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Electronic supplementary information

Novel Dendritic Large Molecules as Solution-Processable Thermally Activated Delayed Fluorescent Emitters for Simple Structured Non-doped Organic Light Emitting Diodes

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Figures

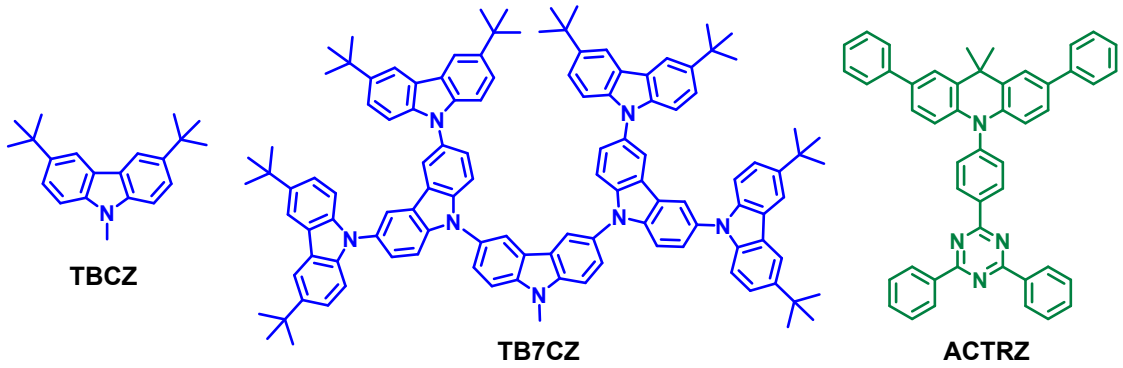

Fig. S1 Chemical structures of carbazole-based dendrons and emissive core used in this study.

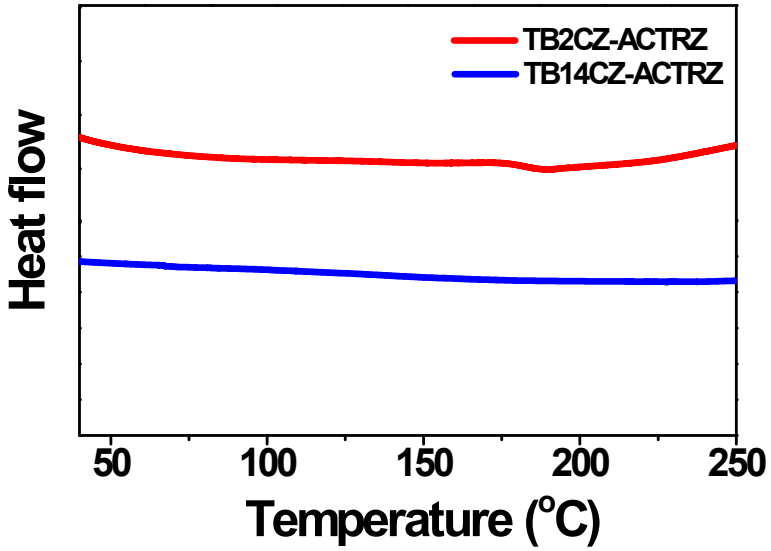

Fig. S2 DSC thermograms of the **TB2CZ-ACTRZ** and **TB14CZ-ACTRZ**.

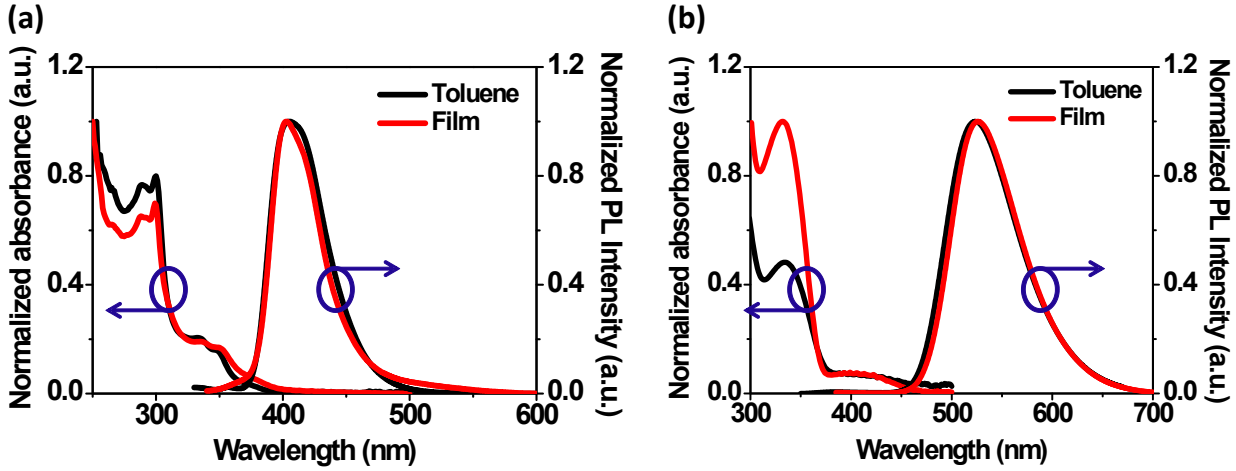

Fig. S3 UV-Vis absorption and PL spectra of (a) **TB7CZ,** and (b) **ACTRZ** in toluene and film states.

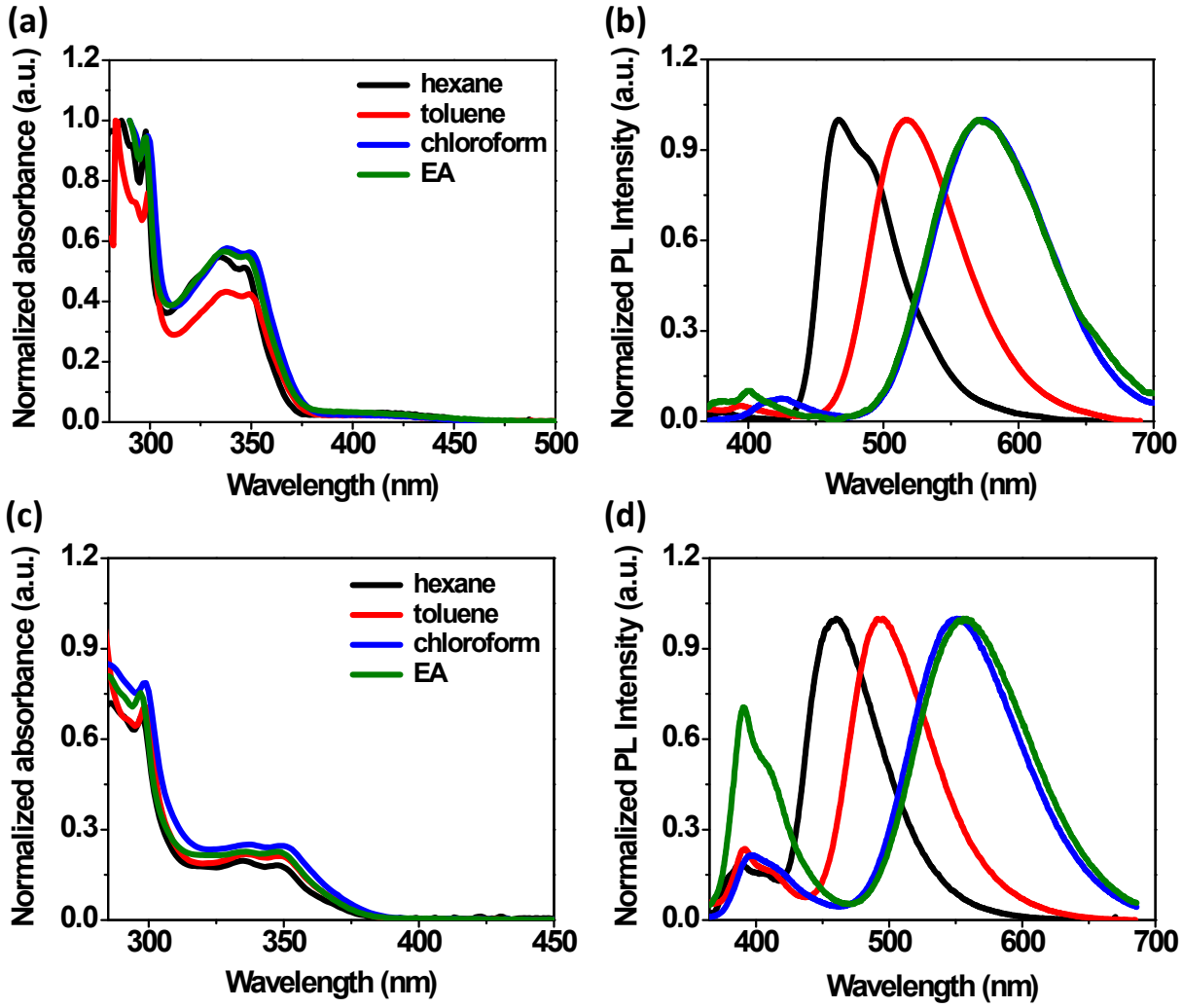

Fig. S4 UV-Vis absorption and PL spectra of **TB2CZ-ACTRZ** (**a** and **b**) and **TB14CZ-ACTRZ** (**c** and **d**) in different polar solvents.

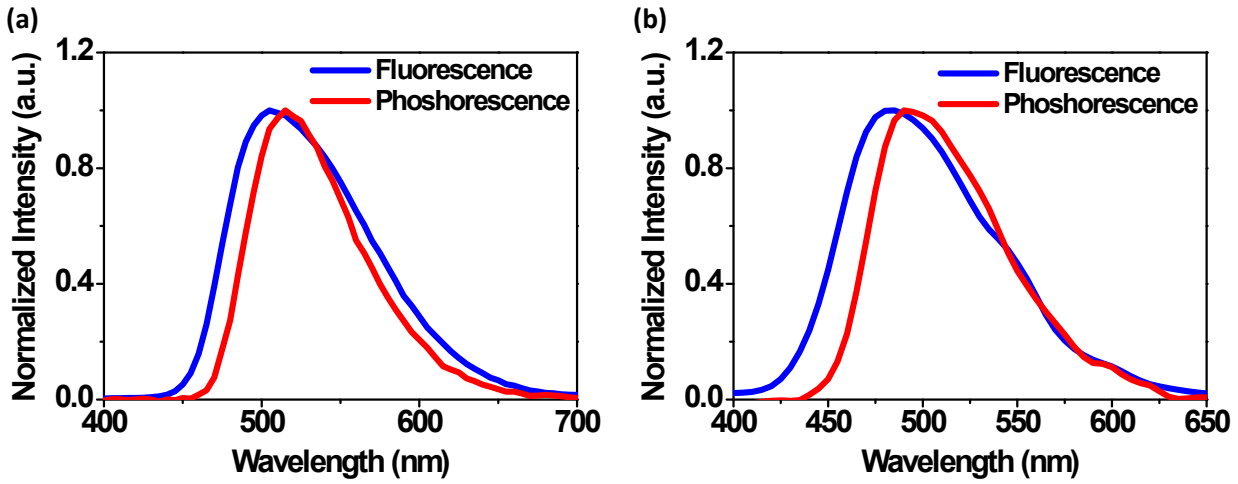

Fig. S5 Low temperature fluorescence and phosphorescence spectra measured at 77K in film states. (a) **TB2CZ-ACTRZ** and (b) **TB14CZ-ACTRZ**

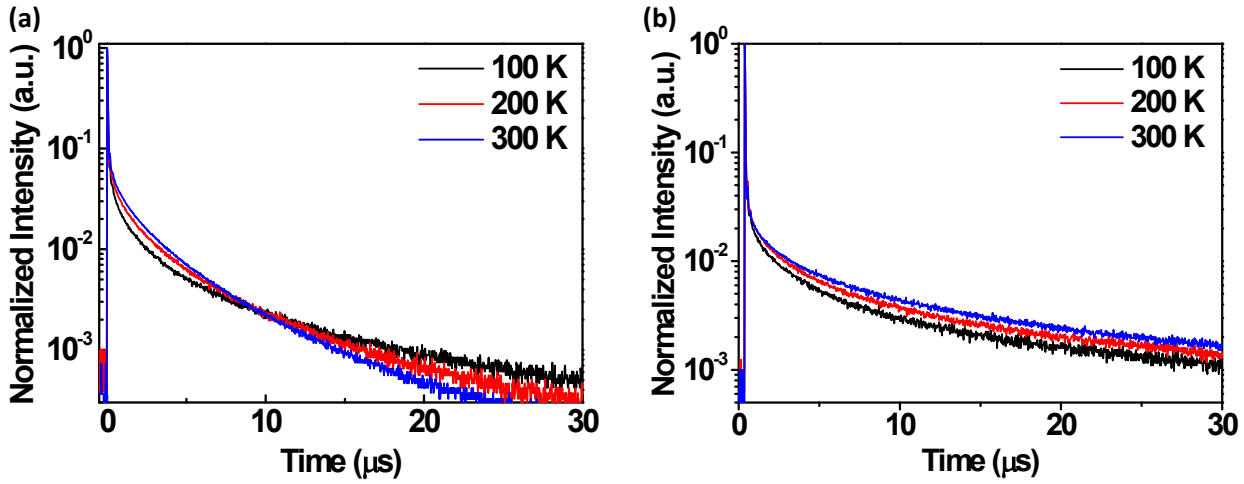

Fig. S6 Temperature-dependent transient PL decay of (a) **TB2CZ-ACTRZ** and (b) **TB14CZ-ACTRZ** in film states.

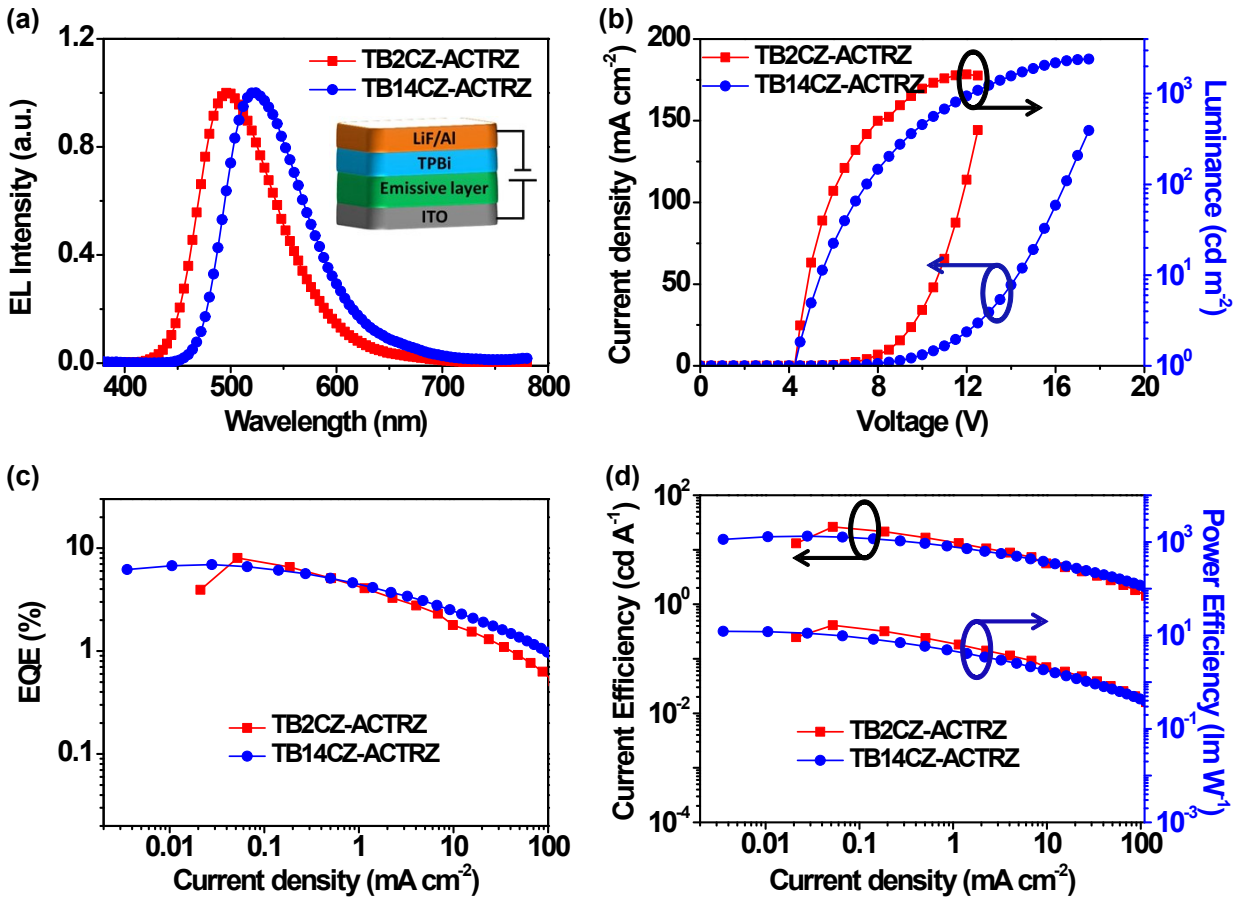

Fig. S7 Characteristics of TADF-OLED devices for **TB2CZ-ACTRZ** (t=120 nm) and **TB14CZ-ACTRZ** (t=90 nm): (a) the normalized EL spectra (measured at 1000 cd m^{-2}), (b) current density–voltage–luminance (*J*–*V*–*L*), (c) EQE versus current density, and (d) current efficiency and power efficiency versus current density plots. The inset in Fig. a is the device structure.

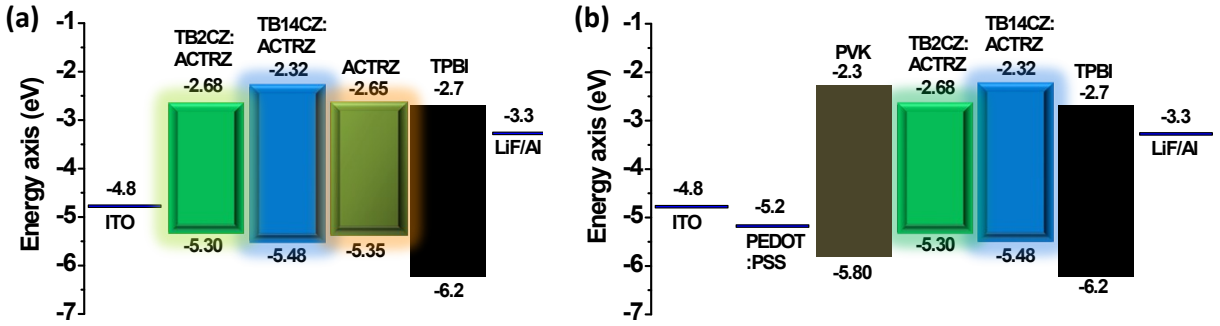

Fig. S8 Schematic energy level diagrams of (a) **device A**, and (b) **device B**.

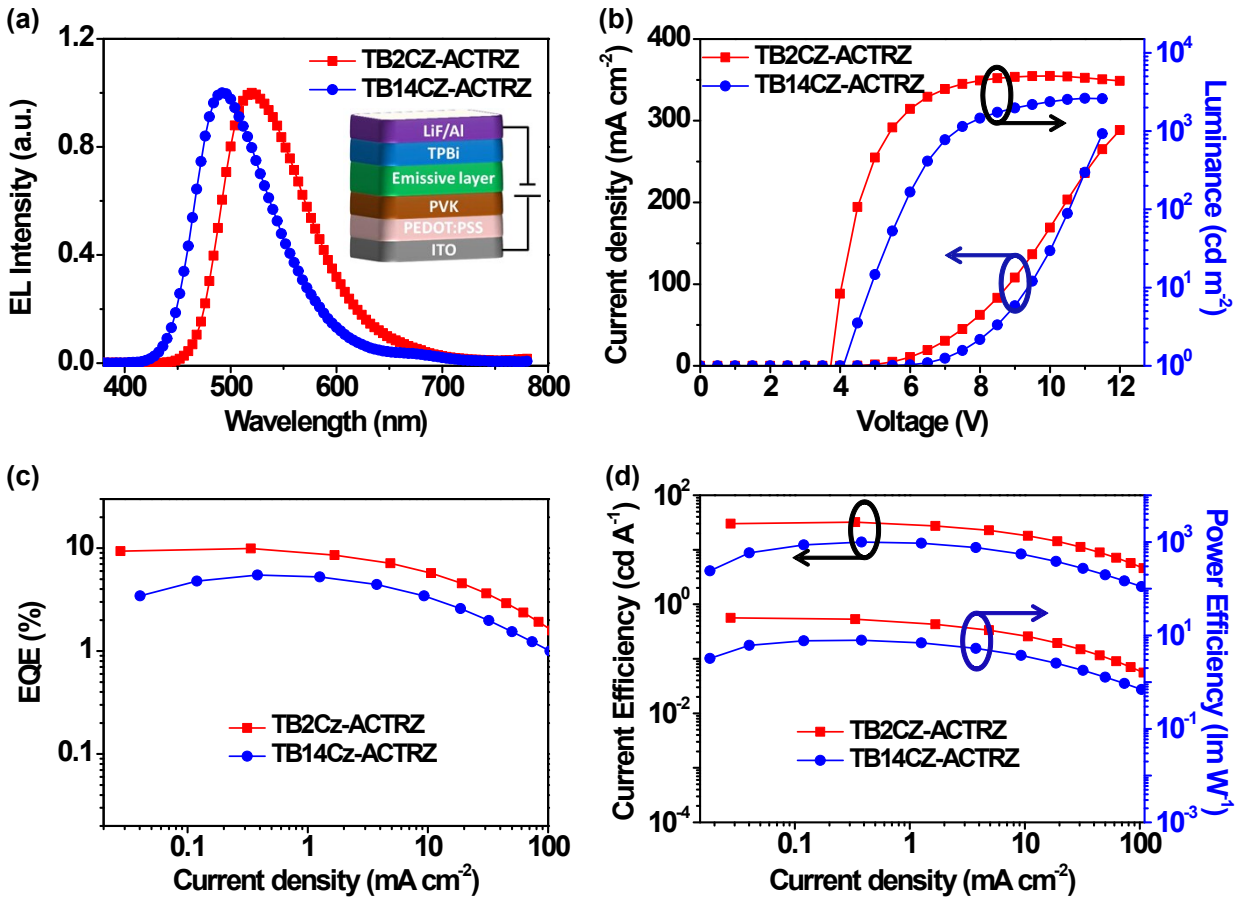

Fig. S9 Characteristics of TADF-OLED devices for **TB2CZ-ACTRZ** and **TB14CZ-ACTRZ**: (a) the normalized EL spectra, at 1000 cd m^{-2} (inset shows the device structure), (b) current density–voltage–luminance (*J*–*V*–*L*), (c) EQE *versus* current density and (d) current efficiency and power efficiency *versus* current density plots.

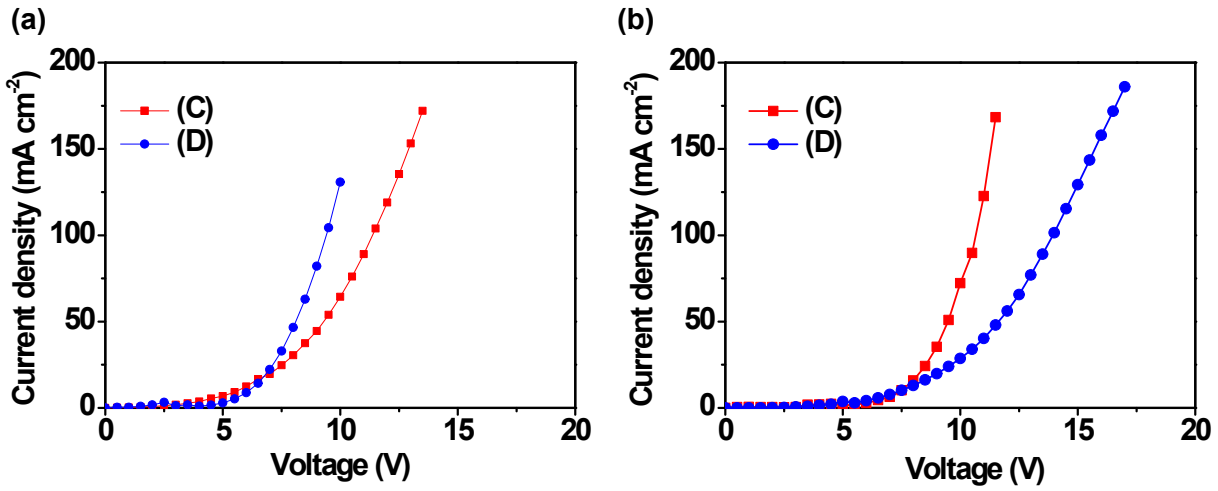

Fig. S10 Current density–voltage (*J*–*V*) characteristics of hole only devices in simple (device C) and multilayered structure (device D): (a) **TB2CZ-ACTRZ** and (b) **TB14CZ-ACTRZ**.

Tables

Table S1: Optical, photophysical, and electrochemical data of key fragments (**TB7CZ** and **ACTRZ)**.

compound	λ_{abs} [a/b] (nm)	λ_{em} [a/b](nm)	E_g [c] (eV)	HOMO [d] (eV)	LUMO [e] (eV)
TB7CZ	300, 333, 349/ 299, 335, 350	404/403	3.30	-5.51	-2.21
ACTRZ	332, 406/ 334, 406	524/526	2.70	-5.35	-2.65

[a] In toluene. [b] In thin film. [c] Calculated from absorption threshold (film state). [d] Calculated using oxidation onset in film state. [e] Obtained by adding optical band gap to HOMO level.

Table S2: UV-Vis absorption and PL data of **TB2CZ-ACTRZ** and **TB14CZ-ACTRZ** in different polar solvents.

compound	Hexane [a/b] (nm)	Toluene [a/b] (nm)	Chloroform [a/b] (nm)	EA [a/b] (nm)
TB2CZ-ACTRZ	298, 335, 347/ 389, 467, 488	299, 338, 349/ 394, 517	299, 338, 349/ 425, 575	298, 337, 348/ 400, 572
TB14CZ-ACTRZ	298, 335, 348/ 388, 460	299, 336, 349/ 392, 492	299, 337, 350/ 396, 551	297, 336, 348/ 390, 558

[a] UV-Vis absorption. [b] PL data.

Table S3: **TB2CZ-ACTRZ** and **TB14CZ-ACTRZ** dendrimers based TADF-OLED performance data (**device A**).

Compound	V_{on} [a] (V)	Luminance [b] (cd m^{-2})	CE [b] (cd A^{-1})	PE [b] (lm W^{-1})	EQE (%) [b]	λ_{max} [c] (nm)	CIE [c] (x,y)
TB2CZ-ACTRZ	4.1	1626	26.4	16.6	8.0	524	0.32, 0.57
TB14CZ-ACTRZ	4.2	2370	17.7	12.1	6.8	496	0.22, 0.42

[a] Turn-on voltage at a brightness of 1 cd m^{-2}. [b] Maximum value. [c] At a luminance of 1000 cd m^{-2}. * CE : current efficiency, PE: power efficiency, EQE: external quantum efficiency. Thickness of TB2Cz-ACTRZ= 120 nm; Thickness of TB14Cz-ACTRZ = 90 nm

Table S4: **TB2CZ-ACTRZ** and **TB14CZ-ACTRZ** dendrimers based TADF-OLED performance data (**device B**).

Compound	V_{on} [a] (V)	Luminance [b] (cd m^{-2})	CE [b] (cd A^{-1})	PE [b] (lm W^{-1})	EQE (%) [c] at max/100/500 cd m^{-2}	λ_{max} [d] (nm)	CIE [d] (x,y)
TB2CZ-ACTRZ	3.5	5060	32.0	23.7	9.9/9.9/7.4	520	0.31, 0.57
TB14CZ-ACTRZ	4.0	2622	13.9	7.9	5.5/5.4/2.9	492	0.21, 0.42

[a] Turn-on voltage at a brightness of 1 cd m^{-2}. [b] Maximum value. [c] Data at maximum, 100 and 1000 cd m^{-2}. [d] At a luminance of 1000 cd m^{-2}. * CE : current efficiency, PE: power efficiency, EQE: external quantum efficiency.