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Electronic supplementary information

Excellent Bipolar Host Material Exhibiting EQE of 24.0% with Small Efficiency Roll-off in Solution-processable Thermally Activated Delayed Fluorescence OLEDs

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Figures and Tables

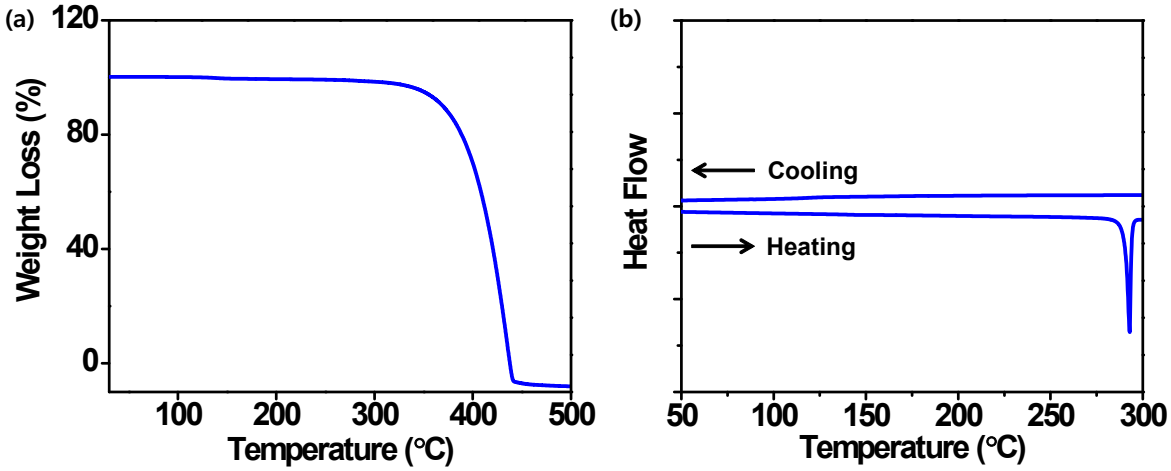

Fig. S1 TGA (a) and DSC (b) thermograms of **APC**.

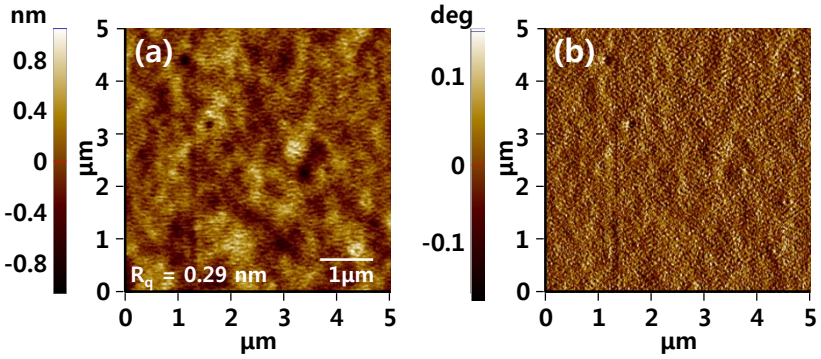

Fig. S2 AFM (a) topography and (b) phase images (5 × 5 µm) of **APC**:t4CzIPN blend film (6.0 wt%).

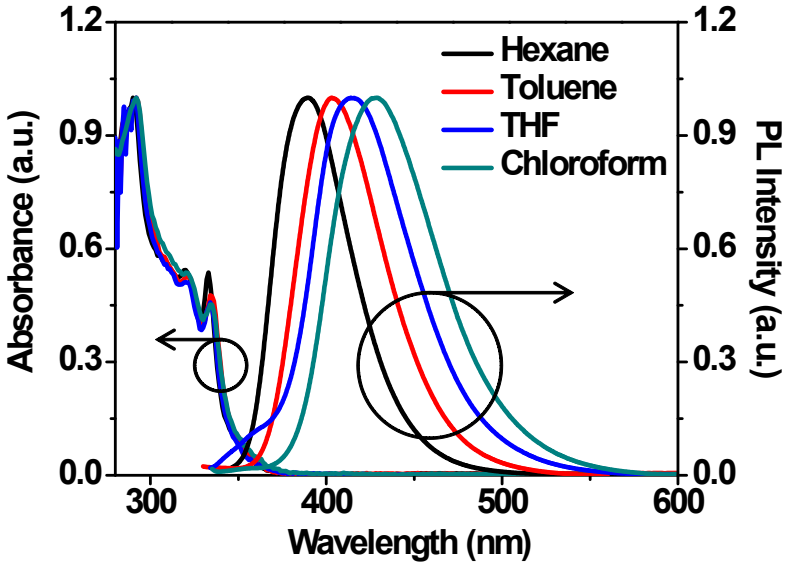

Fig. S3 UV-Vis absorption and photoluminescence spectra of **APC** in different polar solvents.

Table S1. Photophysical data of **APC** in different polar solvents.

Host	Hexane [a/b] (nm)	Toluene [a/b] (nm)	THF [a/b] (nm)	Chloroform [a/b] (nm)
APC	290, 317, 333/390	292, 321, 334/403	292, 320, 334/414	292, 320, 334/429

[a] Absorbance. [b] PL value

Table S2. Photophysical properties and kinetic parameters of t4CzIPN-doped (6.0 wt%) **APC** films.

Comp.	k_p ($\times10^7$ s^{-1})[a]	k_d ($\times10^5$ s^{-1})[b]	k_r^S ($\times10^7$ s^{-1})[c]	k_{ISC} ($\times10^7$ s^{-1})[d]	k_{RISC} ($\times10^5$ s^{-1})[e]	k_{nr}^T ($\times10^5$ s^{-1})[f]
APC	3.96	3.4	0.41	3.55	27	0.61

[a] Prompt emission rate constant. [b] Delayed emission rate constant. [c] Radiative decay rate constant of the singlet excited state. [d] Intersystem crossing rate constant. [e] Reverse intersystem crossing rate constant. [f] Non-radiative decay rate constant for triplet excited state.

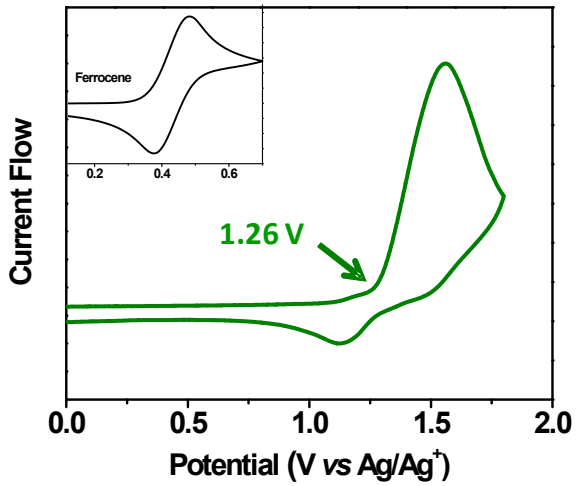

Fig. S4 Cyclic voltammogram of the **APC** in the film state (inset shows the corresponding plot of ferrocene).

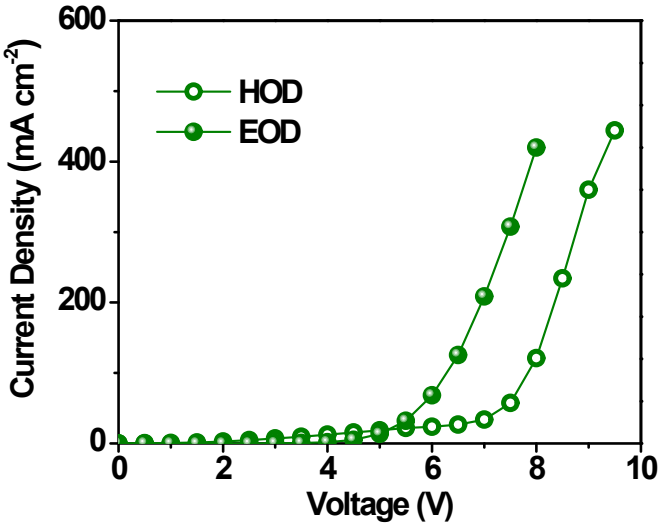

Fig. S5 Hole only and electron devices of **APC**.

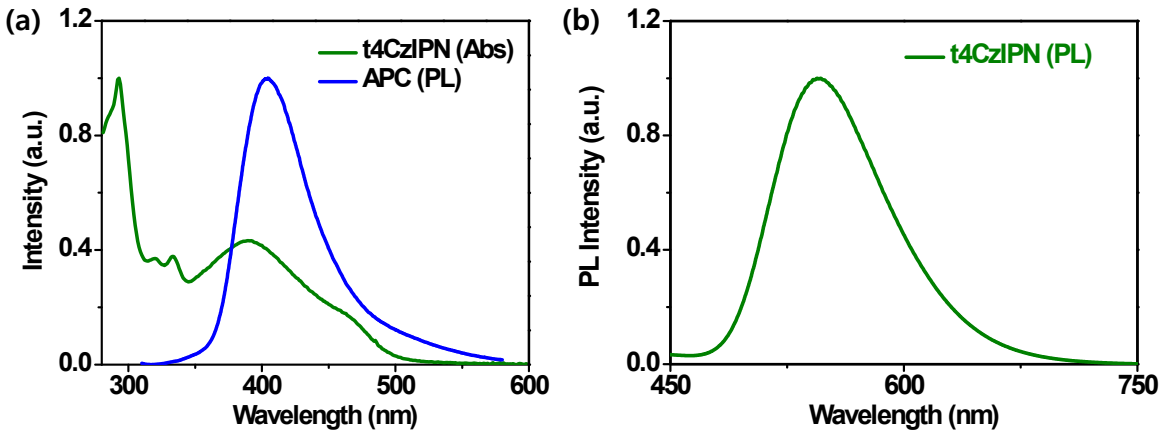

Fig. S6 (a) UV–Vis absorption spectrum of t4CzIPN emitter and PL spectrum of **APC** host in the film state, and (b) PL spectrum of t4CzIPN in the film state.

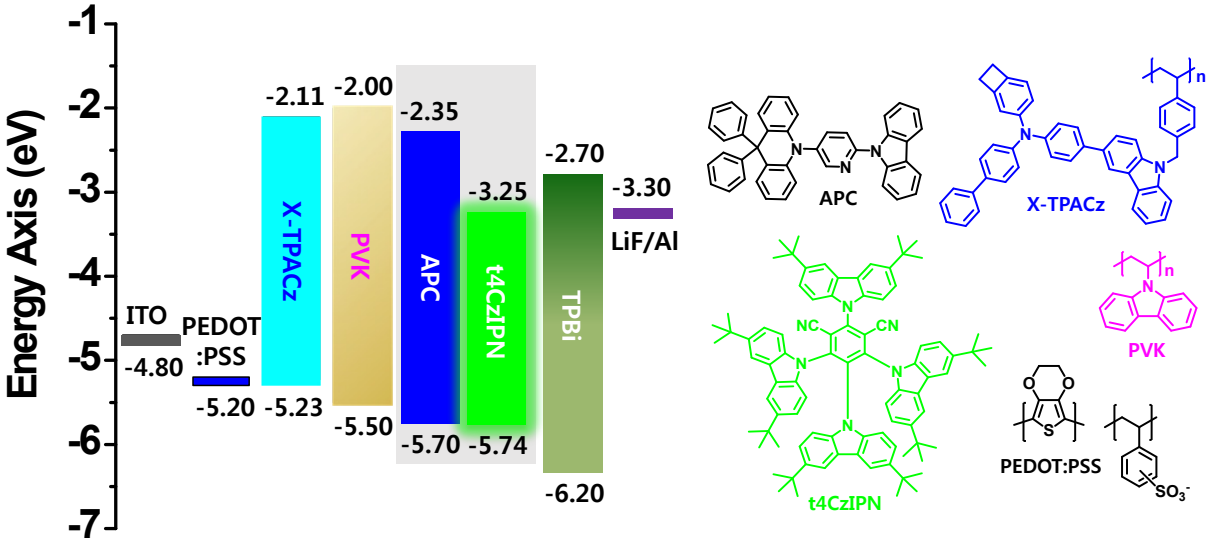

Fig. S7 Energy level diagram and chemical structures of the materials used in this study.

Table S3. Comparison of the state-of-the-art performing solution-processed TADF OLEDs.

S. No.	Host	Dopant	EQE_{max} (%)	EQE_{500} (%)	EQE_{1000} (%)	Roll-off (%)[a]	Reference
1.	**APC**	**t4CzIPN**	**24.0**	**23.1**	**21.7**	**9.6**	**Present work**
2.	CBP	TBP-DMA	22.1	--	20.3	8.0	1
3.	DCzPPy	DACT-II	30.8	29.0	27.0	12.0	2
4.	SiCz	t4CzIPN	18.3	~15.0	12.0	34	3
5.	mCPDPO	t4CzIPN	18.8	16.6	12.4	34	4
6.	mCP	4CzIPN	21.0	<16.0	<16.0	>24	5
7.	Cz-3CzCN	CzCzCN	23.8	~17.0	12.6	47	6
8.	Cz-3CzCN	Cz-4CzCN	23.5	~12.0	7.8	67	6
9.	mCP	COPO1	20.1	~10.0	~3.0	~85	7
10.	TPA-3/PO-T2T	9PhFDPhTz	24.0	15.5	10.1	58.0	8
11.	PVK:OXD-7	5	23.8	~18.0	16.5	31	9
12.	DPOBBPE	5CzCN	25.8	~19.0	~12.0	~53	10
13.	SiCz	4CzFCN	20.0	<1.0	--	--	11
14.	CzSi	MA-TA	22.1	--	--	--	12

[a] Roll-off from maximum value to 1000 cd m^{-2} brightness.

Table S4. Comparison of the maximum performance and roll-off behavior at 1000 cd m^{-2} for t4CzIPN emitter fabricated through the solution as well as vacuum process.

S. No.	Host	Dopant	Fabrication process	EQE_{max} (%)	EQE_{1000} (%)	Roll-off (%)	Reference
1.	**APC**	**t4CzIPN**	**Solution**	**24.0**	**21.7**	**9.6**	**Present work**
2.	IAPC	t4CzIPN	Solution	19.2	17.5	9.0	13
3.	SiCT	t4CzIPN	Solution	19.2	12.4	36.0	14
4.	mCPDPO	t4CzIPN	Solution	18.8	12.4	34.0	4
5.	SiCz	t4CzIPN	Solution	18.3	12.0	34.0	3
6.	SiCz	t4CzIPN	Vacuum	17.1	13.5	21.0	3
7.	PE-PCzP	t4CzIPN	Solution	17.1	16.5	4.0	15

References

1. X. Cai, D. Chen, K. Gao, L. Gan, Q. Yin, Z. Qiao, Z. Chen, X. Jiang and S.-J. Su, *Adv. Funct. Mater.*, 2018, **28**, 1704927-1704935.
2. K.-W. Tsai, M.-K. Hung, Y.-H. Mao and S.-A. Chen, *Adv. Funct. Mater.*, 2019, **29**, 1901025.
3. Y. J. Cho, K. S. Yook and J. Y. Lee, *Adv. Mater.*, 2014, **26**, 6642-6646.
4. M. Godumala, S. Choi, S. K. Kim, S. W. Kim, J. H. Kwon, M. J. Cho and D. H. Choi, *J. Mater. Chem. C,* 2018, **6**, 10000-10019.
5. T. Zhou, G. Xie, S. Gong, M. Huang, J. Luo and C. Yang, *ACS Appl. Mater. Interfaces*, 2017, **9**, 34139-34145.
6. X. Ban, A. Zhu, T. Zhang, Z. Tong, W. Jiang and Y. Sun, *Chem. Commun.*, 2017, **53**, 11834-11837.
7. Z. Ren, R. S. Nobuyasu, F. B. Dias, A. P. Monkman, S. Yan and M. R. Bryce, *Macromolecules*, 2016, **49**, 5452-5460.
8. J. Zhao, C. Zheng, Y. Zhou, C. Li, J. Ye, X. Du, W. Li, Z. He, M. Zhang, H. Lin, S. Tao and X. Zhang, *Mat. Horizons*, 2019, DOI: 10.1039/c9mh00373h.
9. W.-P. To, D. Zhou, G. S. M. Tong, G. Cheng, C. Yang and C.-M. Che, *Angew. Chem. Int. Ed.*, 2017, **56**, 14036-14041.
10. S. K. Jeon, H.-J. Park and J. Y. Lee, *ACS Appl. Mater. Interfaces*, 2018, **10**, 5700-5705.
11. Y. J. Cho, B. D. Chin, S. K. Jeon and J. Y. Lee, *Adv. Funct. Mater.*, 2015, **25**, 6786-6792.
12. Y. Wada, S. Kubo and H. Kaji, *Adv. Mater.*, 2018, **30**, 1705641-1705648.
13. C. H. Jeong, M. Godumala, J. Yoon, S. Choi, Y. W. Kim, D. H. Choi, M. J. Cho and D. H. Choi, *ACS Appl. Mater. Interfaces,* 2019, **11**, 17602-17609.
14. S. Choi, J. Yoon, M. Godumala, H. J. Kim, S. H. Park, S. K. Kim, H. Lee, J. H. Kwon, M. J. Cho and D. H. Choi, *Dyes Pigments,* 2019, **167,** 120-126.
15. S. Shao, S. Wang, X. Xu, Y. Yang, J. Lv, J. Ding, L. Wang, X. Jing and F. Wang, *Macromolecules*, 2019, **52**, 3394-3403.