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Supporting Information

Extremely-low-voltage, high-efficiency and stability-enhanced inverted bottom OLEDs enabled by a p-type/ultra-thin metal/n-doped electron injection layer

Lei Ding[1,3,#,], Jiang-Nan Wang[3,#], Ting Ni[3], Qifan Xue[2], Sujuan Hu[4], Runfeng Wu[4], Yanqiu Sun[1], Dongxiang Luo[5,6,*], Hua Zheng[7], Yuan Liu[8], and Baiquan Liu[4,*]*

[1]School of Chemistry and Life Sciences, Suzhou University of Science and Technology, Suzhou, 215009, China

[2]State Key Laboratory of Luminescent Materials and Devices, Institute of Polymer Optoelectronic Materials and Devices, School of Materials Science and Engineering, South China University of Technology, 381 Wushan Road, Guangzhou, 510640, China

[3]Jiangsu jitri org Optoelectronics Technology Co., Ltd, Suzhou, 215215, China

[4]School of Electronics and Information Technology, Sun Yat-sen University, Guangzhou, 510275, China

[5]Huangpu Hydrogen Innovation Center/Guangzhou Key Laboratory for Clean Energy and Materials, School of Chemistry and Chemical Engineering, Guangzhou University, Guangzhou, 510006, China

[6]Institute of Semiconductors, South China Normal University, 510631, China

[7]School of Electrical Engineering and Intelligentization, Dongguan University of Technology, Dongguan, 523808, China

[8]School of Integrated Circuits, Guangdong University of Technology, Guangzhou, 510090, China

EXPERIMENTAL SECTION

Device fabrication. IBOLEDs were fabricated on cleaned ITO glass substrates (110 nm, 15 Ω/□) treated with UV ozone for 15 min. All layers were deposited by thermal evaporation under a vacuum pressure around 10^{-6} Torr. Al and Ag are evaporated at the same rate. We use a film thickness gauge (Inficon SQC-310C) to monitor their rates online, so that their evaporation rates are maintained at 0.1~0.2 Å/s.The EILs were evaporated at the rates of 0.2-0.3 Å·s^{-1}. The other organic materials and electrode metal were evaporated at rates ranging between of 2-3 Å·s^{-1} and 6-10 Å·s^{-1}, metals in the EILs were evaporated at rates of 0.2 Å·s^{-1}. The coating equipment was used by Suzhou Fangsheng FS-450.

Device characterization. The current density-voltage-luminance data of all devices was tested by a system built with Keithley 2400 SourceMeter and Konica Minolta CS2000A Spectrophotometer. During the test, the 2400 SourceMeter outputs a fixed current and detects the voltage on the device, while the CS2000A collects spectral and luminance data.

Except the brightness, voltage and current data, other data are obtained by calculation, in which the current density is calculated from the current and the light-emitting area, the current efficiency is calculated from the brightness and current density, and the power efficiency is calculated from the brightness, current density and voltage, the external quantum efficiency is calculated from the spectrum and current density. The device is assumed to be Lambertian when calculating power efficiency and external quantum efficiency.

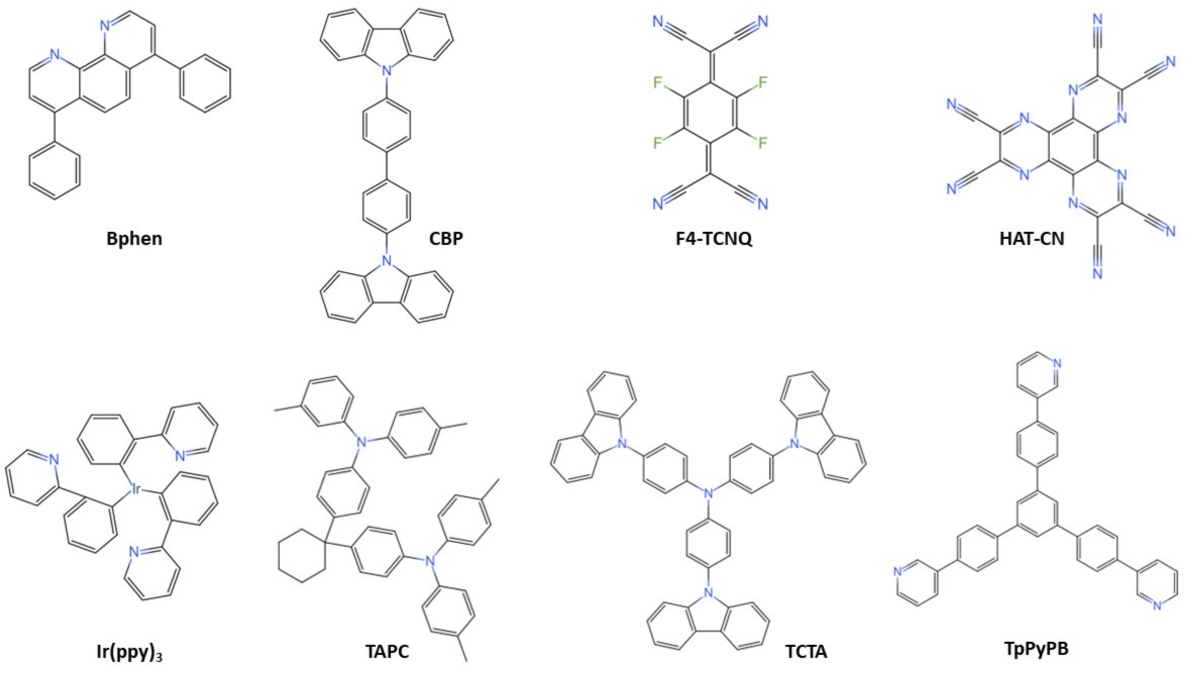

Figure S1. Chemical structures of the used organic materials.

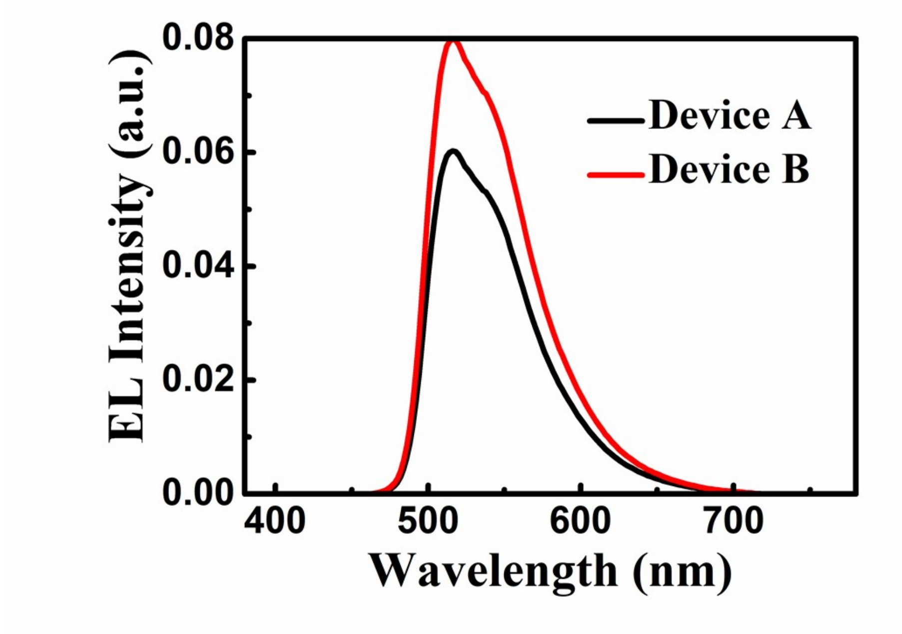

Figure S2. EL spectrum of Devices A and B.

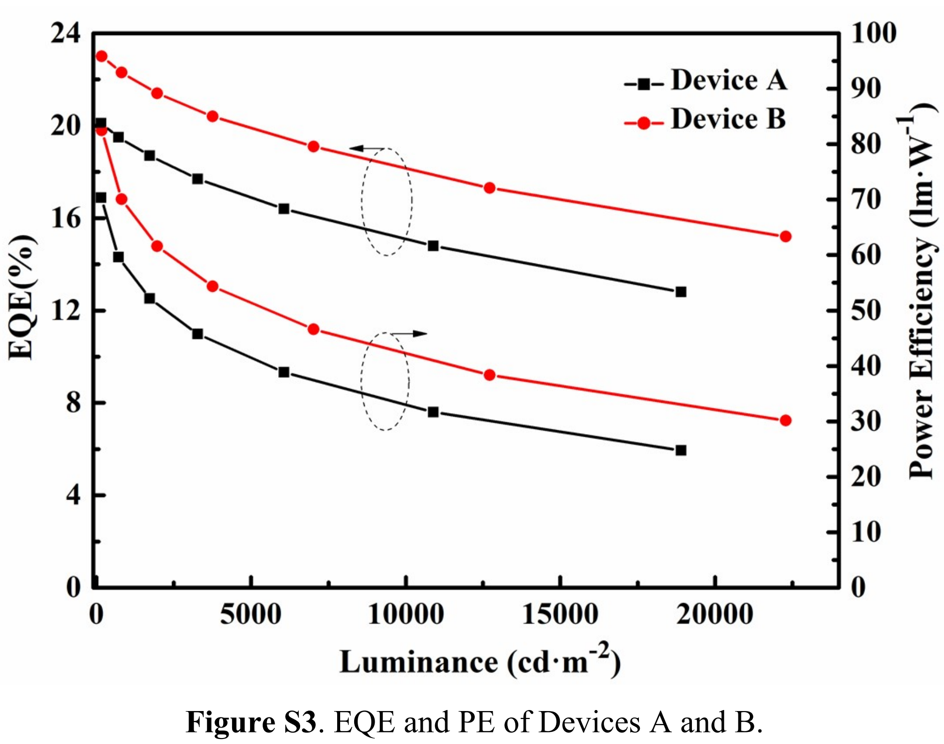

Figure S3. EQE and PE of Devices A and B.

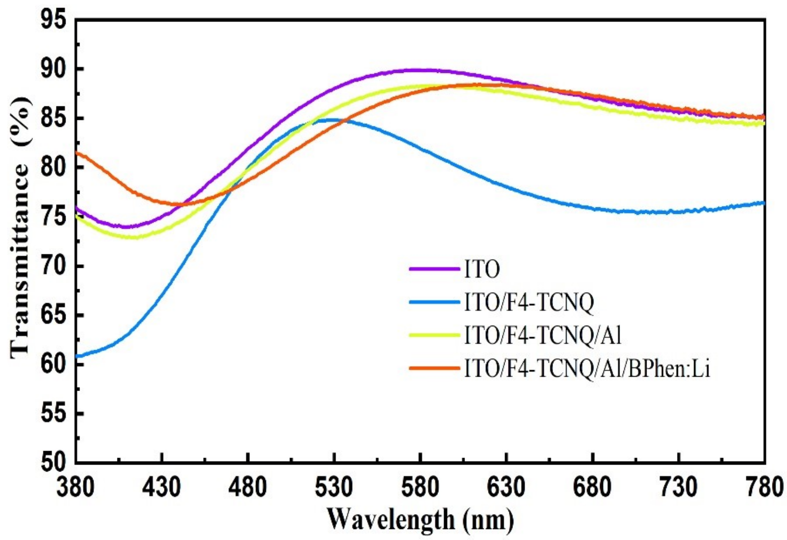

Figure S4. Transmittance spectra for ITO, ITO/F4-TCNQ(1 nm), ITO/F4-TCNQ(1 nm)/Al(0.5 nm) and ITO/F4-TCNQ(1 nm)/Al(0.5 nm)/ Bphen: Li(20 nm) films.

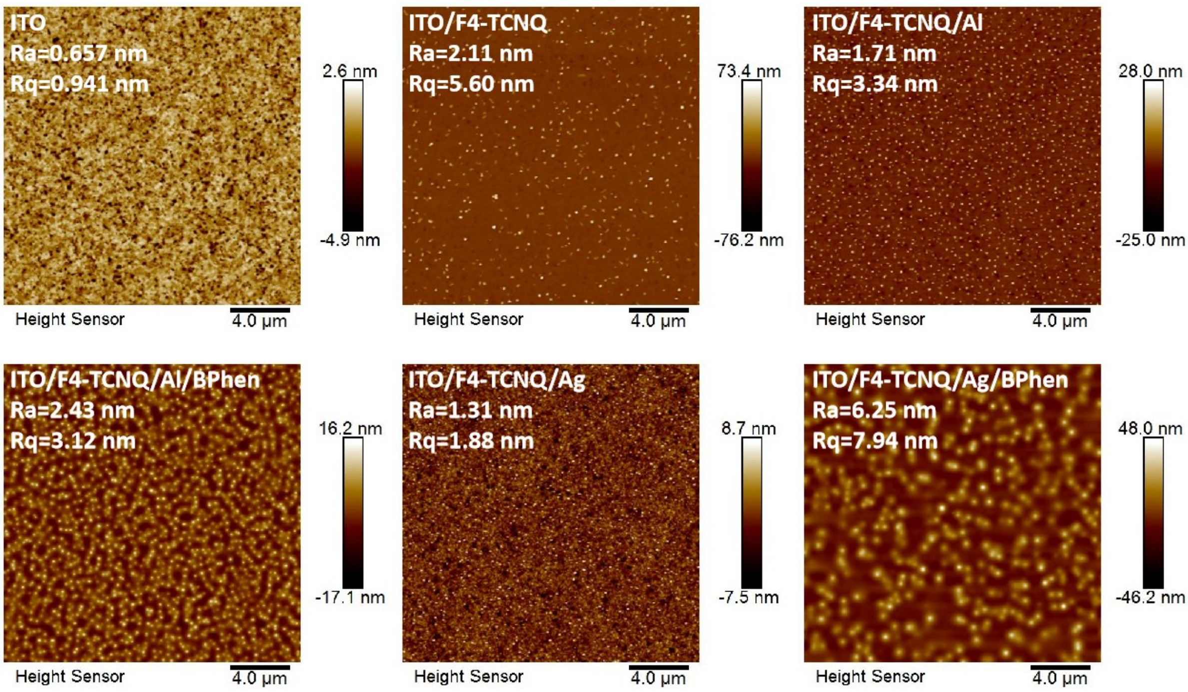

Figure S5. 2D AFM images: ITO, ITO/F4-TCNQ(1 nm), ITO/F4-TCNQ(1 nm)/Al, ITO/F4-TCNQ(1 nm)/Al(0.5 nm)/Bphen(20 nm), ITO/F4-TCNQ(1 nm)/Ag and ITO/F4-TCNQ(1 nm)/Ag(0.5 nm)/Bphen(20 nm).

Table S1. Material parameters used in simulations.

Layer	Materials	WF[a] (eV)	ε[b]	LUMO[c] (eV)	E_g[d] (eV)	μ_p[e] ($cm^2\ V^{-1}\ s^{-1}$)	μ_n[f] ($cm^2\ V^{-1}\ s^{-1}$)	Thickness (nm)
Anode	Al	4.2	—	—	—	—	—	—
EIL-1	F4-TCNQ	—	2.5	4.7	4.2	1e-5	1e-3	15
	BPhen:Li	—	2.5	4.18	4.2	1e-5	1e-3	200
EIL-2	F4-TCNQ/Al	—	2.5	4.7	4.2	1e-5	1e-3	15
	BPhen:Li	—	2.5	4.58	4.2	1e-5	1e-3	200
EIL-3	F4-TCNQ/Ag	—	2.5	4.7	4.2	1e-5	1e-3	15
	BPhen:Li	—	2.5	4.28	4.2	1e-5	1e-3	200
EIL-4	F4-TCNQ/ MoO_3	—	2.5	4.7	4.2	1e-5	1e-3	15
	BPhen:Li	—	2.5	4.22	4.2	1e-5	1e-3	200
Cathode	ITO	4.7	—	—	—	—	—	—

[a]Work function; [b]Relative dielectric constant; [c]The LUMO level; [d]The band gap; [e]Hole mobility; [e]Electron mobility.