Supporting Information

Small size graphene oxide (GO) using as hole injection layer achieving higher device performance than PEDOT:PSS in organic light-emitting diodes

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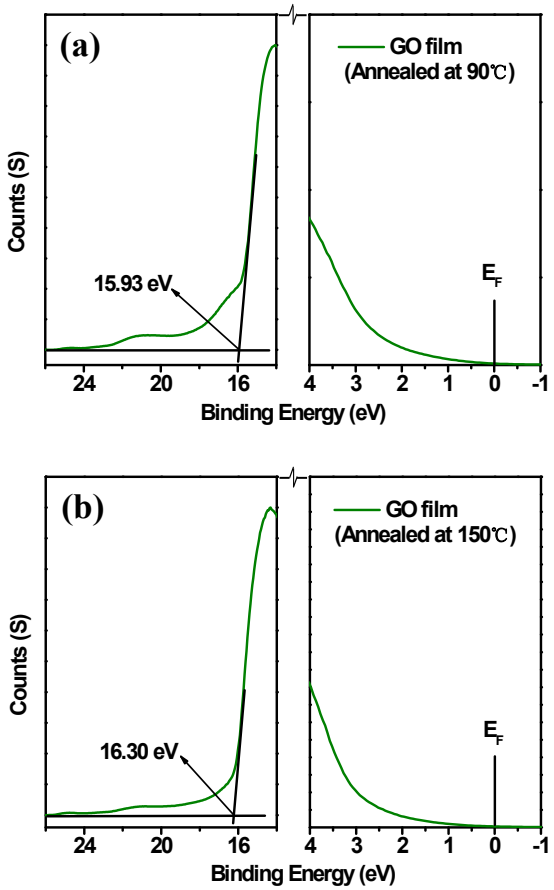

Fig. S1 UPS spectrum of small size GO film spin-cocated on ITO substrate under different annealing temperature.

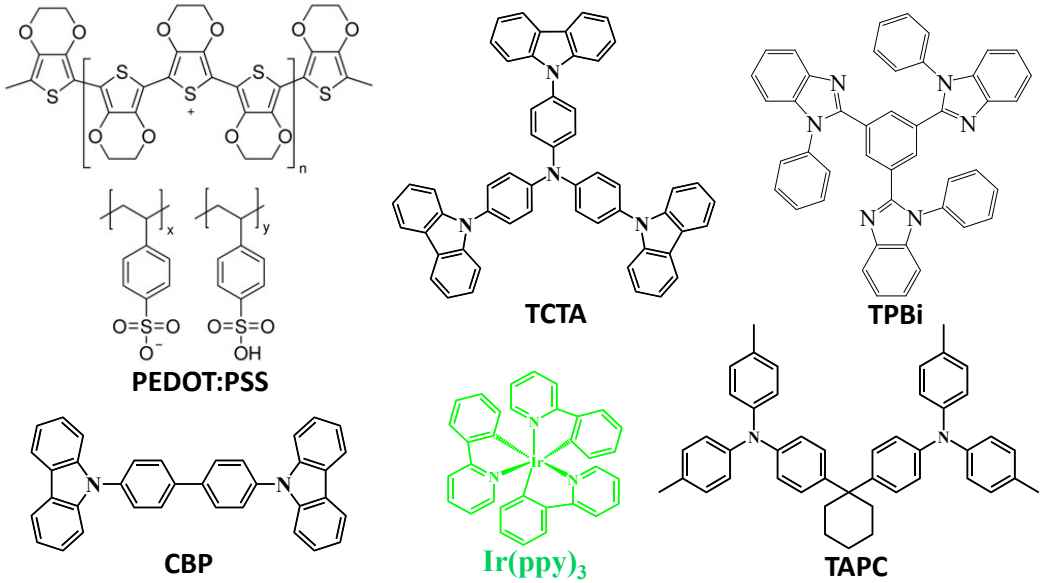

Fig. S2 The chemical structures for all organic materials involved in device fabrication in this work.

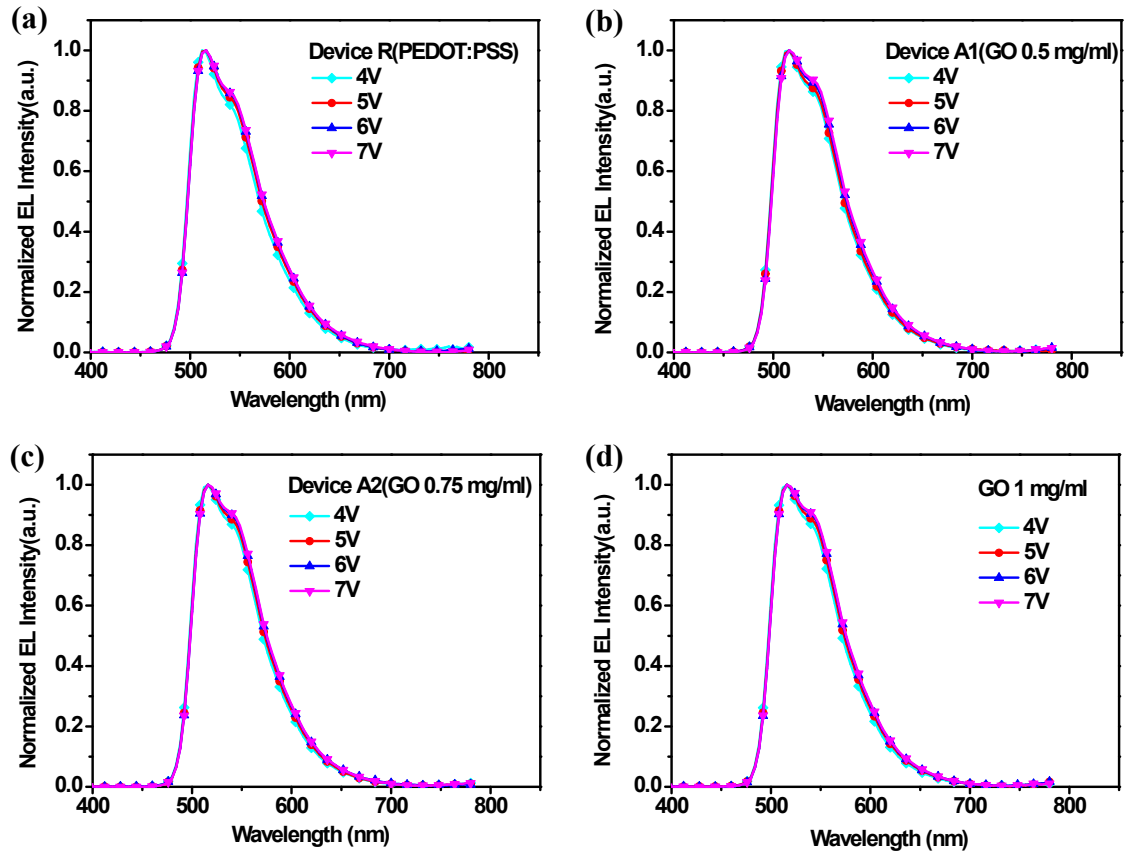

Fig. S3 The EL spectra for all PEDOT:PSS-based device R and small size-GO-based devices A1-B3 under different voltages.

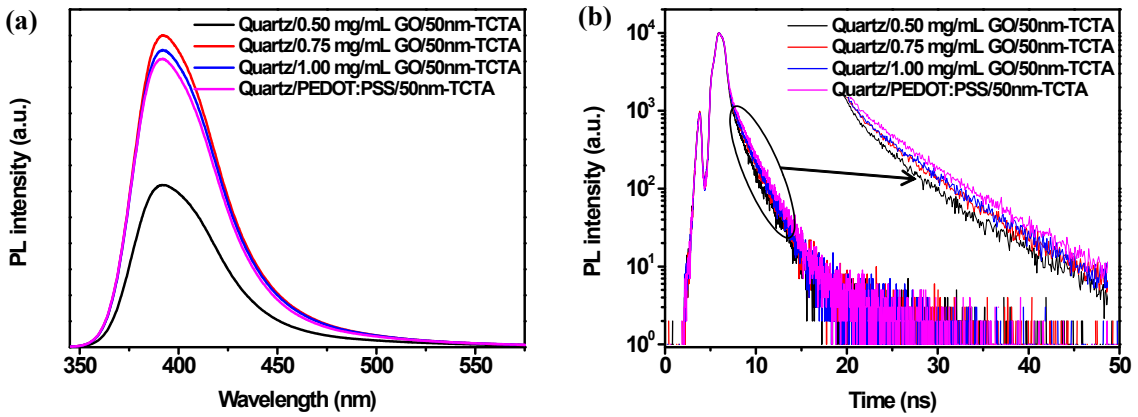

Fig. S4 The steady-state **(a)** and time-resolved **(b)** PL spectra of TCTA films deposited on small size GO and PEDOT:PSS HILs. And the steady-state PL spectra was tested with a exciton wavelength at 312 nm.

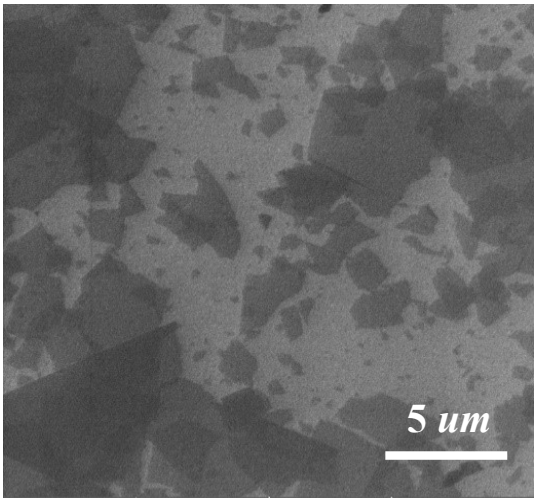

Fig. S5 SEM image of large size GO films with a concentration of 0.75 mg/mL spin-cocated on ITO substrate and annealed at 120 ℃.

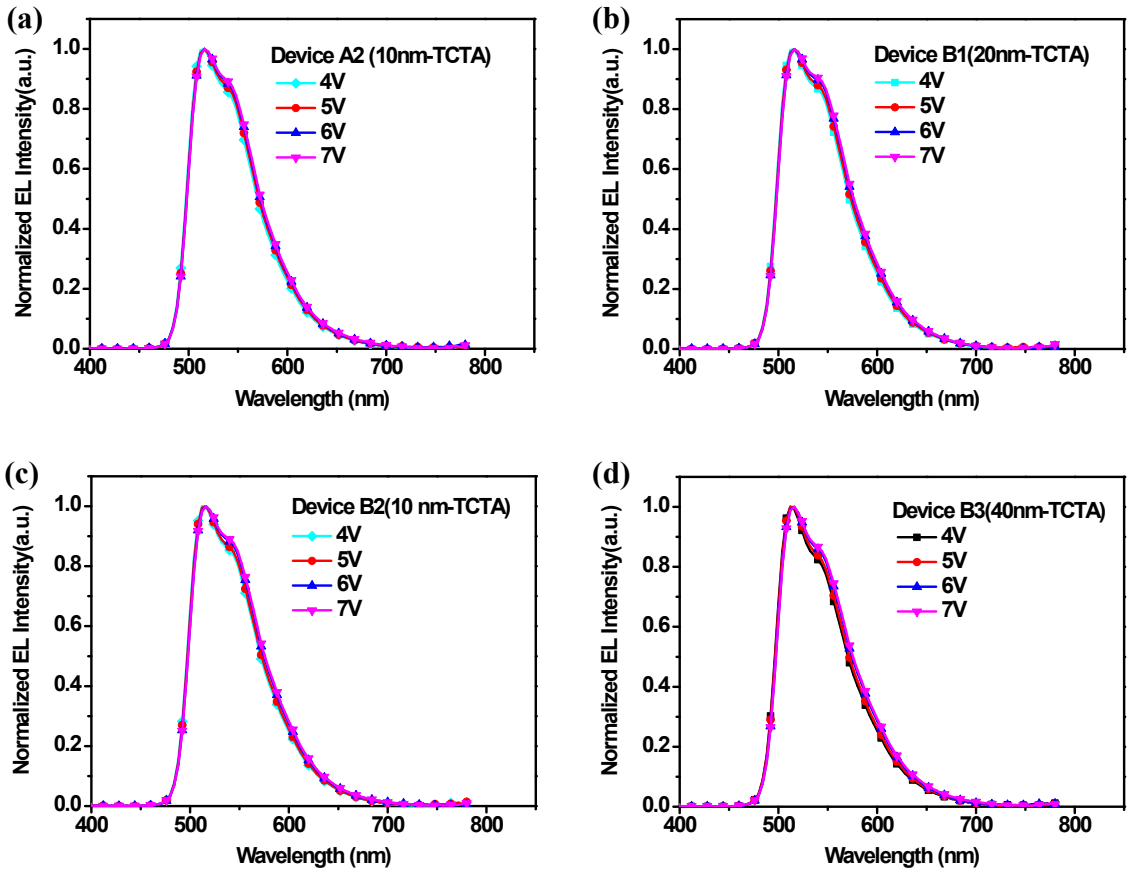

Fig. S6 The EL spectra for all small size-GO-based devices A2 and B1-B3 under different voltages.

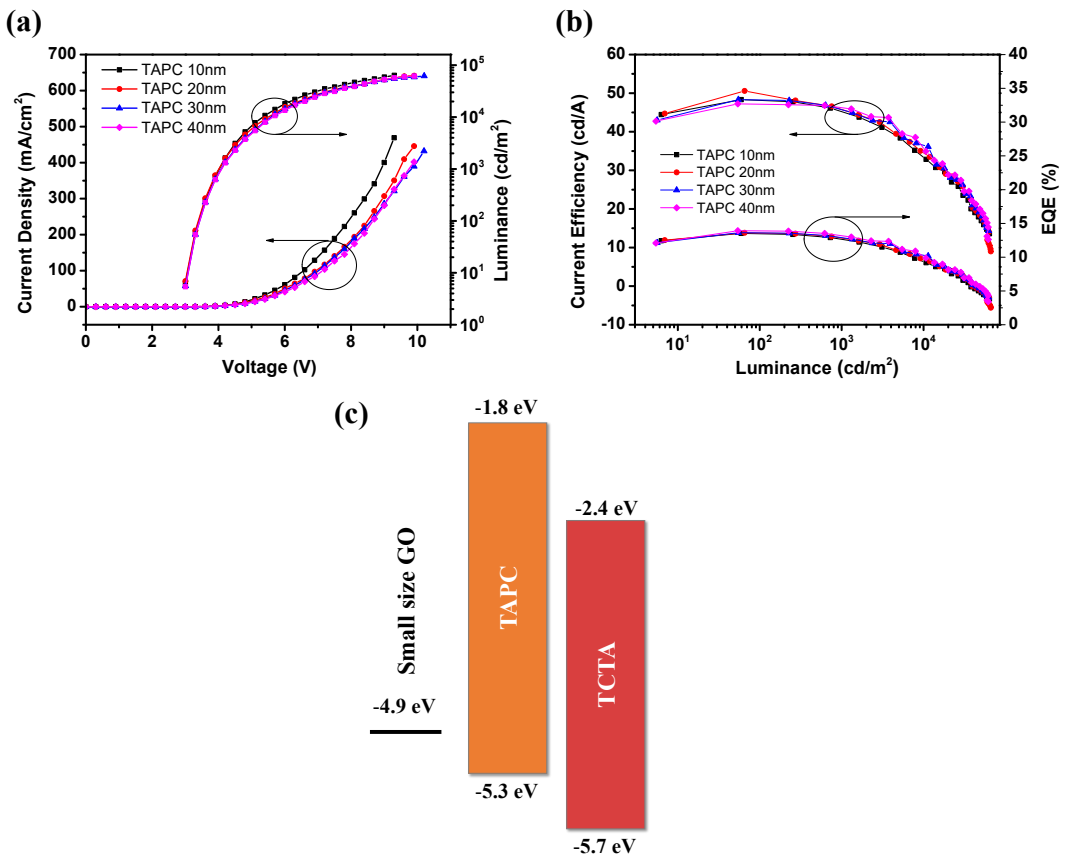

Fig. S7 (a) Current density-voltage-luminance and **(b)** Current efficiency-luminance-EQE characteristics curves of small size GO-based devices with different thickness of TAPC; **(c)** the energy level comparison of TCTA and TAPC. And the detailed device structure is ITO/GO film (0.75mg/mL)/TAPC(10, 20, 30, and 40 nm)/CBP: 8 wt% $Ir(ppy)_3$ (20 nm)/TPBi(50 nm)/LiF(1 nm)/Al(120 nm).

Table S1. The performance summary of small size GO-based devices with different thickness of TAPC.

Devices	Turn-on voltage (V) [a]	Maximum			
		CE(cd/A)[b]	PE (lm/W)[b]	EQE (%)	Luminance (cd/m²)
TAPC 10 nm	3.0	48.32	46.54	13.52	63730
TAPC 20 nm	3.0	50.57	46.81	13.61	62690
TAPC 30 nm	3.0	48.33	46.01	13.63	62050
TAPC 40 nm	3.0	47.22	46.86	13.92	61460

[a] Turn-on voltage estimated at a luminance of >1 cd/m²; [b] CE and PE are the abbreviations of current

efficiency and power efficiency

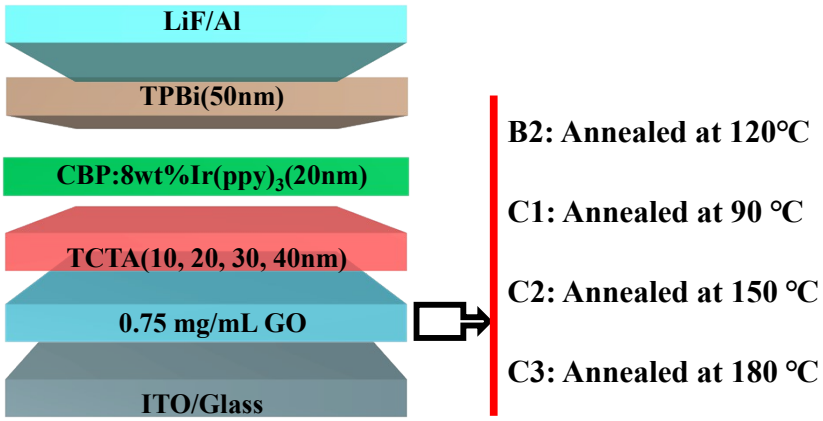

Fig. S8 The structure diagram of all small size-GO-based devices B2 and C1-C3.

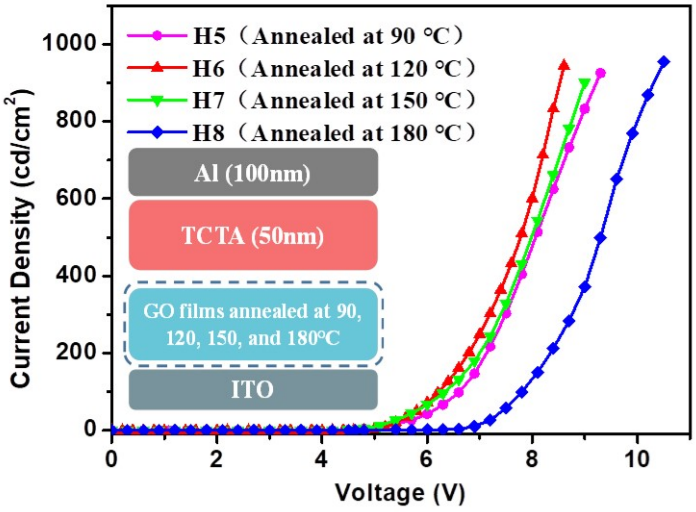

Fig. S9 The current density-voltage characteristics curve of hole-only devices with 0.75 mg/mL GO as HIL and annealed at different temperature in glove box. H5: 90 ℃; H6: 120 ℃; H7: 150 ℃ and H8: 180 ℃.

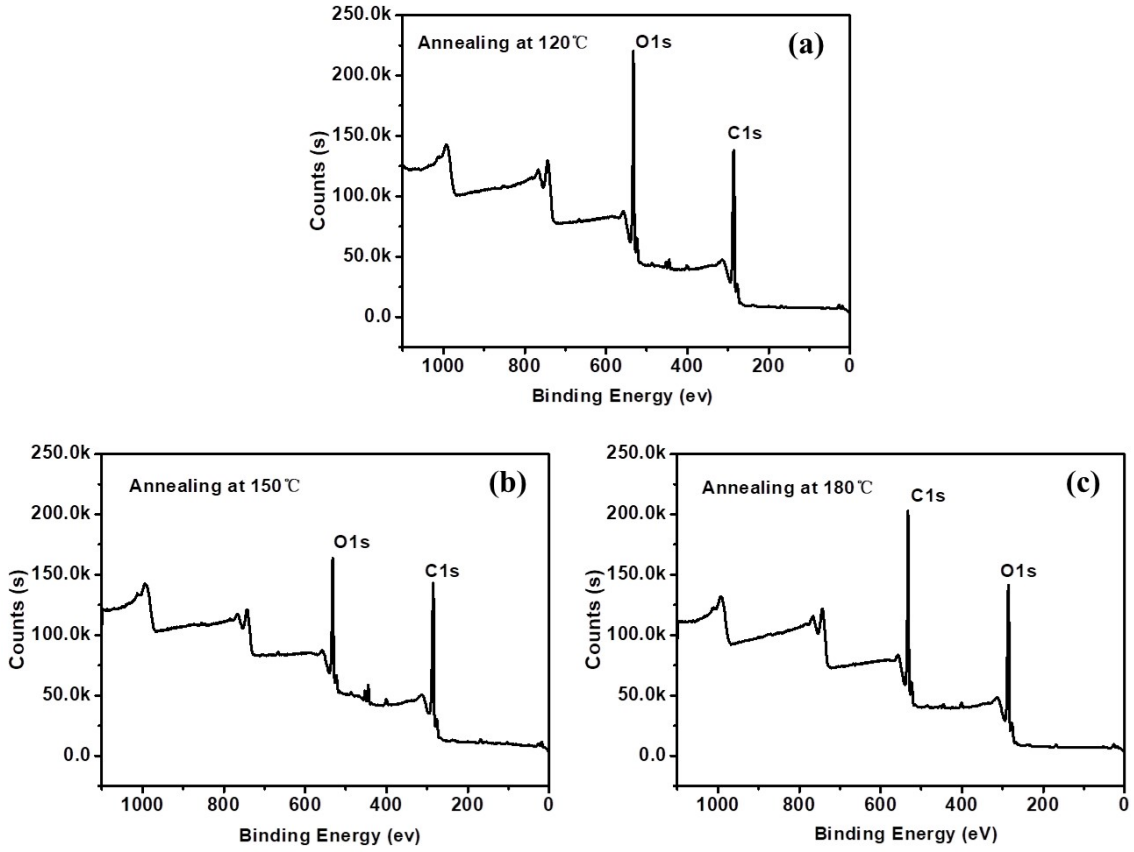

Fig. S10 The survey XPS spectrum of GO films annealed at different temperature, (a) for 120 ℃, (b) for 150 ℃, and (c) for180 ℃.

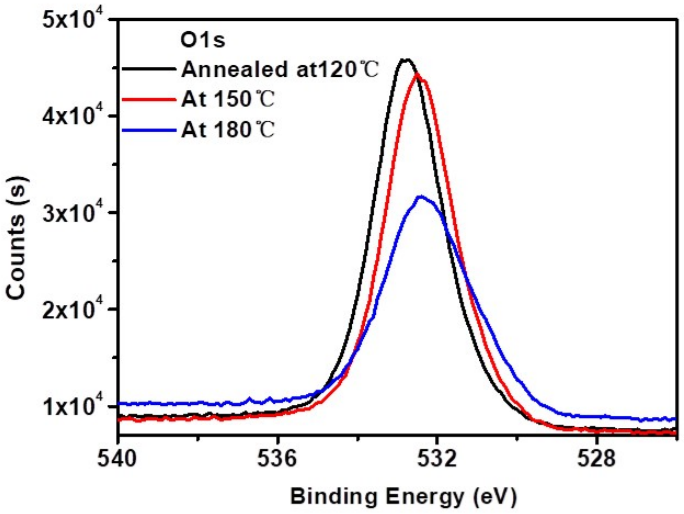

Fig. S11 High-resolved O1s XPS spectra of GO films annealed at different temperatures.