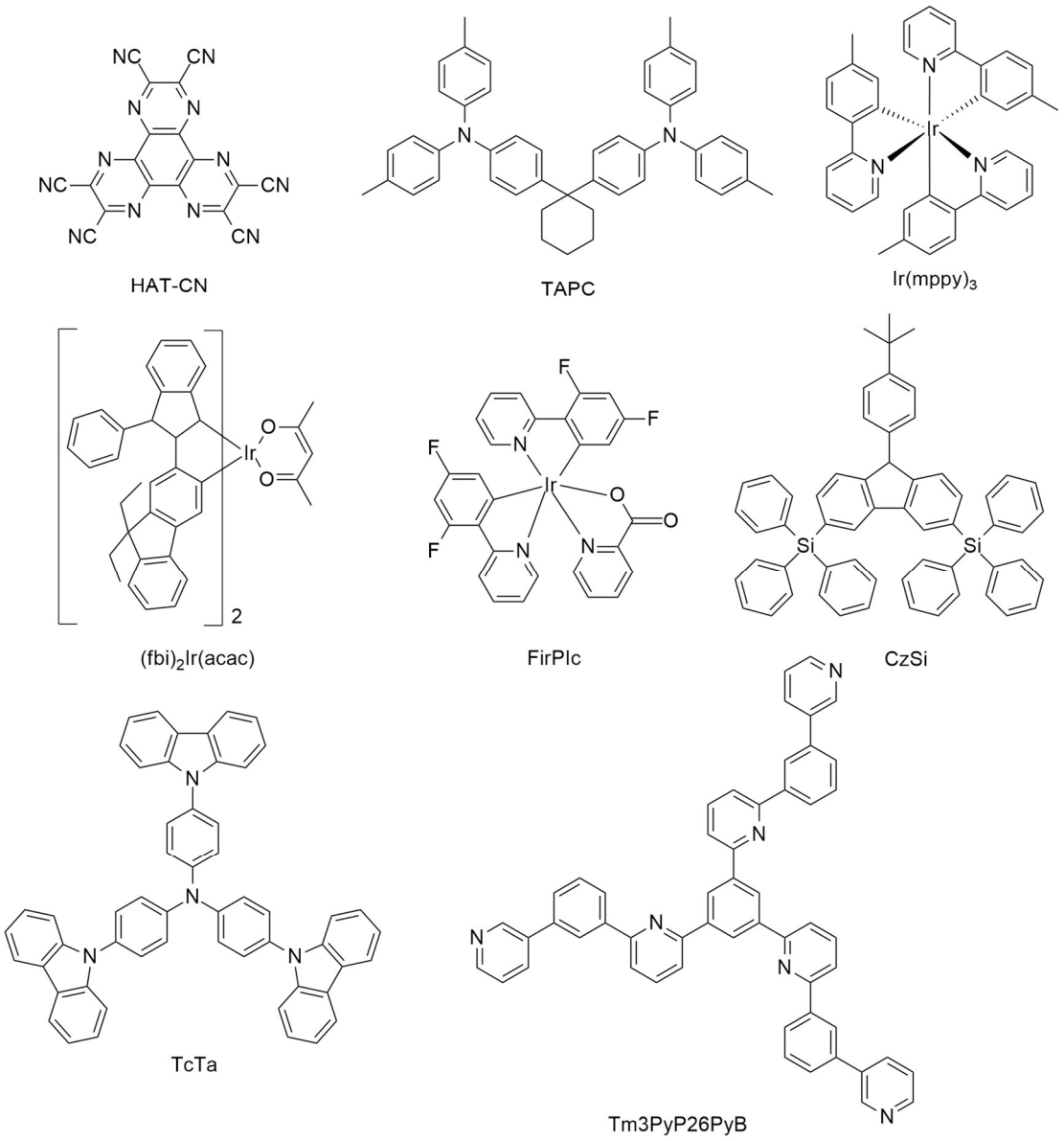
Supplementary Materials

Highly Efficient White Organic Light-Emitting Diodes Based on Phosphorescent Iridium Complexes with Multi-Light-Emitting Layers

Ruixia Wu, Xiaokang Li, Weiqiang Liu and Liang Zhou *

* Correspondence to: State Key Laboratory of Rare Earth Resource Utilization, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Renmin Street 5625, Changchun 130022, China. Tel.: +86-431-8526-2855; Fax: +86-431-8569-8041

E-mail address: zhoul@ciac.ac.cn



Scheme S1. The molecular structures of organic materials used in this work.

Table S1. The key properties of single-EML devices with different doping concentrations of $(fbi)_2Ir(acac)$.

Device	$V_{turn-on}$ (V)	B[a] (cd m^{-2})	η_c[b] (EQE[c]) (cd A^{-1})	η_p[d] (lm W^{-1})	η_c[e] (cd A^{-1}) (EQE[f]) (1000 cd m^{-2})	$CIE_{x,y}$[g]
S-1 wt%	2.9	69370	47.56 (14.60%)	42.48	47.35 (14.52%)	(0.318, 0.603)
S-2 wt%	2.9	56100	44.48 (14.42%)	38.49	43.68 (14.11%)	(0.370, 0.570)
S-3 wt%	2.9	62920	41.86 (13.85%)	39.85	40.07 (13.17%)	(0.391, 0.558)

[a] The data for maximum brightness (B), [b] maximum current efficiency (η_c), [c] maximum external quantum efficiency (EQE), [d] maximum power efficiency (η_p), [e] current efficiency (η_c) at the practical brightness of 1000 cd m^{-2}, [f] external quantum efficiency (EQE) at the practical brightness of 1000 cd m^{-2}, [g] Commission Internationale de l'Eclairage coordinates ($CIE_{x,y}$) at 10 mA cm^{-2}.

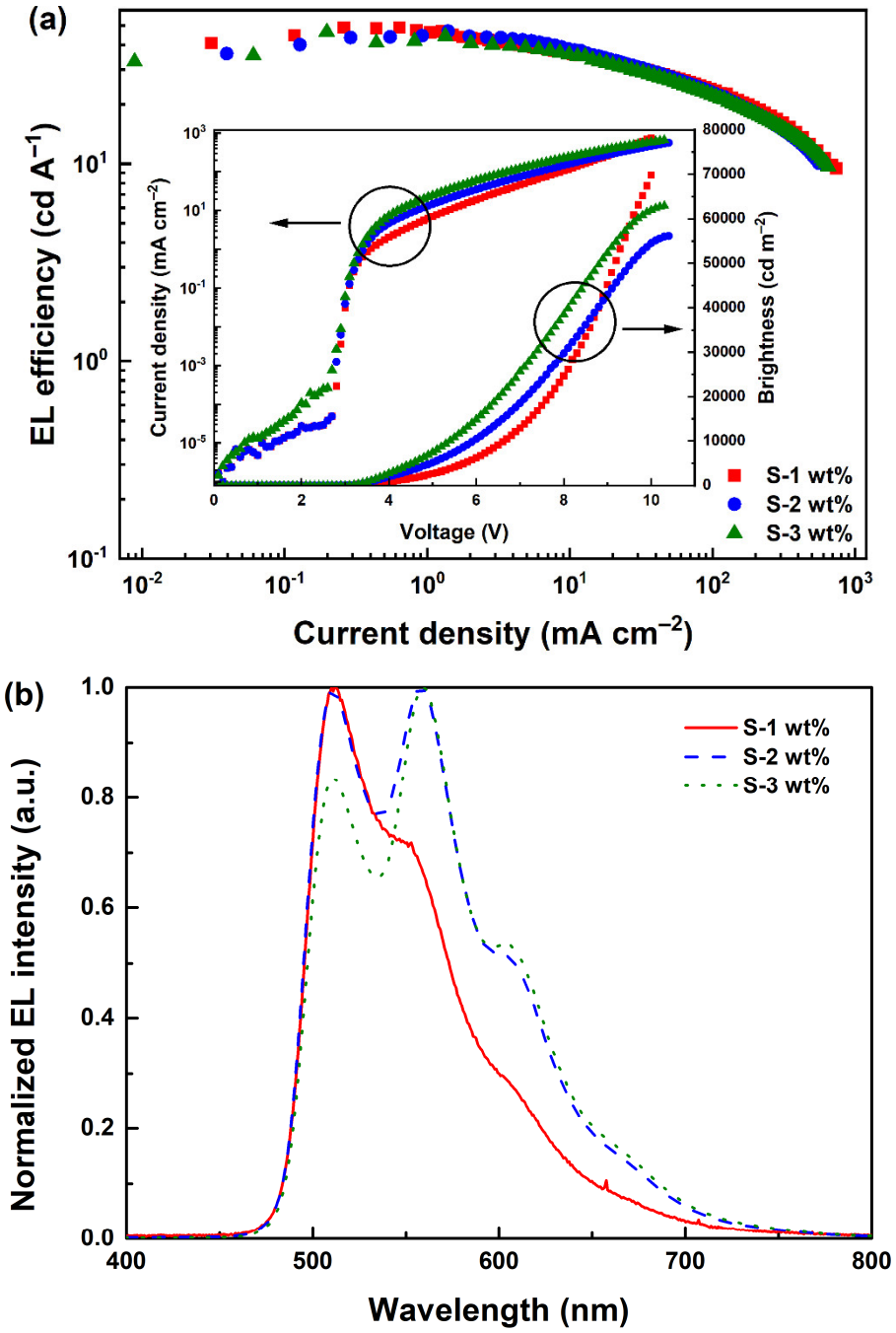


Figure S1. (a) EL efficiency-current density (η-J) characteristics of single-EML devices with $(fbi)_2Ir(acac)$ at different doping concentrations. Inset: Current density-brightness-voltage (J-B-V) characteristics of single-EML devices with $(fbi)_2Ir(acac)$ at different doping concentrations. **(b)** Normalized EL spectra of single-EML devices with $(fbi)_2Ir(acac)$ at different doping concentrations operating at 10 mA cm^{-2}.

Table S2. The key properties of double-EMLs devices with different doping concentrations of $(fbi)_2Ir(acac)$.

Device	$V_{turn-on}$ (V)	B[a] (cd m^{-2})	η_c[b] (EQE[c]) (cd A^{-1})	η_p[d] (lm W^{-1})	η_c[e] (cd A^{-1}) (EQE[f]) (1000 cd m^{-2})	$CIE_{x,y}$[g]
D-1 wt%	2.7	62800	52.65 (17.20%)	48.52	46.83 (15.15%)	(0.334, 0.568)
D-2 wt%	2.7	46150	46.34 (16.24%)	44.12	42.67 (14.85%)	(0.425, 0.526)
D-3 wt%	2.8	48590	43.02 (16.23%)	40.62	36.49 (12.92%)	(0.446, 0.517)

[a] The data for maximum brightness (B), [b] maximum current efficiency (η_c), [c] maximum external quantum efficiency (EQE), [d] maximum power efficiency (η_p), [e] current efficiency (η_c) at the practical brightness of 1000 cd m^{-2}, [f] external quantum efficiency (EQE) at the practical brightness of 1000 cd m^{-2}, [g] Commission Internationale de l'Eclairage coordinates ($CIE_{x,y}$) at 10 mA cm^{-2}.

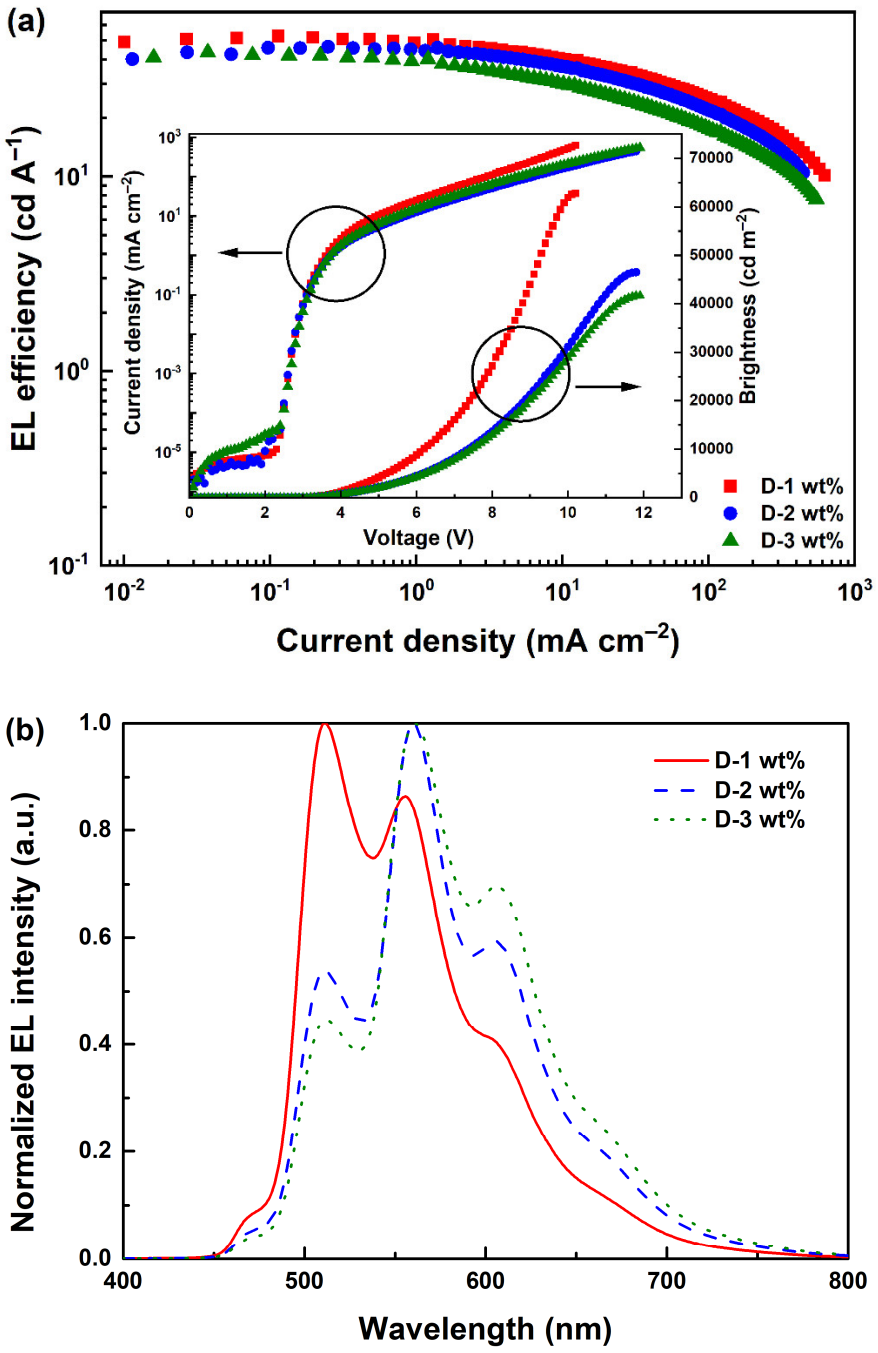


Figure S2 (a) EL efficiency-current density (η-J) characteristics of double-EMLs devices with $(fbi)_2Ir(acac)$ at different doping concentrations. Inset: Current density-brightness-voltage (J-B-V) characteristics of double-EMLs devices with $(fbi)_2Ir(acac)$ at different doping concentrations. **(b)** Normalized EL spectra of double-EMLs devices with $(fbi)_2Ir(acac)$ at different doping concentrations operating at 10 mA cm^{-2}.

Table S3. Summary of EQE, CE and PE values of reported WOLEDs.

ref	EQE_{max}(%)[a]	CEmax(cd A^{-1})[b]	PE_{max}(lm W^{-1})[c]
34	7.0	15.5	12.8
35	12.2	-	-
36	-	21.0	-
this work	16.8%	44.92	42.85

[a] The maximum external quantum efficiency (EQE_{max}); [b] the maximum current efficiency (CE_{max}); [c] the maximum power efficiency (PE_{max}).

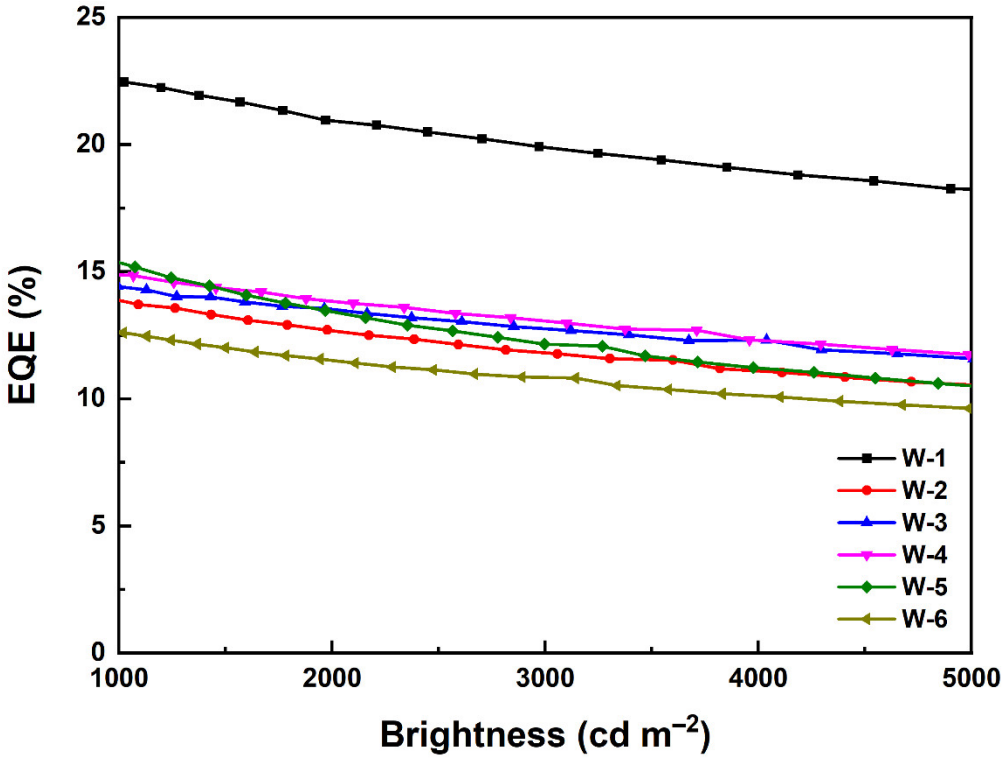


Figure S3. EQE-Luminance characteristics of devices W1-W6.