

## Electronic Supplementary Information (ESI)

### Facile synthesis of a dopant-free hole transporting material with a phenothiazine core for planar perovskite solar cells

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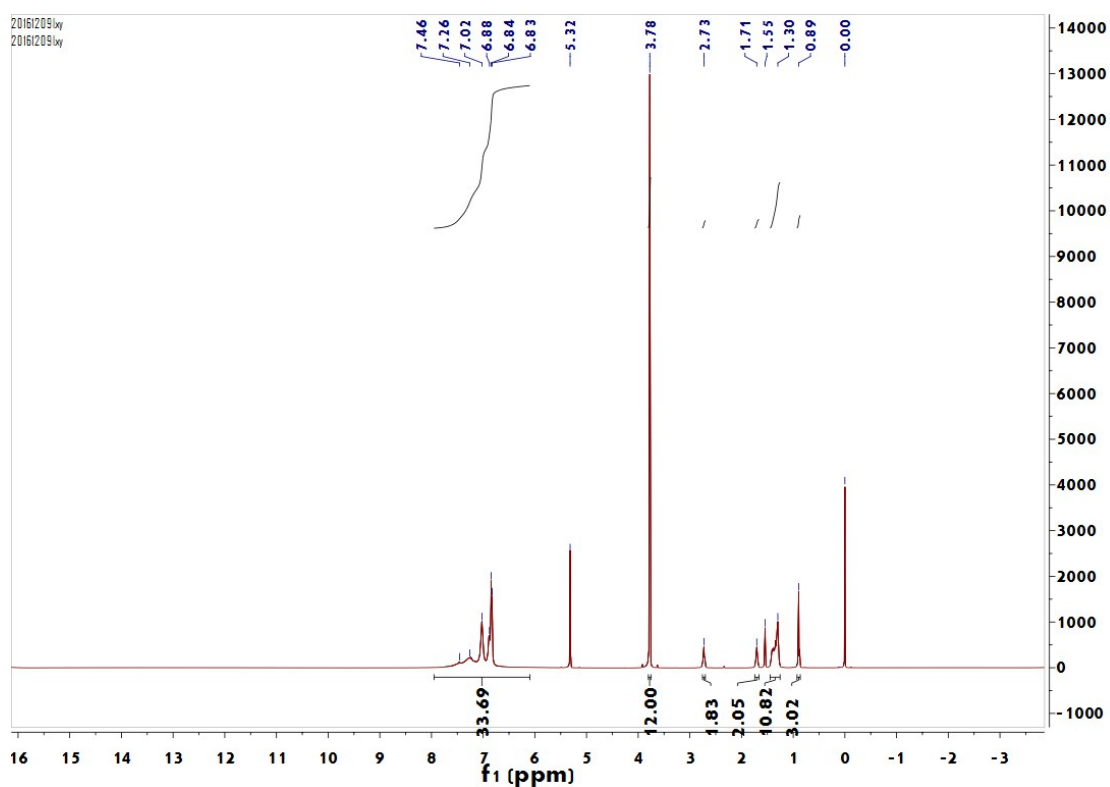


Fig. S1 <sup>1</sup>H NMR spectrum of PTZ-TPA in CD<sub>2</sub>Cl<sub>2</sub>.

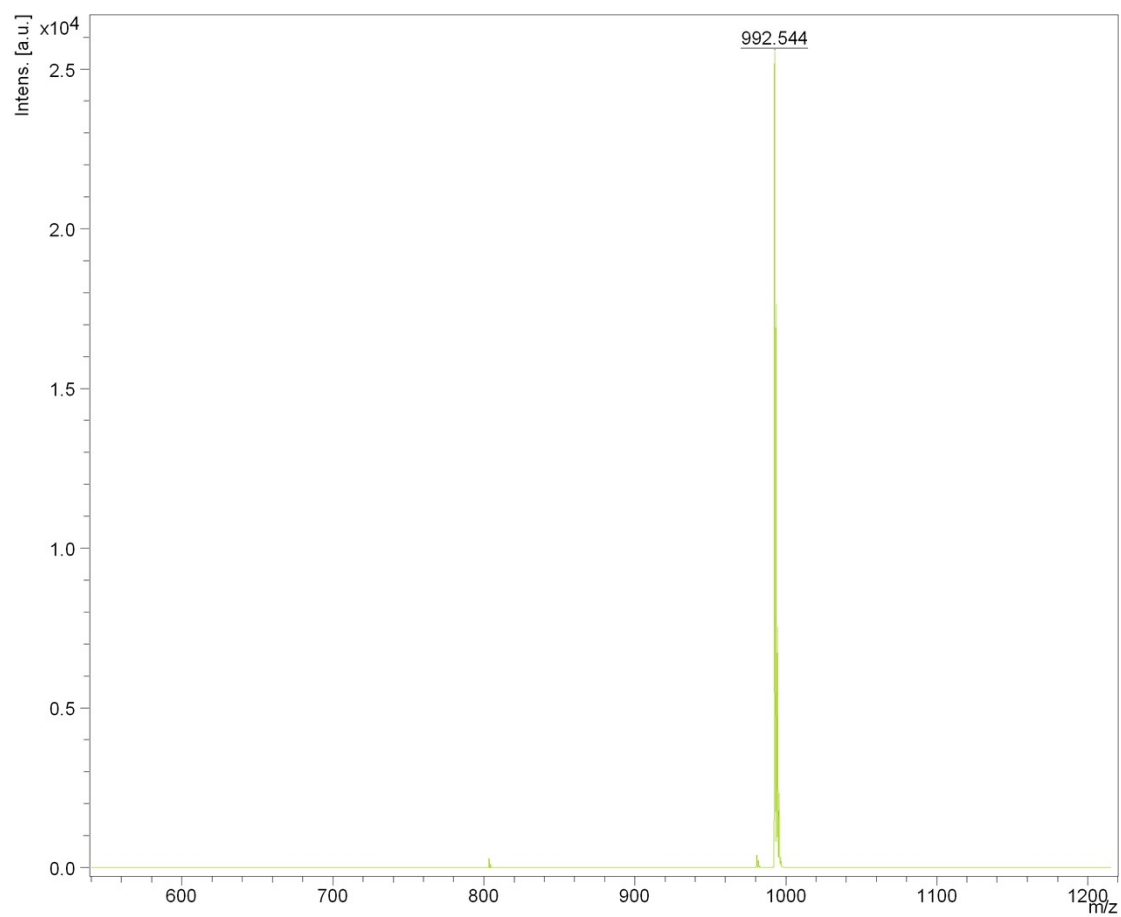


Fig. S2 MALDI-TOF mass spectra of PTZ-TPA

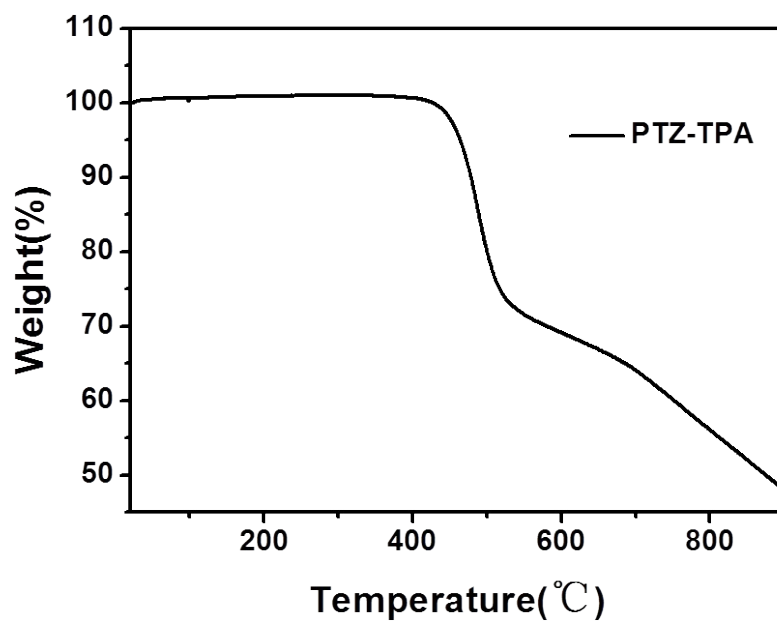
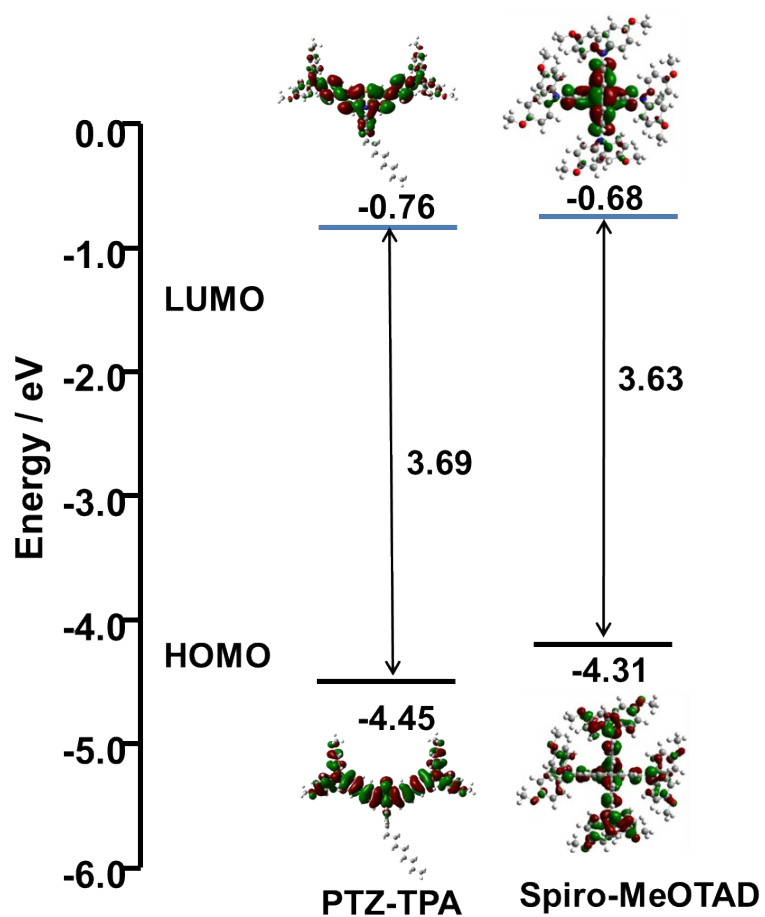


Fig. S3 Thermogravimetric analysis (TGA) curves of PTZ-TPA



**Fig. S4** Energy diagram showing the frontier molecular orbitals computed for PTZ-TPA and Spiro-MeOTAD at the B3LYP/6-31G\* level.

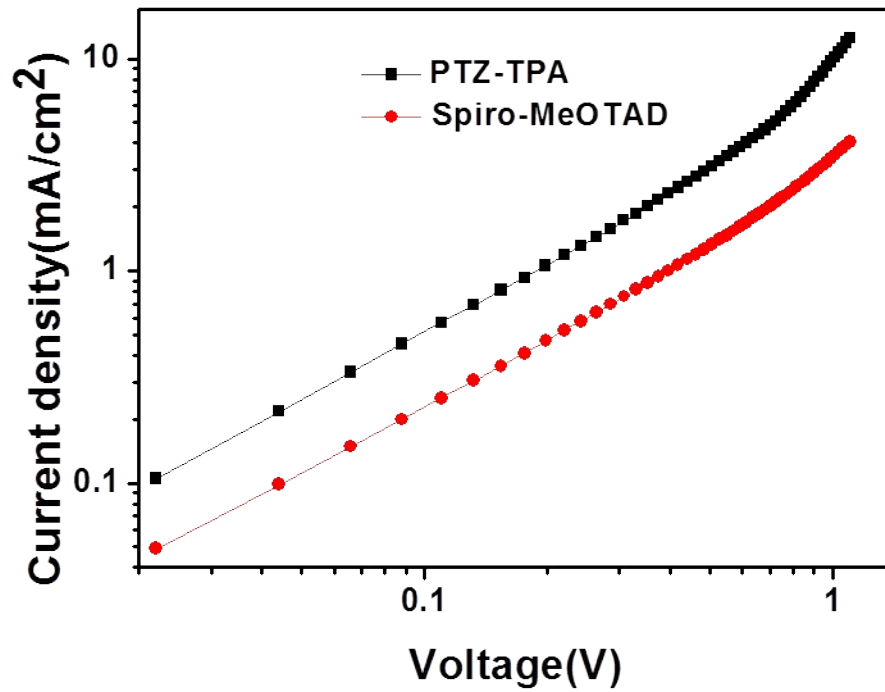


Fig. S5 J-V characteristics of space-charge-limited current of dopant-free HTMs.

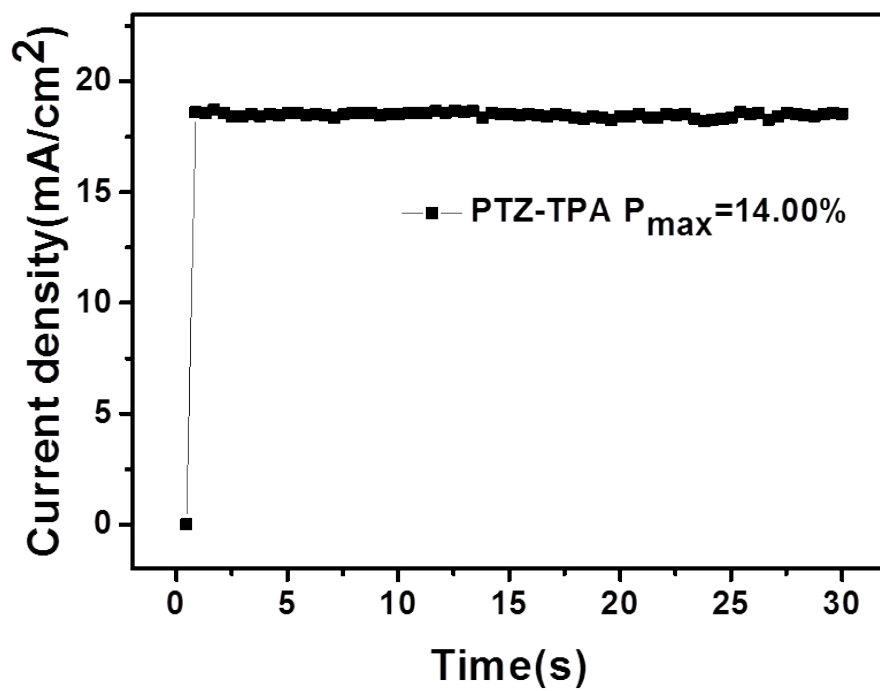


Fig. S6 Steady-state efficiency of PSC using PTZ-TPA

**Table S1** Summary of the parameters from fitting to the TRPL measurement data.

Sample	$A_1$	$\tau_1$ (ns)	$A_2$	$\tau_2$ (ns)
PTZ-TPA	0.4317	6.743	0.4845	1.250
Spiro-MeOTAD	0.3718	4.905	0.7215	0.7655