

Supporting Information

Dendrimer Emitter Doped in Dendrimer Host: Efficient Thermally Activated Delayed Fluorescence OLED with Fully-Solution Processed Organic-Layers

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Keywords: thermally activated delayed fluorescence, organic electroluminescence, dendrimer, carbazole, solution process

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1. AFM images

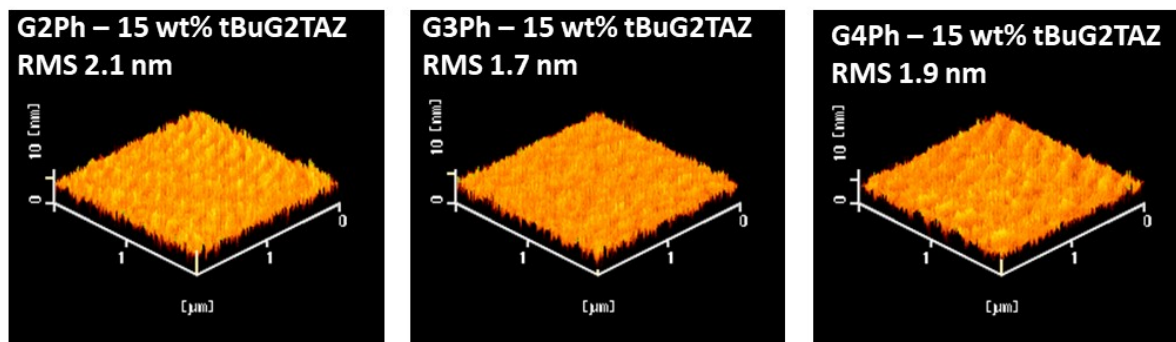


Figure S1. AFM images of the surfaces of 15wt%tBuG2TAZ doped G_nPh film on PEDOT-PSS.

2. UV-vis and PL spectra

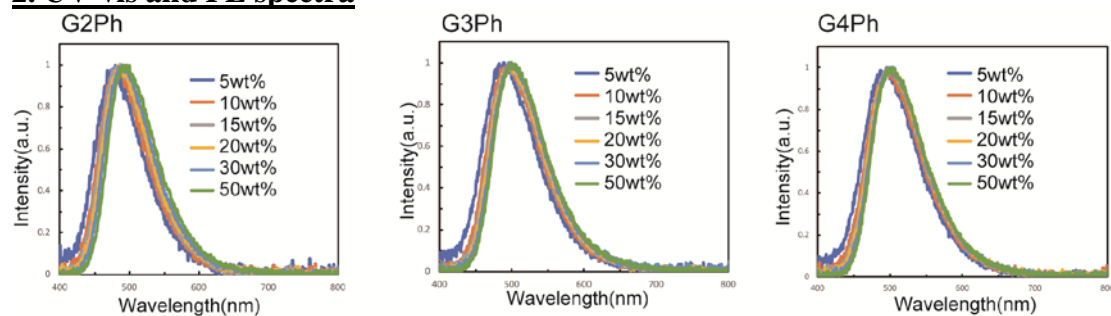


Figure S2. PL spectra of tBuG2TAZ-*GnPh* films at various tBuG2TAZ doping ratio.

Table S1. PLQY of tBuG2TAZ film doped in *GnPh*.

tBuG2TAZ content (wt.%)	G2Ph	G3Ph	G4Ph
5	0.76	0.70	0.66
10	0.85	0.76	0.72
15	0.83	0.76	0.70
20	0.81	0.74	0.67
30	0.77	0.69	0.65
50	0.55	0.64	0.61
100(neat)	0.44	0.44	0.44

Table S2. S_1 state energy (eV) of tBuG2TAZ film doped in *GnPh* determined from the onset of the PL in the spectra (Fig. S2).

tBuG2TAZ content (wt.%)	G2Ph	G3Ph	G4Ph
5	2.91	2.85	2.84
10	2.88	2.81	2.81
15*	2.85	2.80	2.78
20	2.83	2.78	2.77
30	2.81	2.76	2.76
50	2.77	2.75	2.74
100(neat)	2.69	2.69	2.69

* The 0.01 eV difference compared to the data in Table 1 is because the data used for the analysis is measured with a different spectrometer.

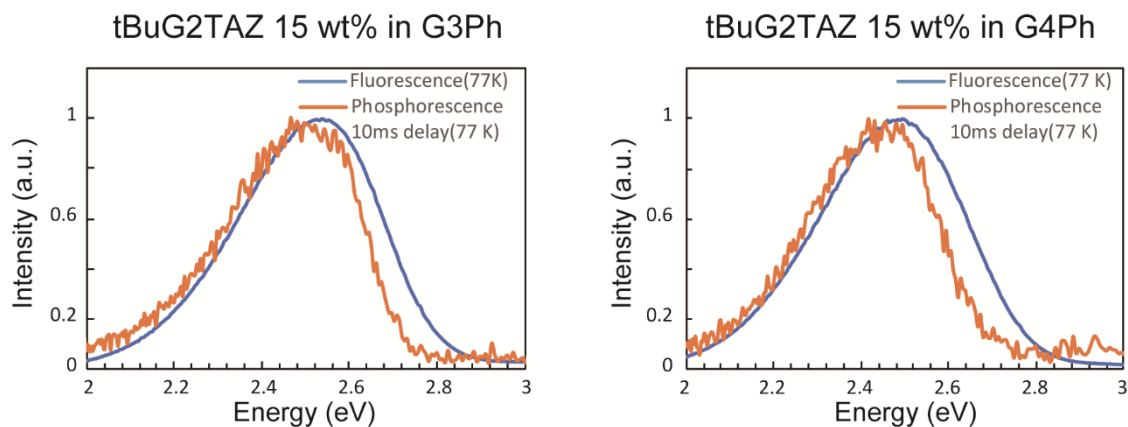


Figure S3. Fluorescence and phosphorescence spectra of tBuG2TAZ 15 % doped G n Ph films at 77 K. The phosphorescence spectra with different delay time (100 μ s, and 1 ms) were consistent with 10 ms delay time.

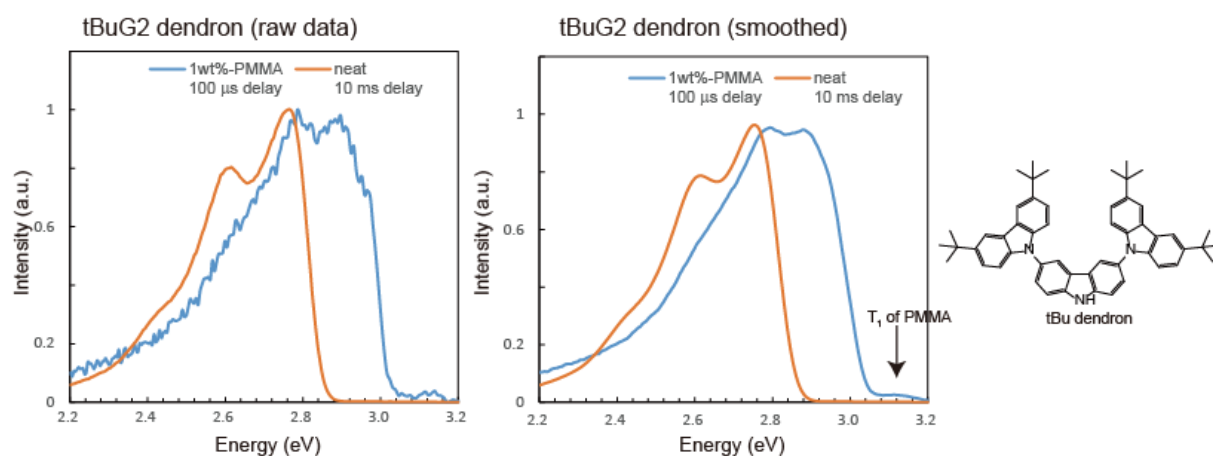


Figure S4. Phosphorescence spectra of 2nd generation tBuCz dendron in PMMA (1wt%) and neat film (excited at 300 nm). The T₁ energy of PMMA is reported to be 3.11 eV.¹

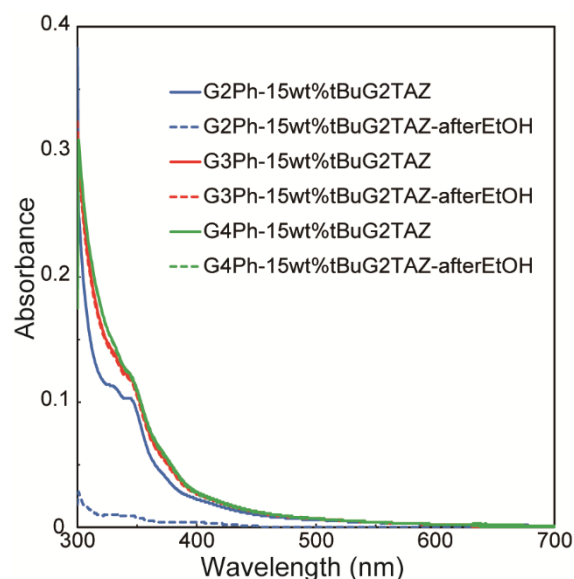


Figure S5. UV-vis spectra of G n Ph doped with 15wt% tBuG2TAZ before and after rinsing with EtOH.

¹ W. E. Graves, R. H. Hofeldt, and S. P. McGlynn, *J. Chem. Phys.*, 1972, **56**, 1309.

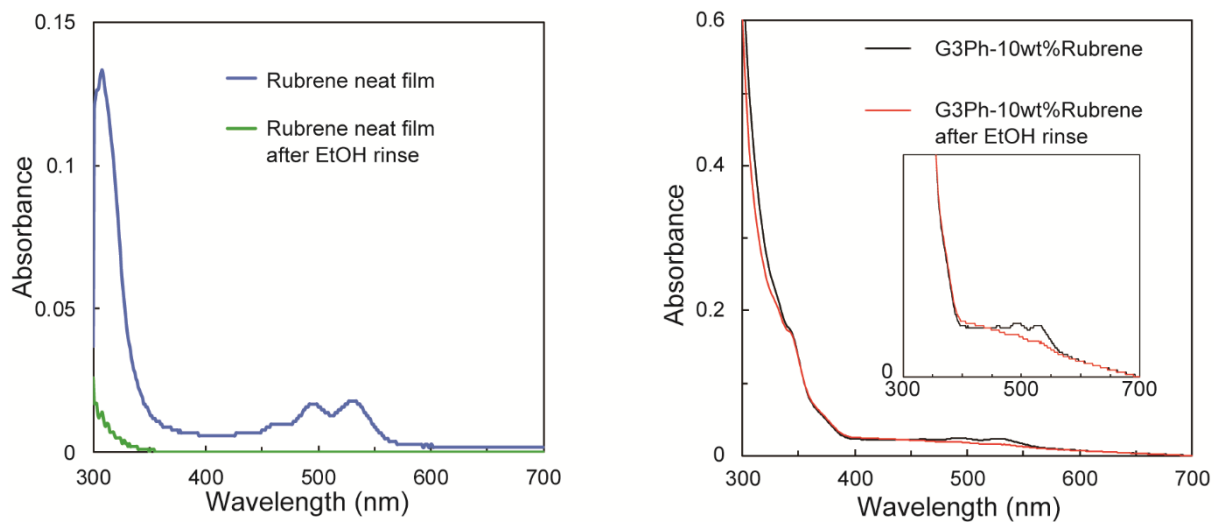


Figure S6. UV-vis spectra of (left) neat film of rubrene before and after rinsing with EtOH. (right) G3Ph film doped with 10 wt% rubrene before and after rinsing with EtOH.

3. PL lifetime analysis

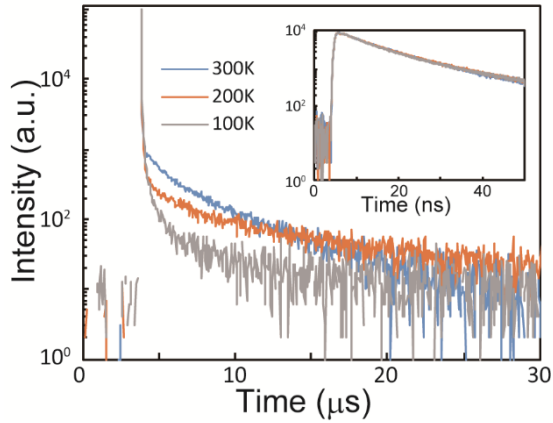


Figure S7. Transient decay spectra of 15% tBuG2TAZ doped G4Ph film under vacuum at 300 K, 200 K, and 100 K. Inset is the data measured at short time range.

The k_{RISC} value was calculated according to the following equation²

$$k_{RISC} = \frac{k_p k_d \Phi_d}{k_{ISC} \Phi_f} \quad (1)$$

k_F is prompt fluorescence decay rate, k_d is delayed fluorescence decay rate, k_{ISC} is intersystem crossing decay rate from S_1 to T_1 , and k_{RISC} is reverse intersystem crossing decay rate from S_1 to T_1 . Φ_f is the quantum yield of prompt fluorescence, and Φ_d is the quantum yield of delayed fluorescence. Each values that are needed for calculations were calculated as follows using the fitting data.

$$k_p = \frac{1}{\tau_p} \quad (2)$$

$$k_d = \frac{1}{\tau_d} \quad (3)$$

$$k_{ISC} = \frac{\Phi_{ISC}}{\tau_p} \quad (4)$$

The Φ_{ISC} was estimated to be $\Phi_{TADF} < \Phi_{ISC} < (1 - \Phi_f)$.

4. OLED device performance

Table S3. Averaged device performance of the OLED device A and B

Host		EQE _{MAX} , @100cd/m ² , @1000cd/m ² (%)	V _{ON} (V)	PE _{max} (lm/W)	CE _{max} (cd/A)	L _{MAX} (cd/m ²)
G3Ph	A	7.2 ± 1.4, 6.5 ± 1.5, 2.5 ± 0.3	2.82 ± 0.05	18.0 ± 3.5	18.9 ± 3.8	1057 ± 137
	B	14.8 ± 1.0, 14.2 ± 1.0, 8.9 ± 0.8	2.54 ± 0.05	39.3 ± 3.3	39.1 ± 2.6	1847 ± 105
G4Ph	A	9.8 ± 0.8, 8.6 ± 0.9, 4.7 ± 0.3	2.91 ± 0.11	25.6 ± 1.9	27.1 ± 2.1	1448 ± 47
	B	14.8 ± 1.0, 14.2 ± 0.7, 8.0 ± 0.4	2.6 ± 0.00	40.5 ± 2.8	40.7 ± 2.8	1776 ± 102

* The average and standard deviation is of 5 devices.