

ELECTRONIC SUPPLEMENTARY INFORMATION

Regio-regular Alternating Diketopyrrolopyrrole-based D₁-A-D₂-A Terpolymers for the Enhanced Performance of Polymer Solar Cells

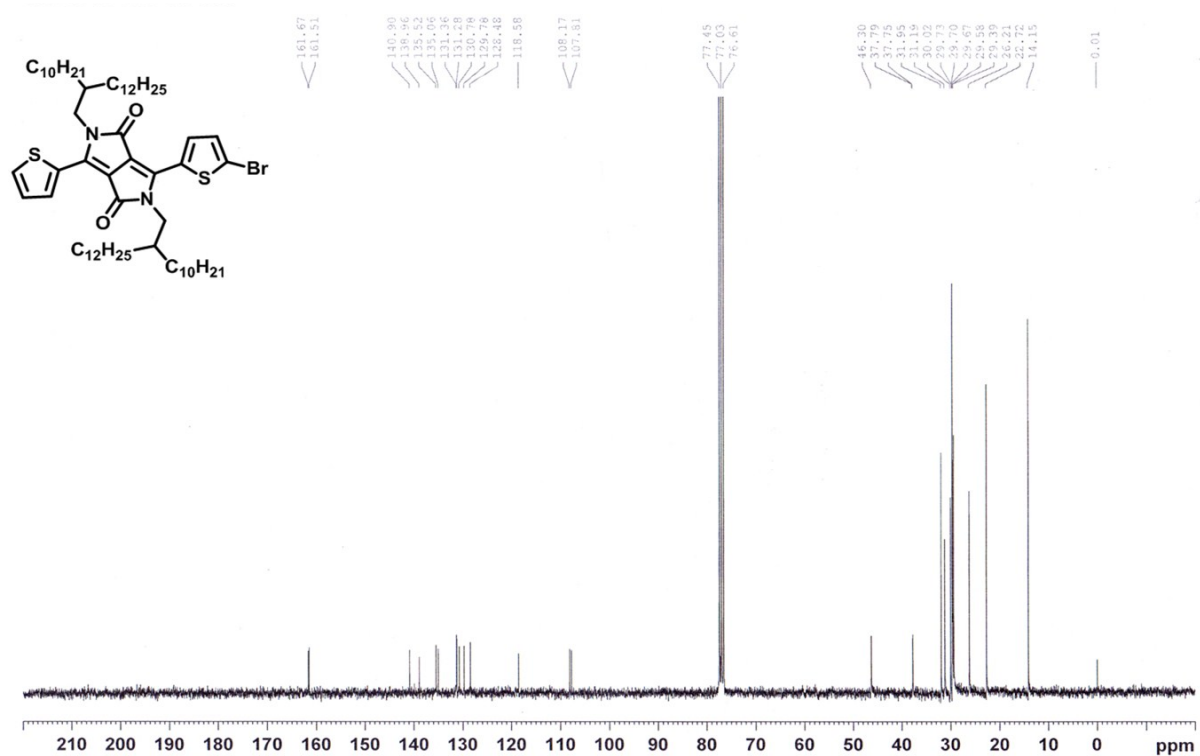
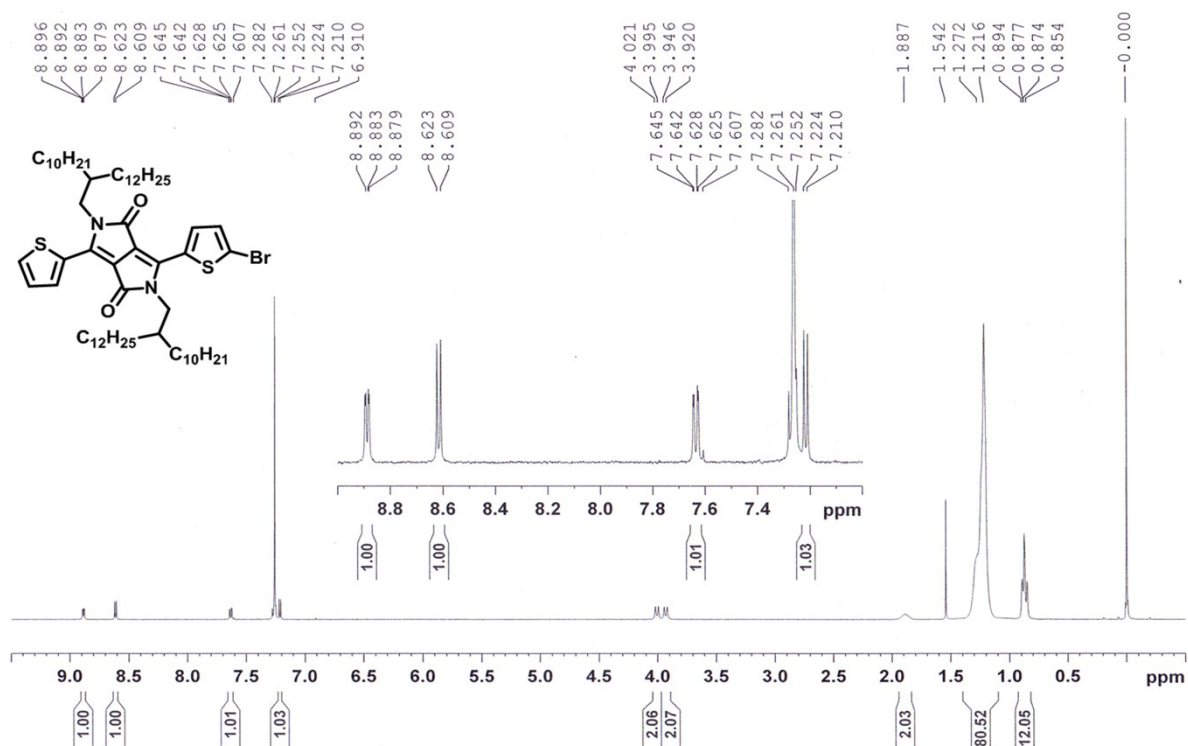
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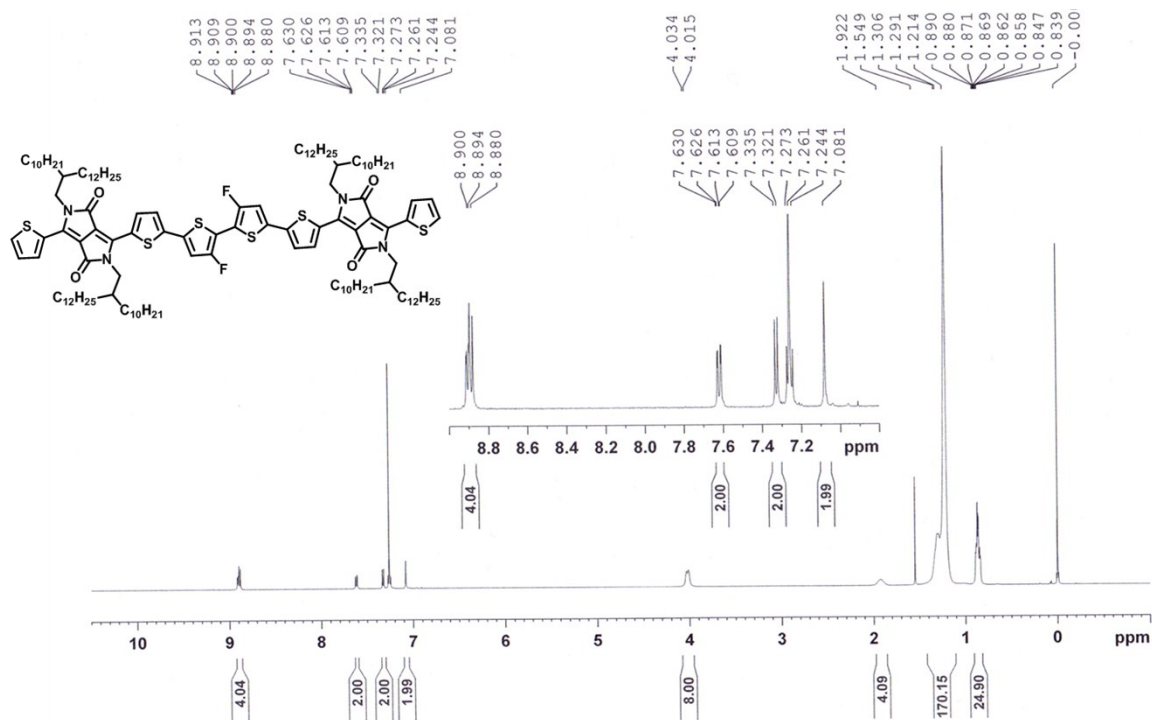


Figure S3. ¹H-NMR spectrum of DPPF2T2DPP

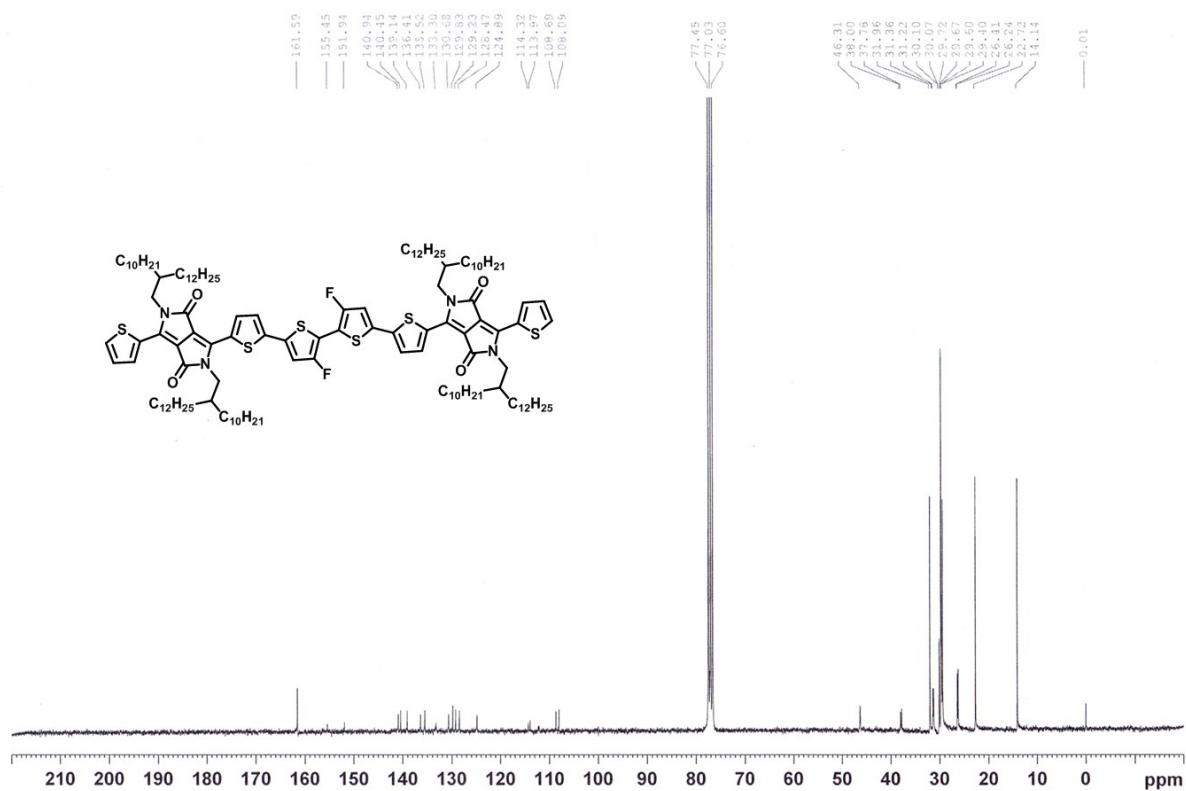


Figure S4. ¹³C-NMR spectrum of DPPF2T2DPP

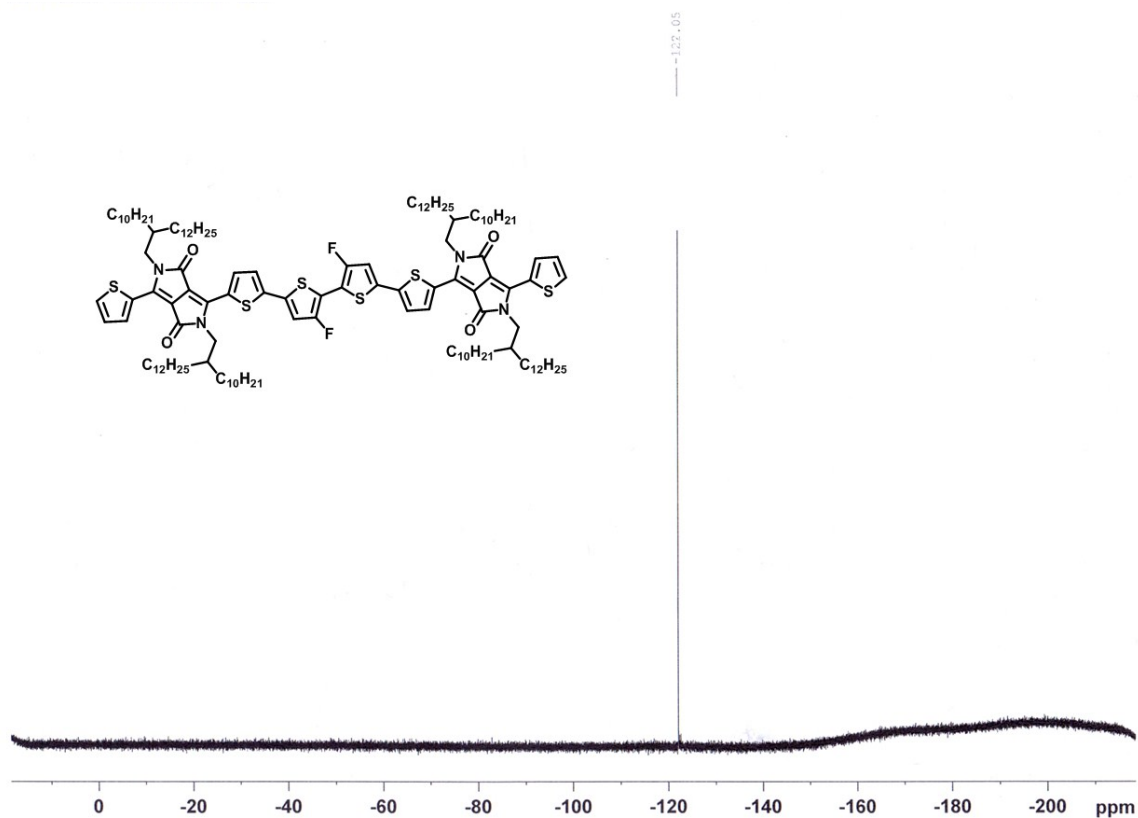


Figure S5. ^{19}F -NMR spectrum of DPPF2T2DPP

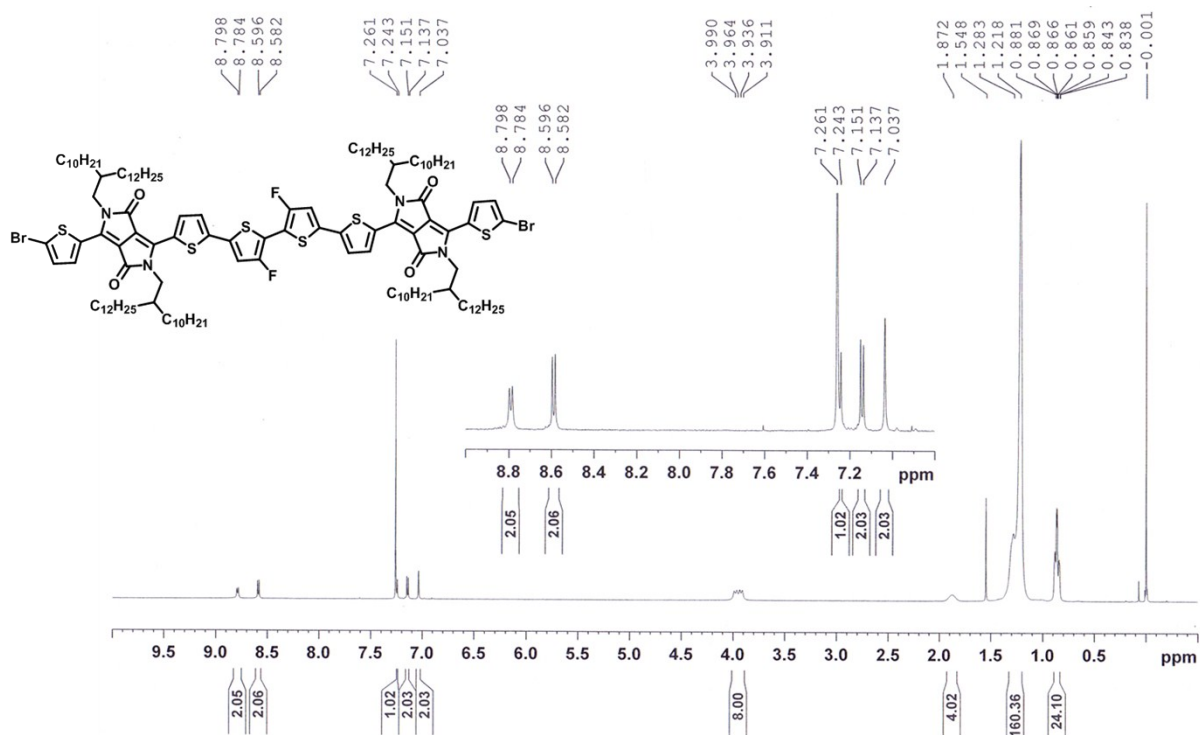


Figure S6. ^1H -NMR spectrum of Br-DPPF2T2DPP-Br

20170505 Br-DPPF2T2DPP-Br 13C

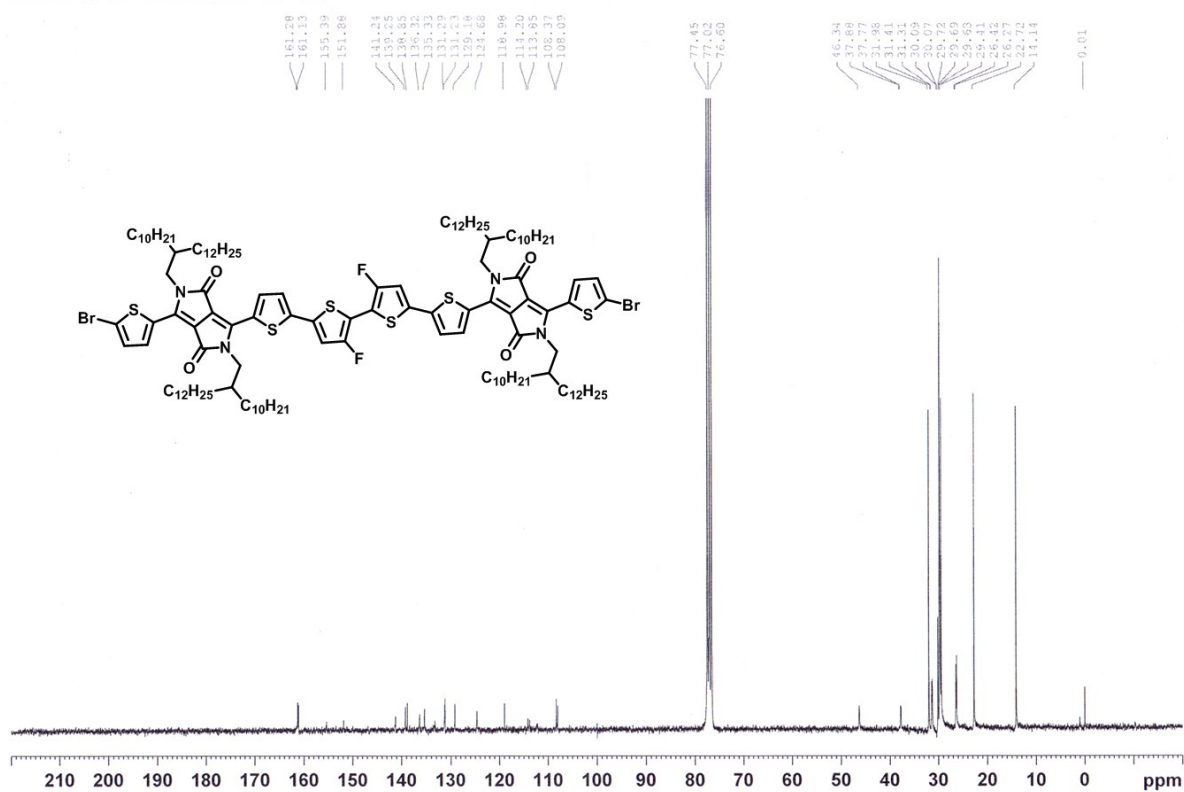


Figure S7. ¹³C-NMR spectrum of Br-DPPF2T2DPP-Br

20170502 Br-DPPF2T2DPP-Br 19F

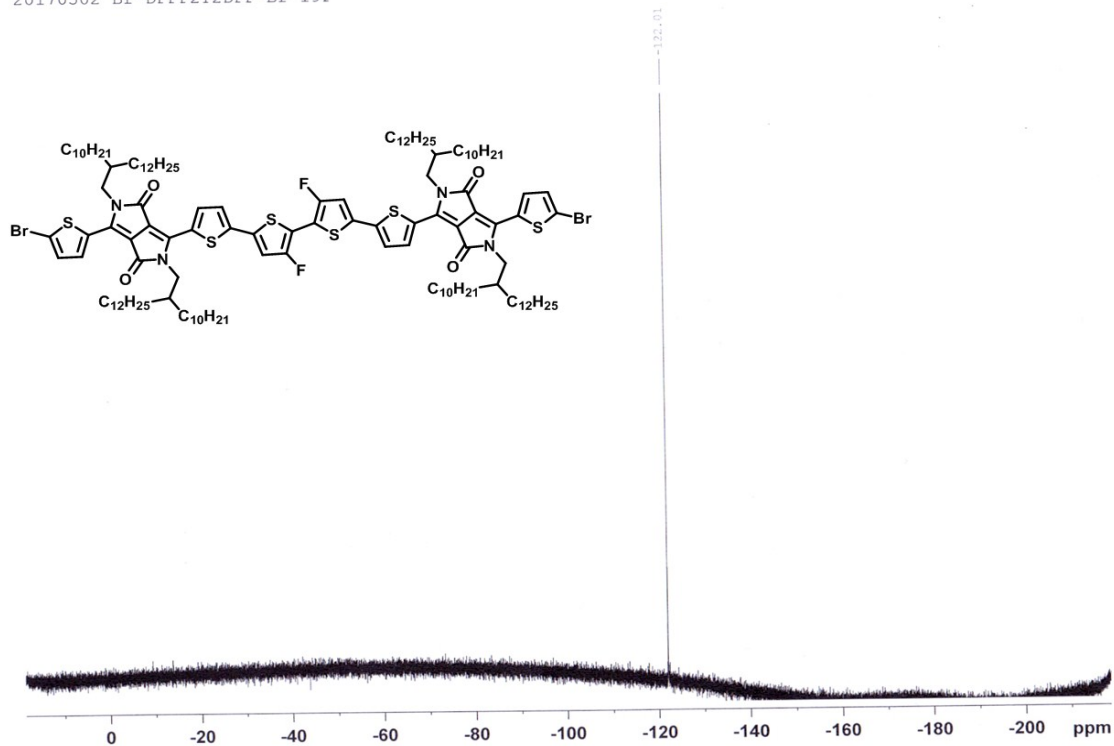


Figure S8. ¹⁹F-NMR spectrum of Br-DPPF2T2DPP-Br

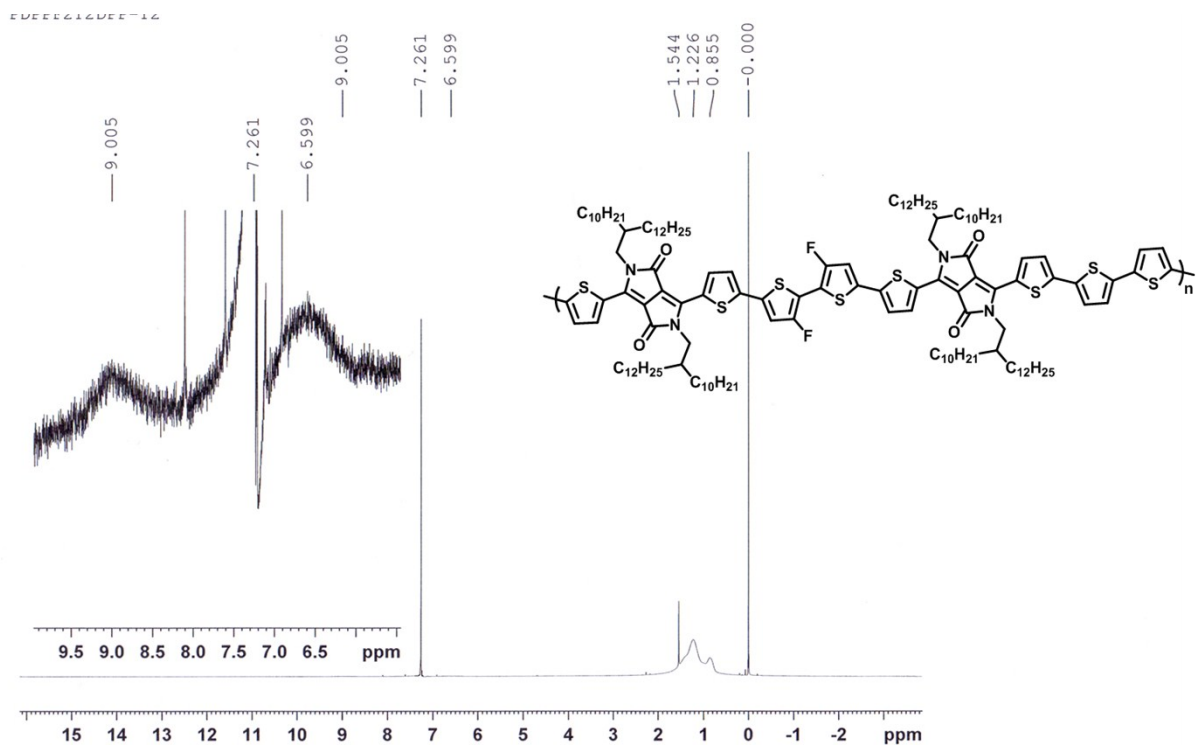


Figure S9. ^1H -NMR spectrum of PDPPF2T2DPP-T2

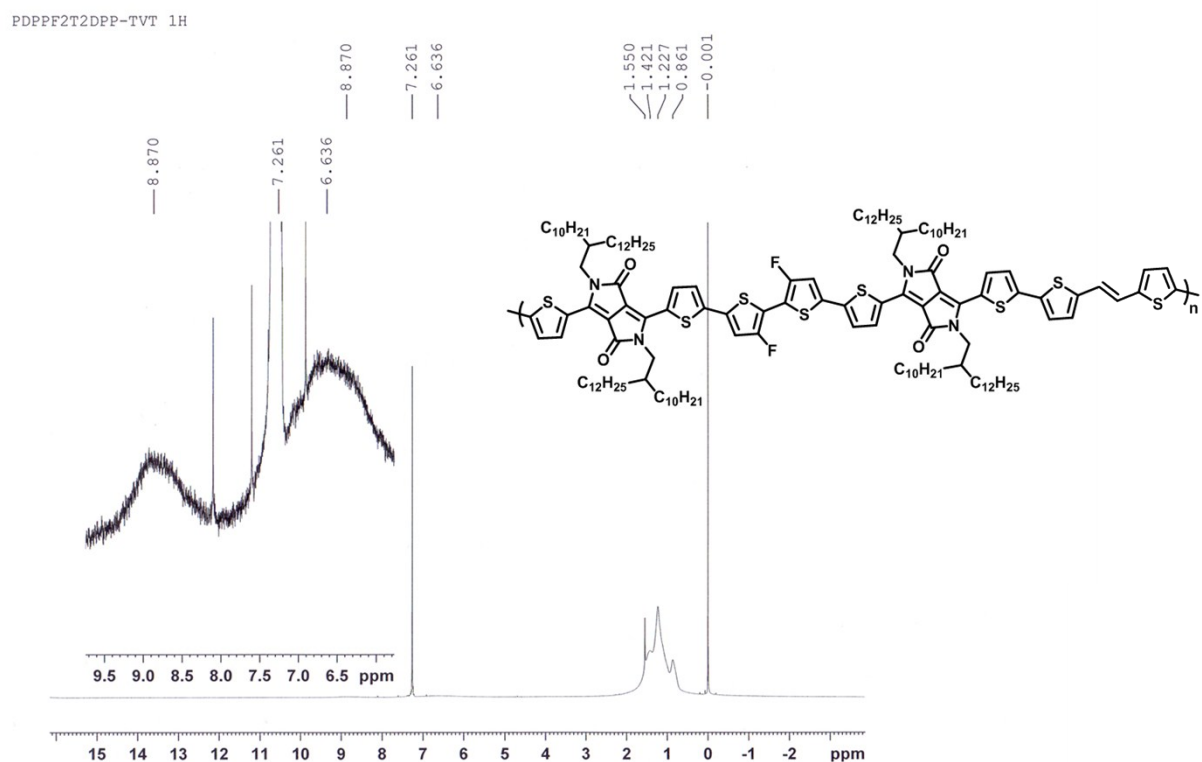


Figure S10. ^1H -NMR spectrum of PDPPF2T2DPP-TVT

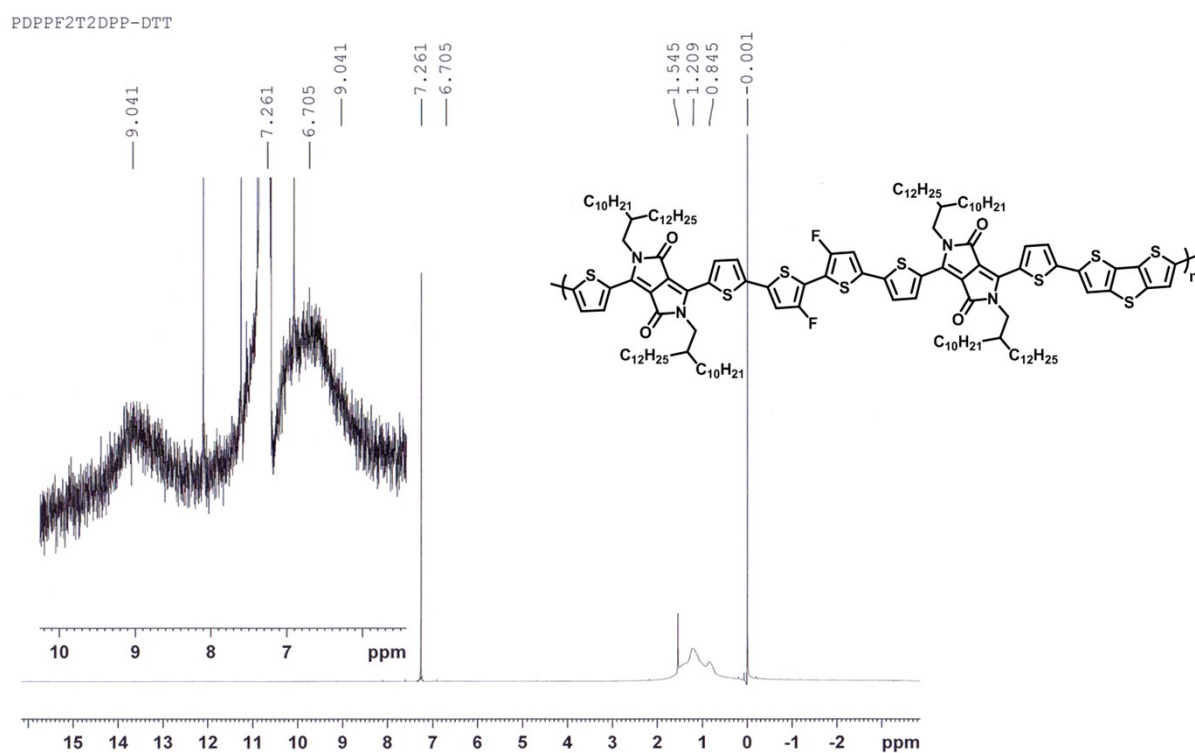


Figure S11. ¹H-NMR spectrum of PDPPF2T2DPP-DTT

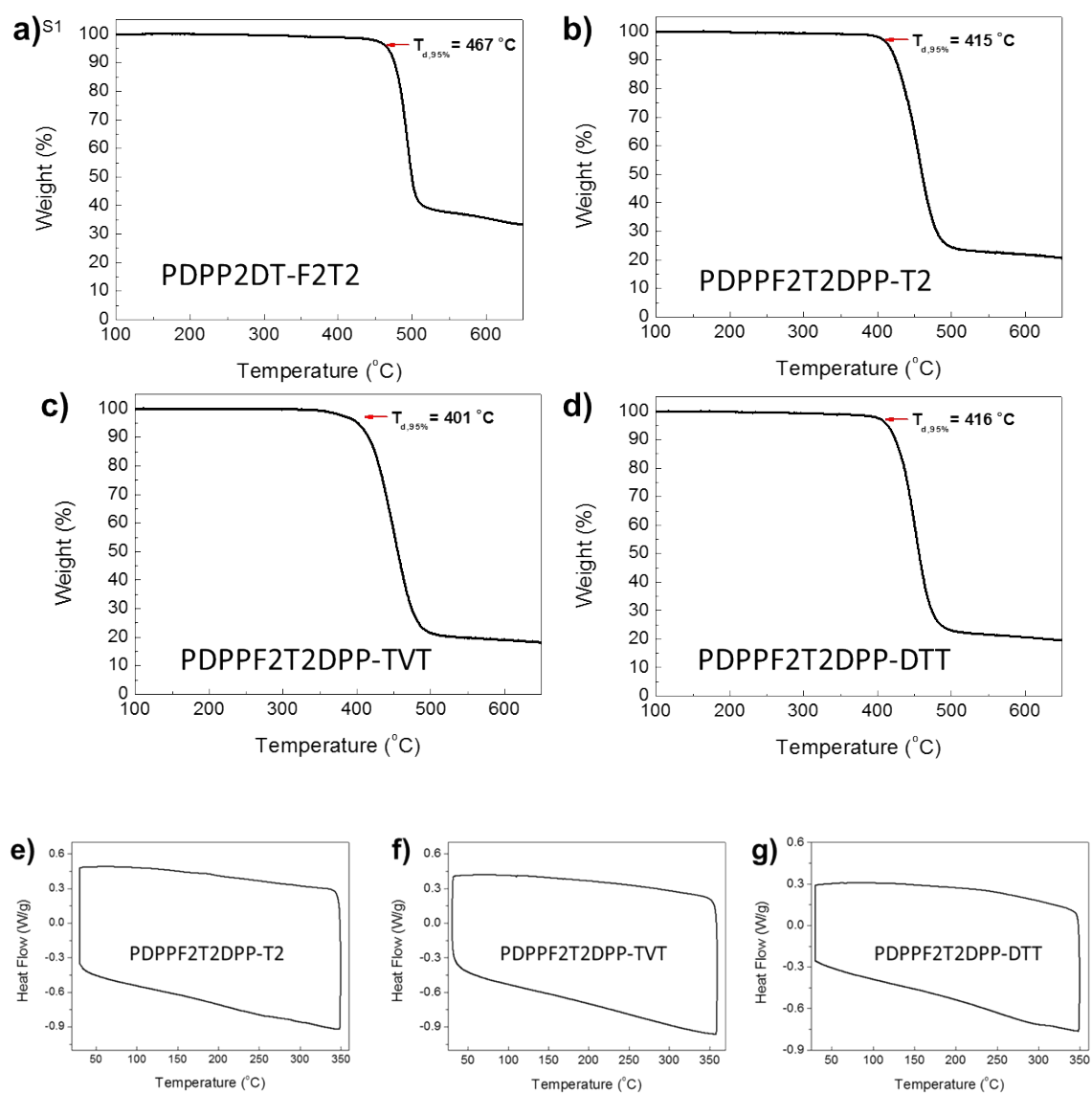


Figure S12. (a-d) TGA and (e-g) DSC curves of the DPP-polymers in this study.

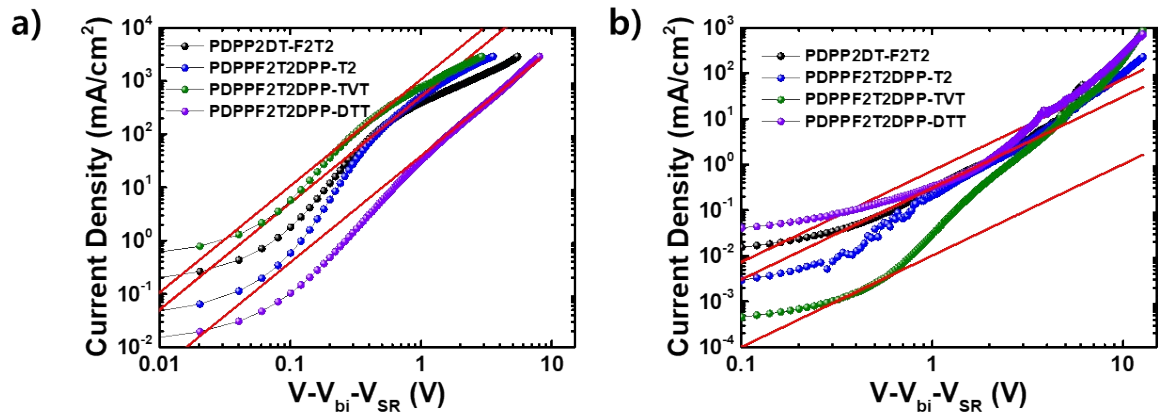


Figure S13. Measured J - V characteristics with red lines fitted by SCLC model for (a) hole-only devices and (b) electron-only devices containing the pristine polymer films.

Table S1 Hole and electron mobilities of polymer films, estimated using the SCLC method

Polymer	μ_h [cm ² s ⁻¹ V ⁻¹]	μ_e [cm ² s ⁻¹ V ⁻¹]
PDPP2DT-F2T2	1.56×10^{-3}	4.39×10^{-8}
PDPPF2T2DPP-T2	1.69×10^{-3}	1.35×10^{-7}
PDPPF2T2DPP-TVT	1.18×10^{-3}	3.10×10^{-9}
PDPPF2T2DPP-DTT	2.46×10^{-3}	7.00×10^{-7}

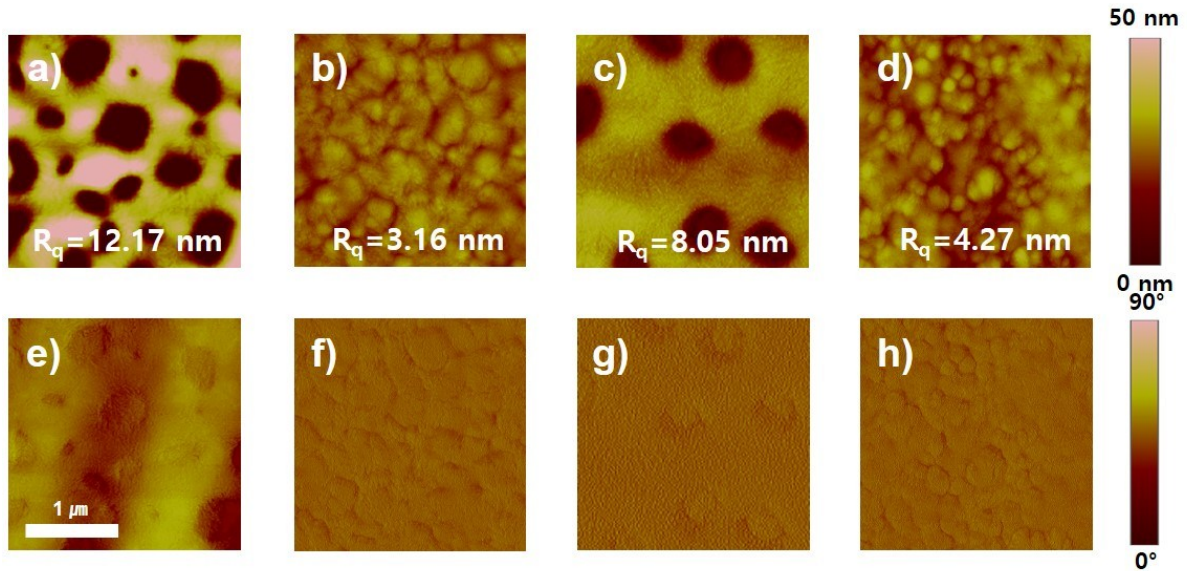


Figure S14. Surface morphology of polymer:PC₇₁BM films without DPE additives. AFM (a–d) topographic and (e–h) phase images: (a,e) PDPP2DT-F2T2, (b,f) PDPPF2T2DPP-T2, (c,g) PDPPF2T2DPP-TVT, and (d,h) PDPPF2T2DPP-DTT.

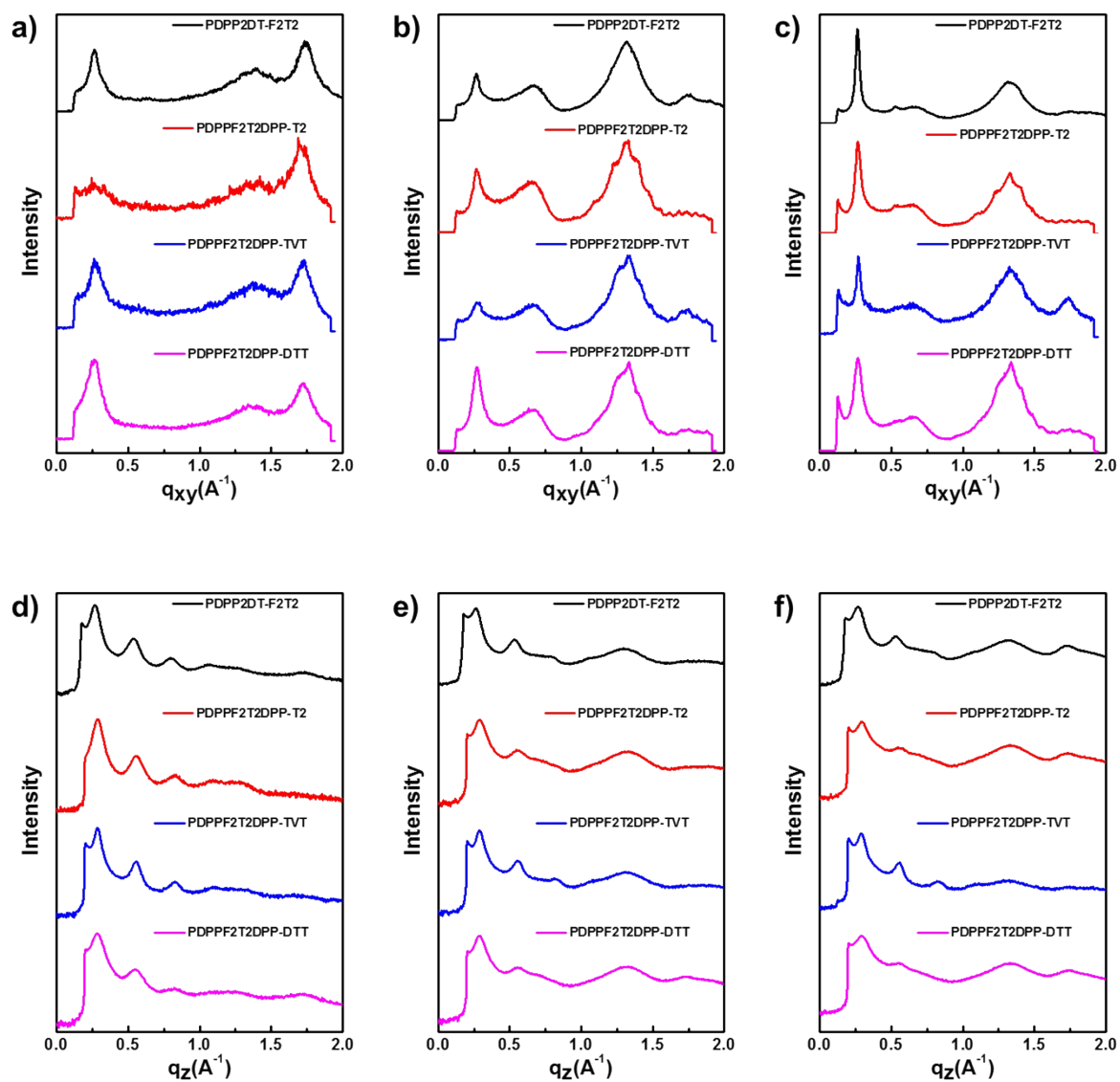


Figure S15. GIWAXS line-cut profiles of (a,d) pristine polymer films, (b,e) polymer:PC₇₁BM blend films without DPE use, and (c,f) polymer:PC₇₁BM blend films with DPE use; (a-c) in-plane profiles and (d-f) out-of-plane profiles)

Table S2. Packing parameters derived from GIWAXS patterns.

	Polymer	Plane	Crystallographic parameters			
			Lamellar spacing		π - π stack	
			q (\AA^{-1})	d-spacing (\AA)	q (\AA^{-1})	d-spacing (\AA)
Pristine polymer	PDPP2DT-F2T2	In	0.262	23.96	1.73	3.63
		Out	0.268	23.43	1.72	3.65
	PDPPF2T2DPP-T2	In	0.275	22.83	1.73	3.63
		Out	0.286	21.95	-	-
	PDPPF2T2DPP-TVT	In	0.263	23.87	1.73	3.63
		Out	0.286	21.95	1.71	3.67
	PDPPF2T2DPP-DTT	In	0.263	23.87	1.73	3.63
		Out	0.284	22.11	1.73	3.63
Polymer:PC ₇₁ BM Blend	PDPP2DT-F2T2	In	0.264	23.78	1.74	3.60
		Out	0.264	23.78	-	-
	PDPPF2T2DPP-T2	In	0.267	23.52	-	-
		Out	0.290	21.65	-	-
	PDPPF2T2DPP-TVT	In	0.275	22.83	1.75	3.58
		Out	0.290	21.65	-	-
	PDPPF2T2DPP-DTT	In	0.273	23.00	-	-
		Out	0.286	21.95	1.72	3.65
Polymer:PC ₇₁ BM Blend with DPE	PDPP2DT-F2T2	In	0.262	23.96	1.70	3.69
		Out	0.268	23.43	1.72	3.65
	PDPPF2T2DPP-T2	In	0.265	23.69	-	-
		Out	0.296	21.21	1.75	3.58
	PDPPF2T2DPP-TVT	In	0.269	23.34	1.73	3.63
		Out	0.290	21.65	-	-
	PDPPF2T2DPP-DTT	In	0.267	23.52	-	-
		Out	0.296	21.21	1.75	3.58