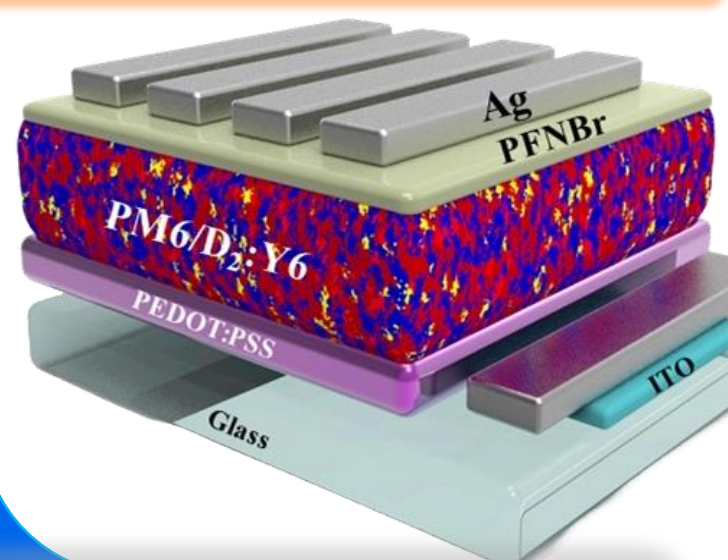


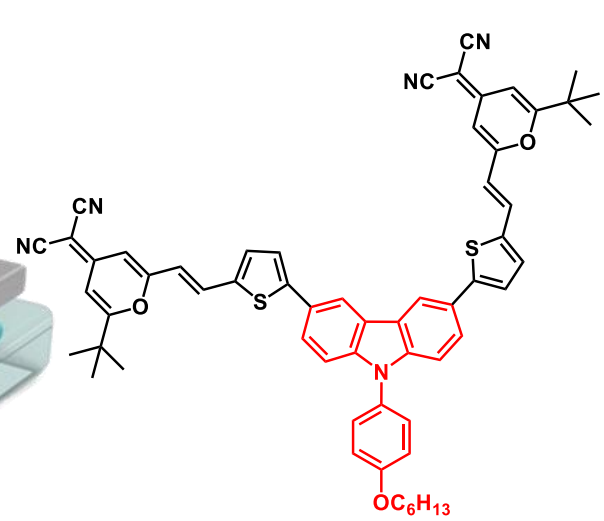
摘要

- 在本研究中，我們採用具有寬帶隙的小分子施體材料CY系列作為PM6/Y6系統中的第三元材料形成施體/施體:受體系統的三元有機太陽能電池，以研究元件的光電特性。第三元材料的選擇可以有效調節主動層的分子能階，並且使Y6聚集被有效抑制，從而有效地調節共混膜的能階排列，進一步改善元件開路電壓進而提升有機太陽能電池的元件效率。
- 我們亦使用微量添加方式，將小分子受體材料OD-NTzTT2F作為PM6:Y6共混系統之第三元材料，製備高性能之三元有機光伏元件，並探討OD-NTzTT2F於二元系統中分子堆疊行為，改善Y6於二元系統中易聚集之特性，進一步提升整體元件性能。

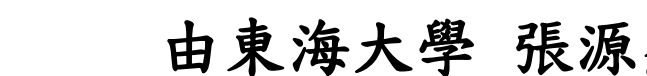
CY-Series



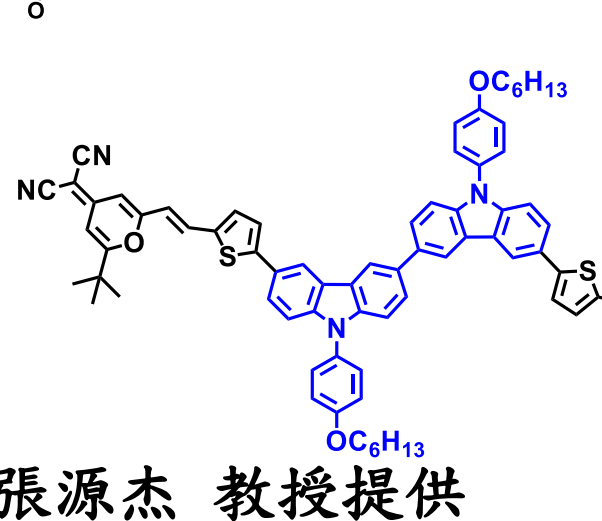
CY-1



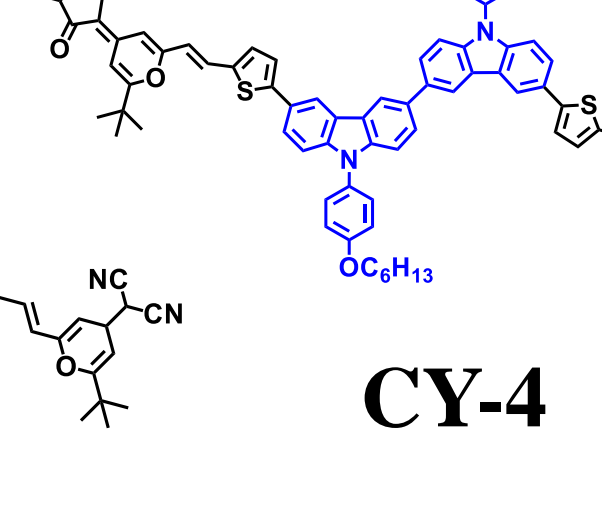
CY-2



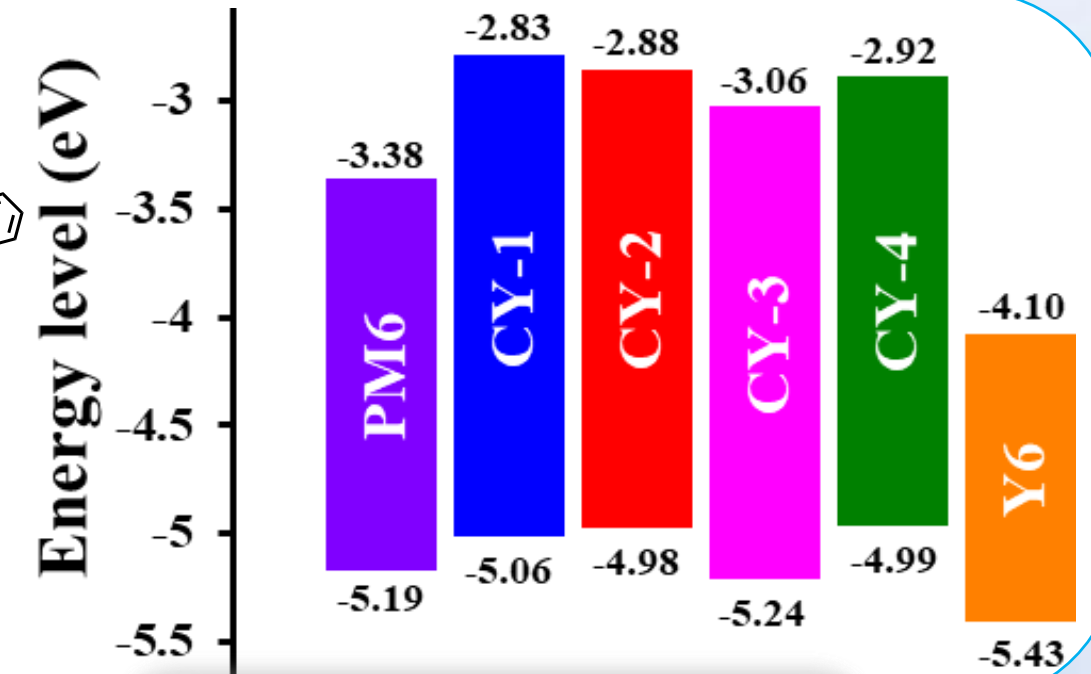
CY-3



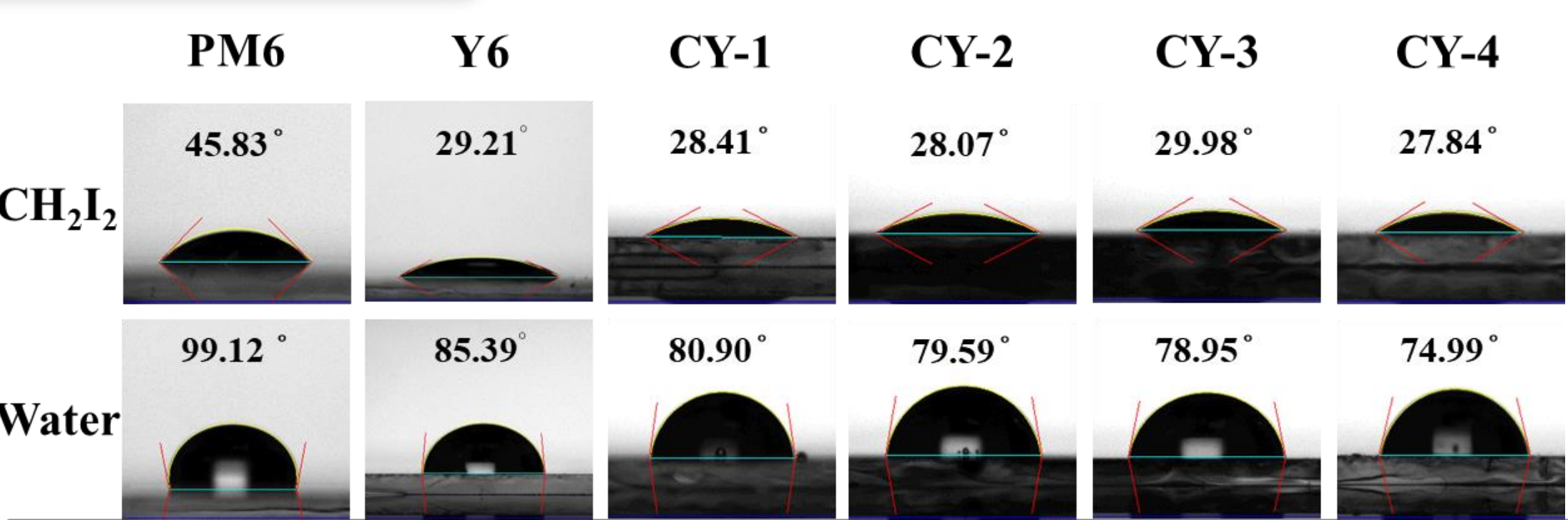
CY-4



由東海大學 張源杰 教授提供

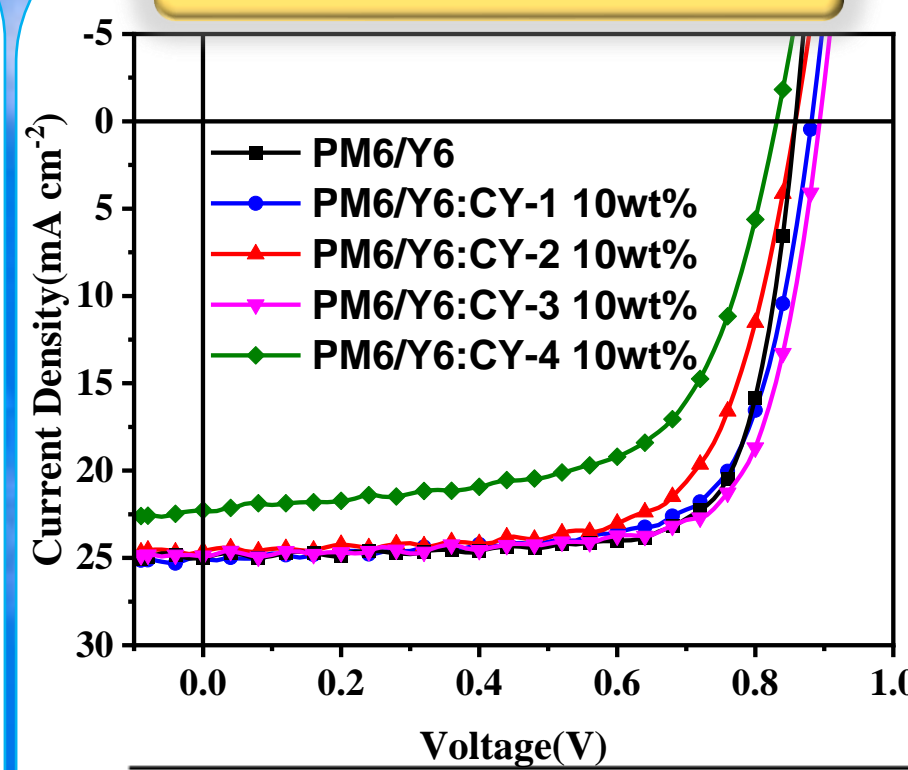


Surface energy

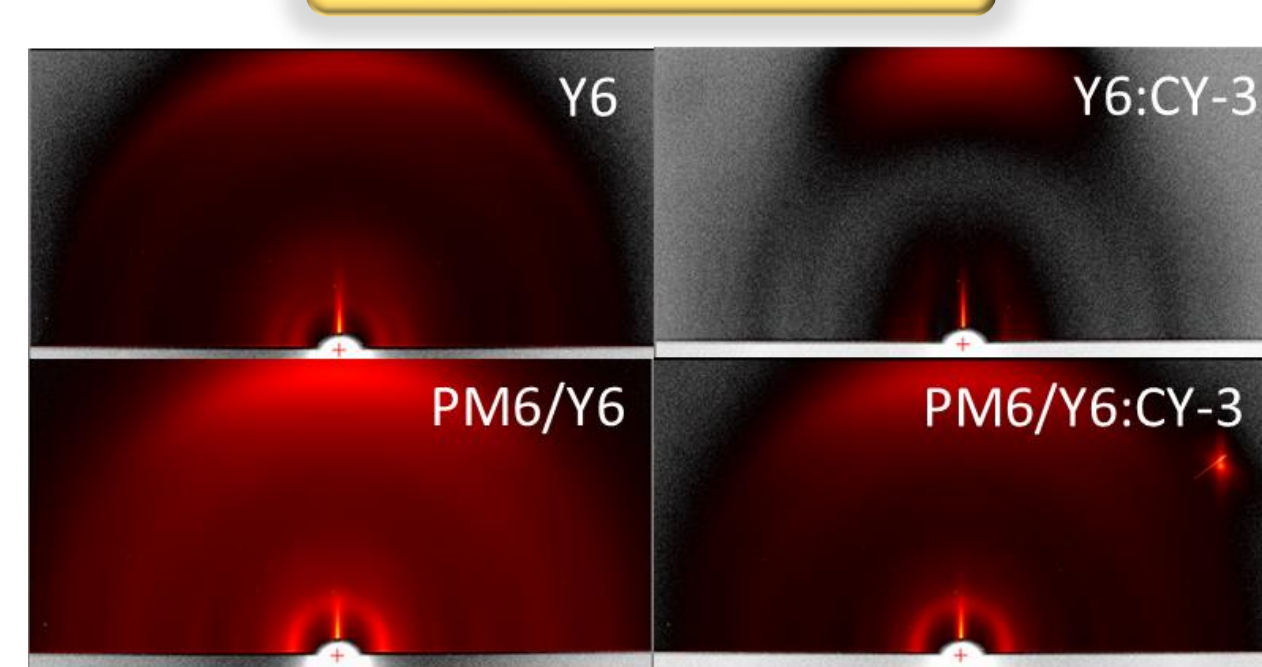


	Water	CH ₂ I ₂	Polar (mN m ⁻¹)	Dispersive (mN m ⁻¹)	Surface energy (mN m ⁻¹)	χ _{PM6-X}	χ _{Y6-X}	ω
CY-1	81.56°	28.38°	7.03	45.04	52.07	0.94	0.01565	-1.29
CY-2	81.07°	28.95°	7.26	44.82	52.09	0.94	0.01600	-1.29
CY-3	79.11°	30.34°	8.15	44.29	52.44	0.99	0.02271	-1.35
CY-4	76.46°	27.81°	9.14	45.25	54.39	1.28	0.08072	-1.67
PM6	99.12°	45.83°	1.59	37.42	39.01	-	0.71409	-
Y6	85.39°	29.21°	5.55	44.73	50.28	0.71	-	-

PCE

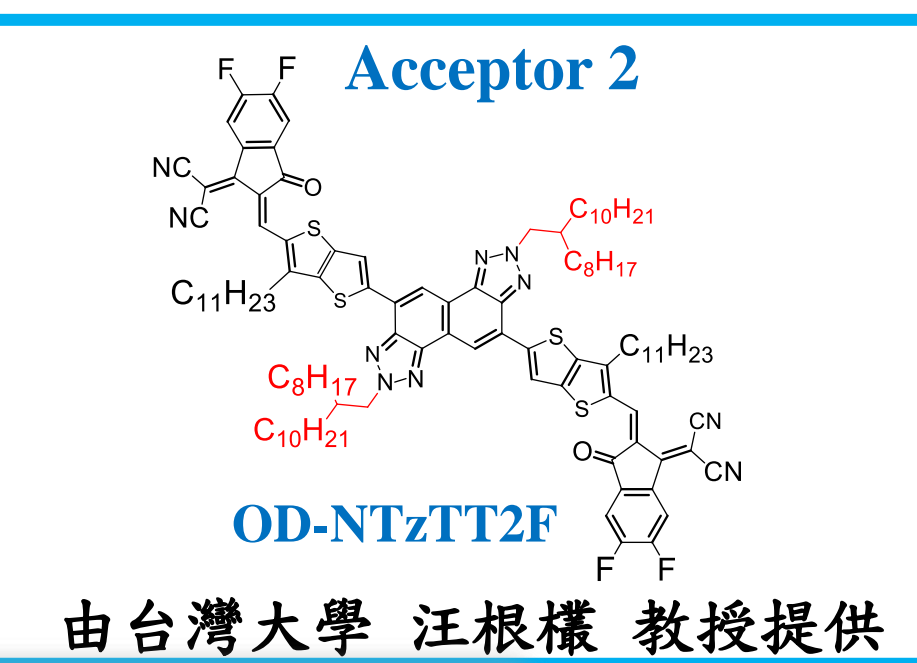
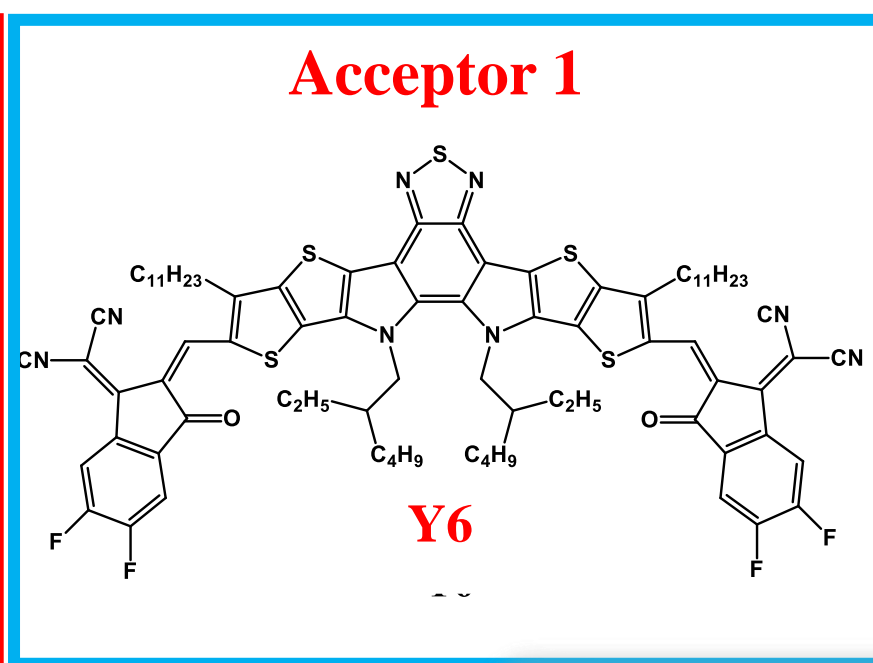
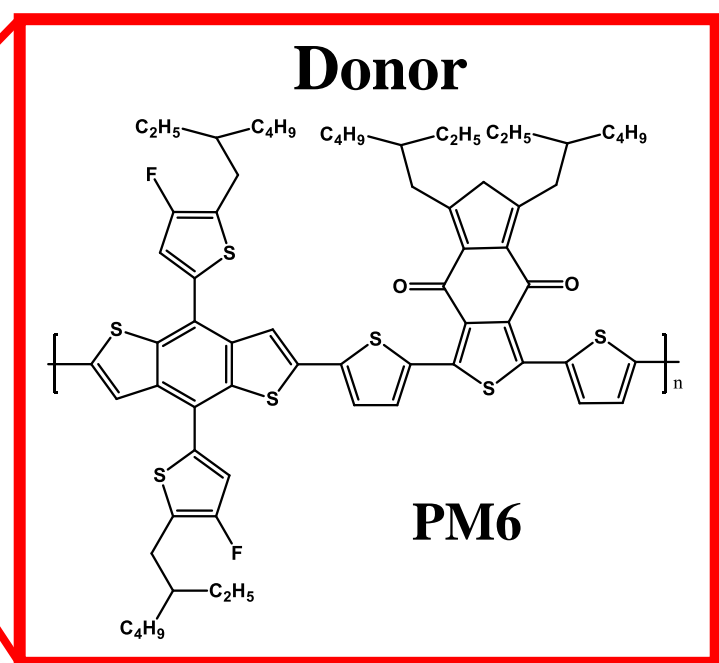
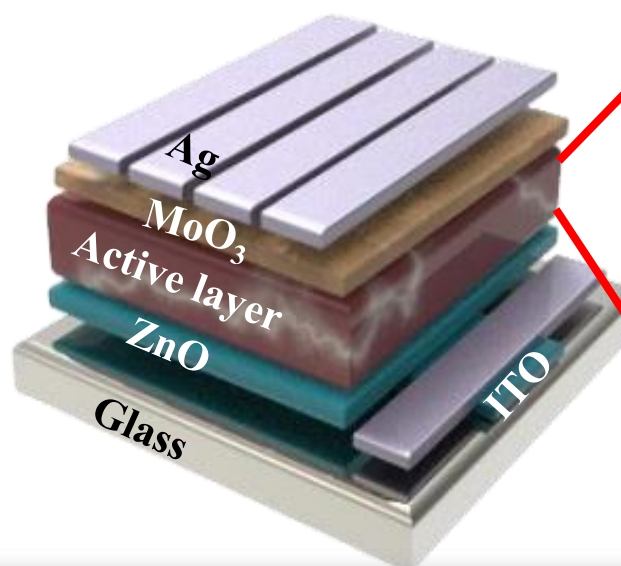


GIWAXS

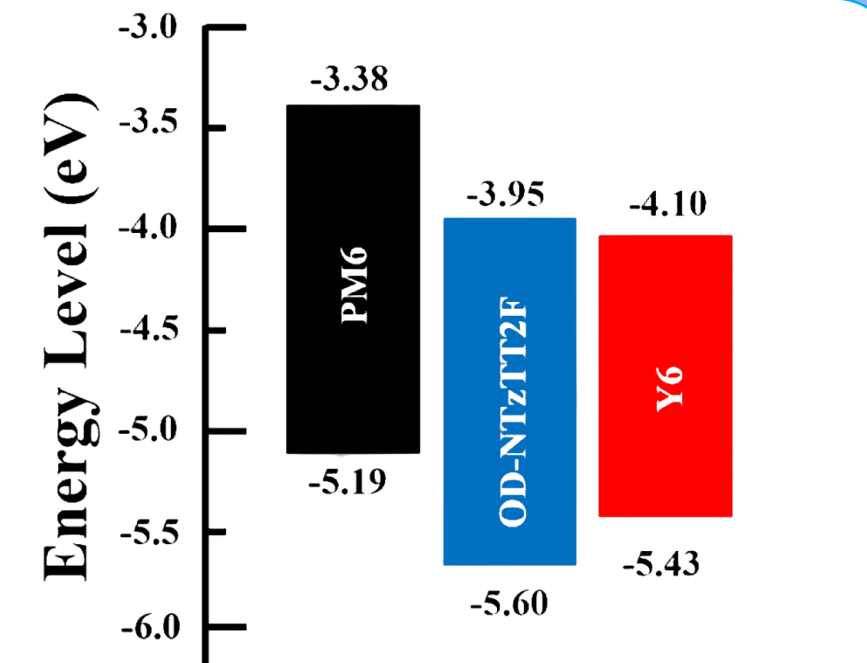


Composition	J _{sc} [mA cm ⁻²]	V _{oc} [V]	FF [%]	PCE _{avg} [%]	PCE _{best} [%]
PM6/Y6	24.50±0.66	0.862±0.004	74.80±1.19	15.79±0.50	16.06
PM6/Y6:CY-1	24.76±0.39	0.880±0.010	69.48±1.01	15.14±0.44	15.69
PM6/Y6:CY-2	24.61±0.35	0.860±0.007	68.70±0.71	14.54±0.31	15.03
PM6/Y6:CY-3	24.96±0.32	0.891±0.006	73.48±1.39	16.34±0.11	16.48
PM6/Y6:CY-4	21.62±0.59	0.828±0.005	63.34±1.14	11.34±0.42	11.78
PM6/BTP-eC9	25.40±0.29	0.840±0.006	75.18±0.71	16.04±0.25	16.44
PM6/BTP-eC9:CY-3	25.57±0.39	0.863±0.007	76.86±0.96	16.96±0.11	17.18*

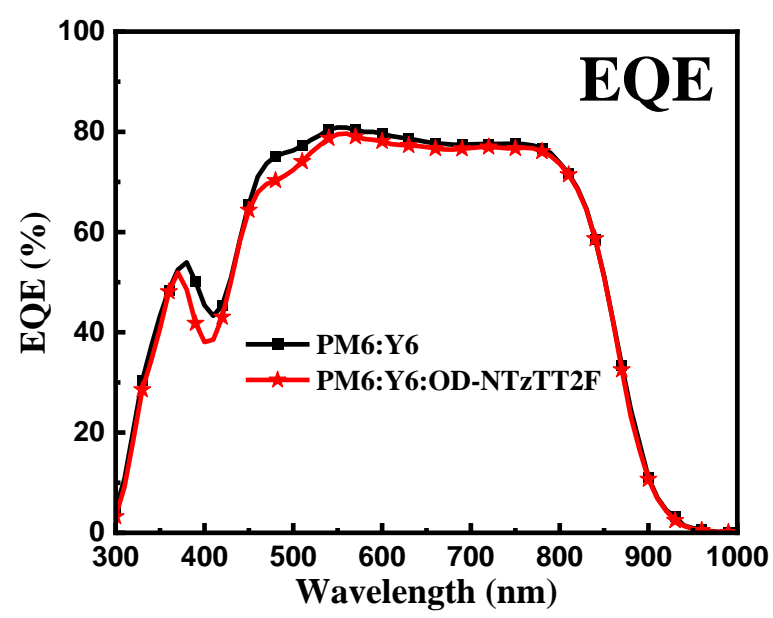
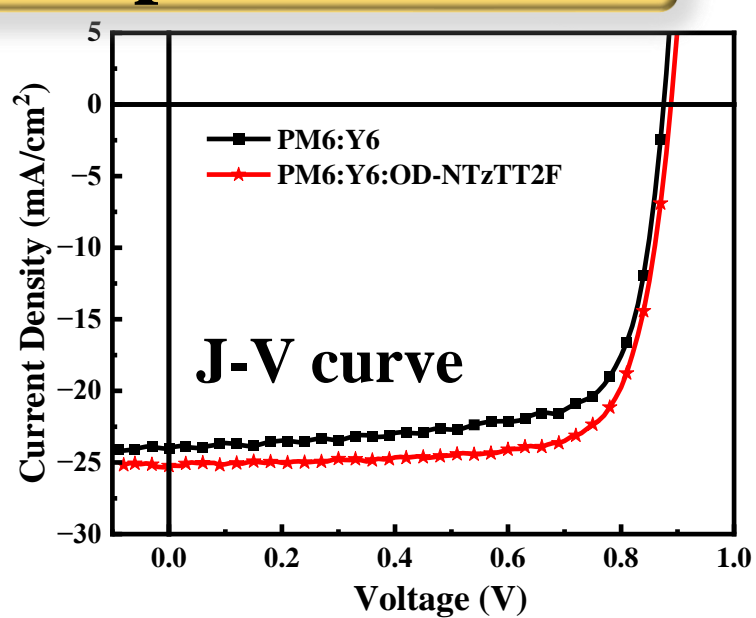
OD-NTzTT2F



由台灣大學 汪根權 教授提供

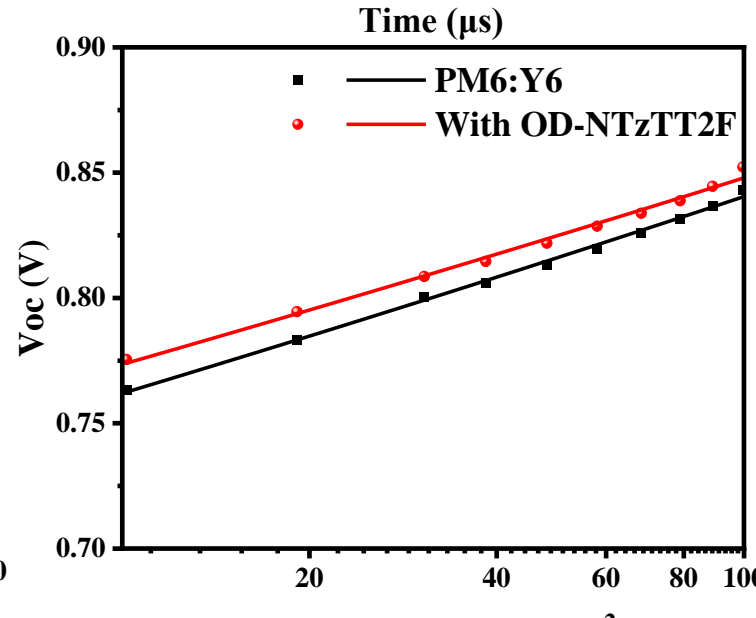
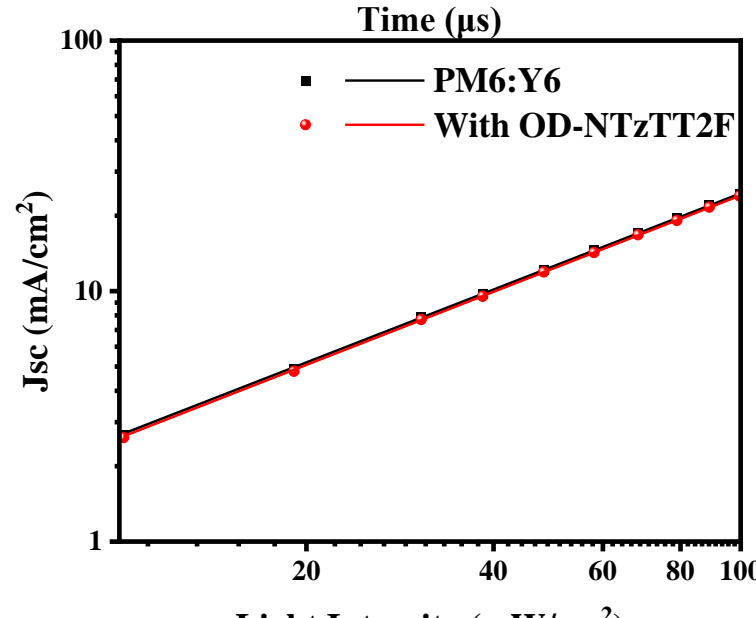
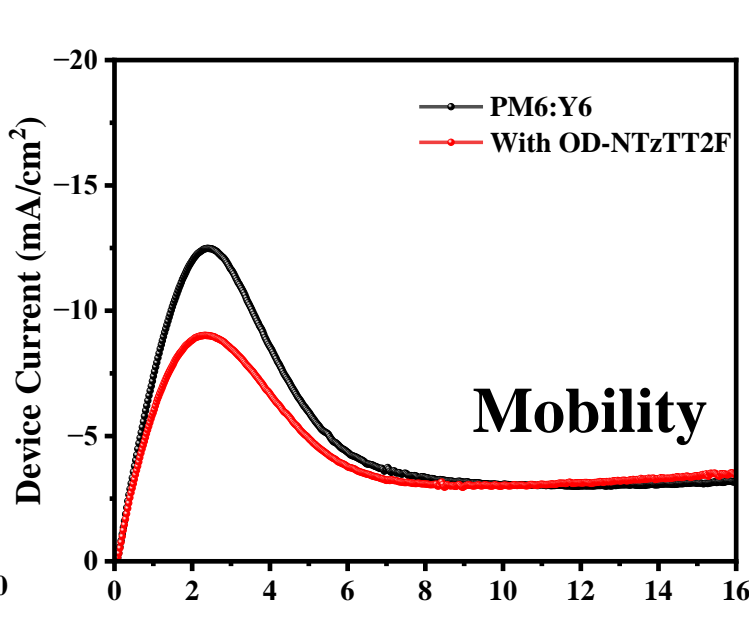
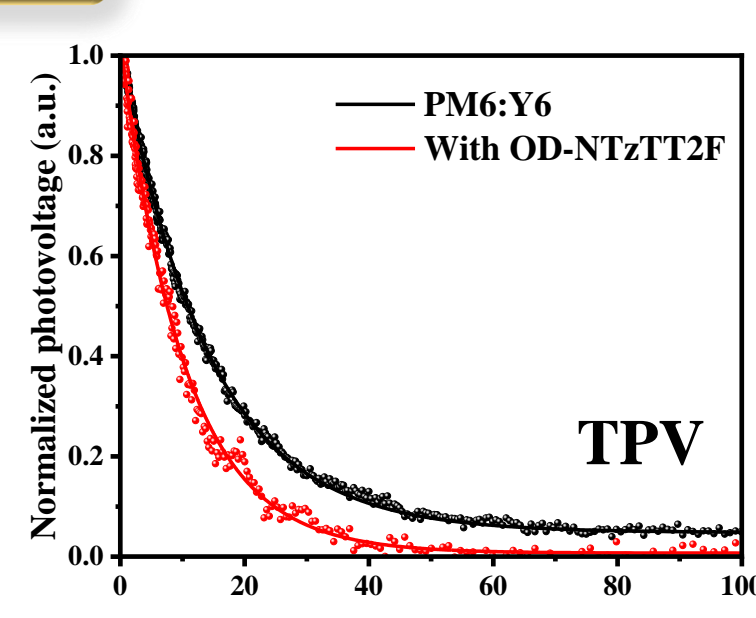
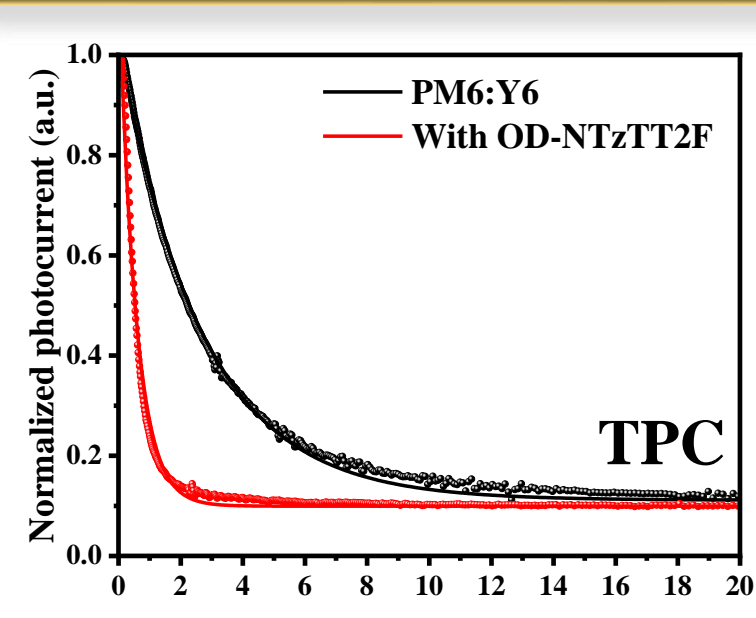


Device performance



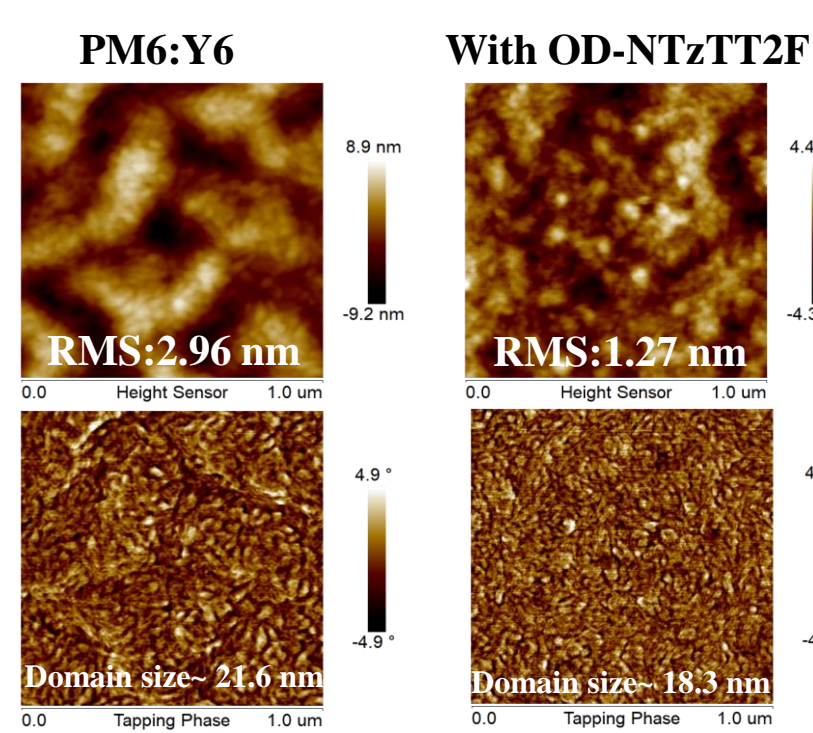
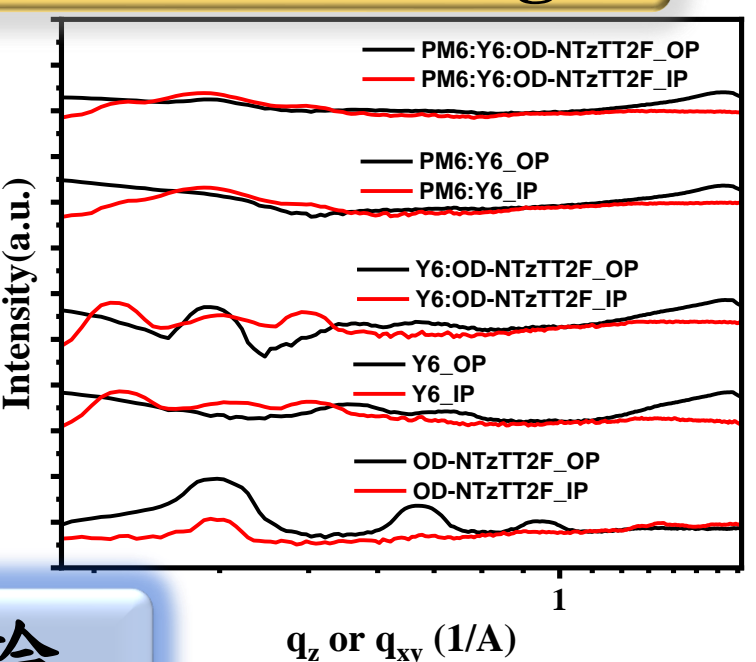
Composition	J _{sc} [mA cm ⁻²]	V _{oc} [V]	FF [%]	PCE _{avg} [%]	PCE _{best} [%]
PM6/Y6	23.79±0.39	0.867±0.007	73.24±1.60	15.05±0.08	15.19
With OD-NTzTT2F	24.68±0.43	0.884±0.003	74.72±0.75	16.30±0.16	16.57

Electrical properties



Composition	T _{pc} [μs]	T _{pv} [μs]	Mobility [cm ² ·V ⁻¹ ·s ⁻¹]	a	n
PM6:Y6	2.66	14.23	5.52 × 10 ⁻⁵	0.973	1.32
With OD-NTzTT2F	0.54	19.72	7.68 × 10⁻⁵	0.975	1.25

Molecule stacking



結論

- 透過選擇適當混溶性和分子能階匹配的第三元材料能夠有效提升元件性能。
- 第三元材料導入至二元系統中可有效改善分子堆疊與共混型態，進而提升元件性能，並且三元系統可以有效提供有機太陽能電池良好的策略與研究方向。