Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Increased elasticity of a low-bandgap conjugated copolymer by random segmentation for mechanically robust solar cells

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1. ^{13}C NMR

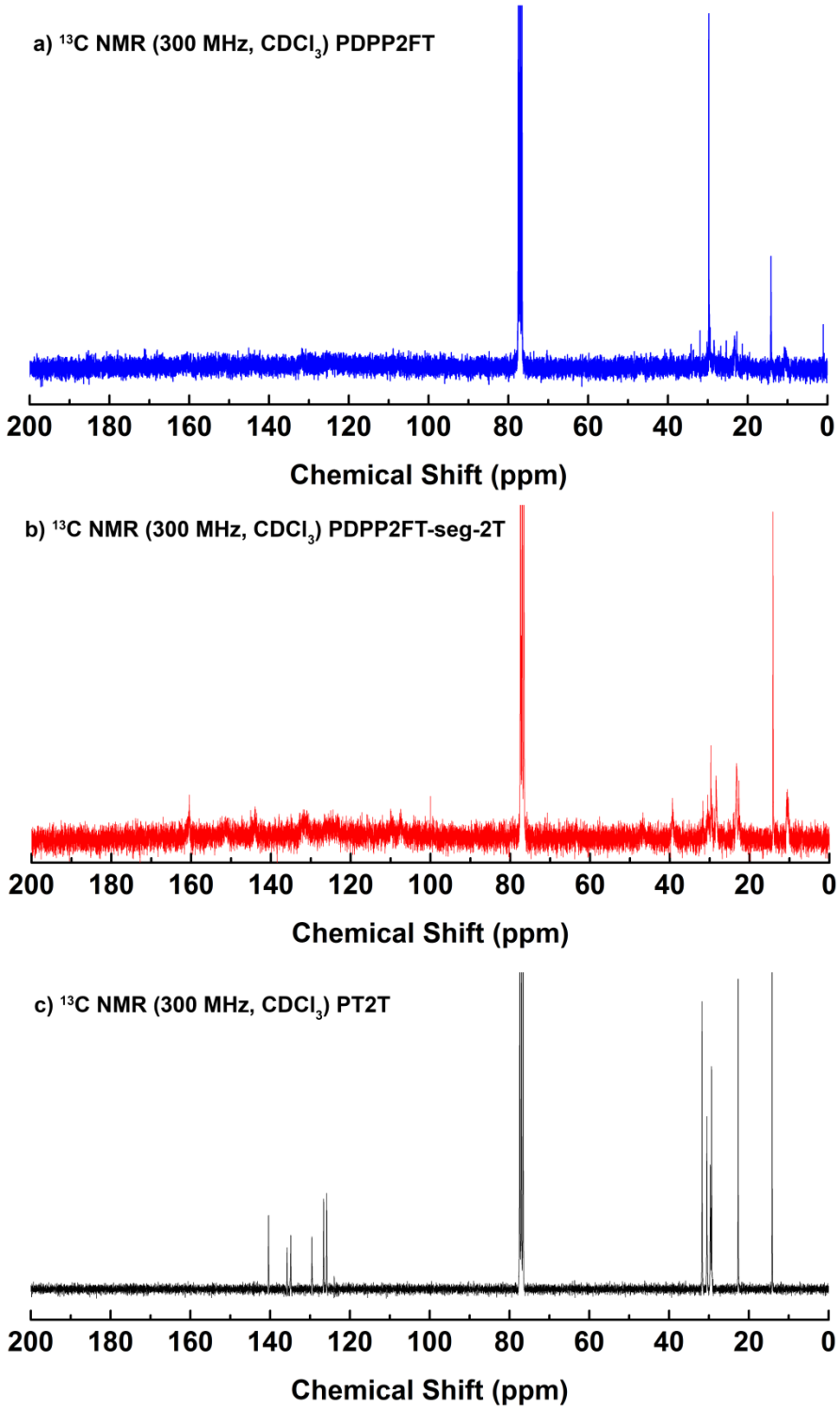

Figure S1. ^{13}C NMR of (a) PDPP2FT, (b) PDPP2FT-seg-2T, and (c) PT2T.

2. UV-vis absorption of polymers (including 100:1 PDPP2FT:PT2T physical blend)

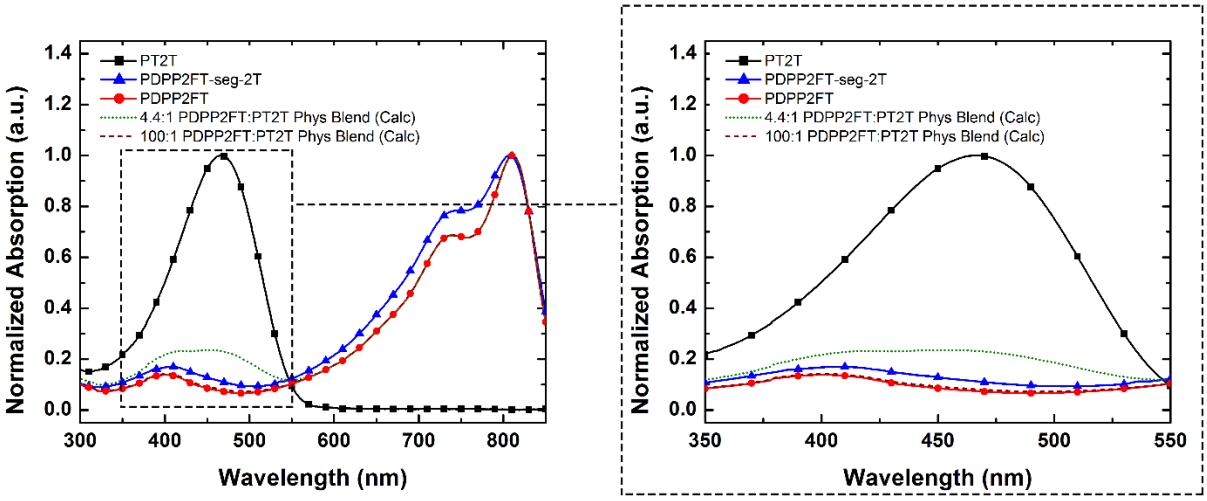

Figure S2. Normalized absorption spectra of solutions of the pure polymers discussed in this paper. Measurements were made at a concentration of 1×10^{-5} M. Calculated absorption spectra of 4.4:1 and 100:1 physical blends of PDPP2FT:PT2T were superimposed onto the graph. The physical blend absorption spectra were calculated from the extinction coefficients of the pure polymers. The region from 350–550 nm is expanded to show the effect of PT2T contamination in PDPP2FT. The increase in absorption by a blend with a ratio of 100:1 PDPP2FT:PT2T over pure PDPP2FT is imperceptible in the absorbing region of PT2T. However, when the ratio of PDPP2FT:PT2T is decreased to 4.4:1 (the ratio in PDPP2FT-seg-2T as determined by NMR), there is a noticeable increase in absorption. The absence of this increased absorption in the PDPP2FT-seg-2T suggests that the segments are covalently bound and not simply a physical blend of the two components.

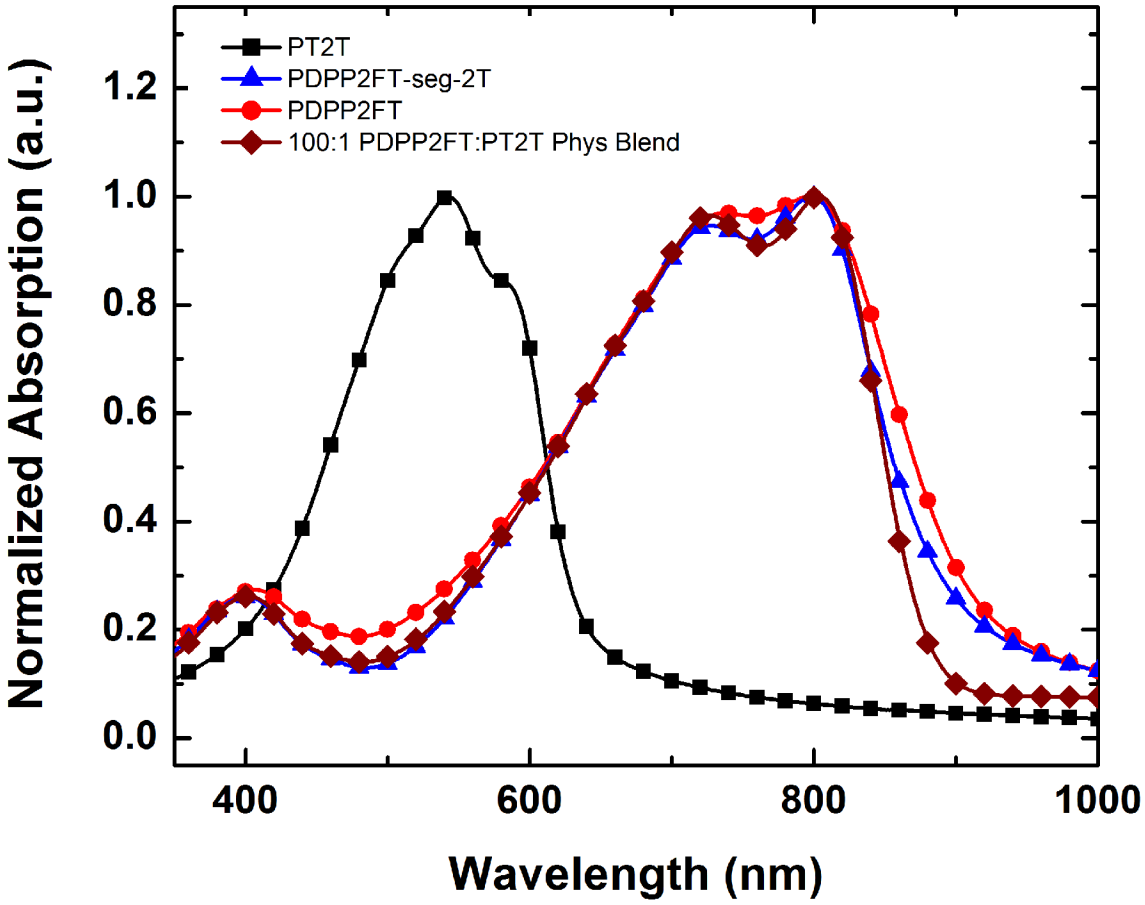

Figure S3. Normalized absorption of thin films discussed in this paper with a 100:1 physical blend of PDPP2FT:PT2T superimposed on top. The physical blend matches the absorption of the pure PDPP2FT thin film well, which suggests that minor contamination of PT2T in PDPP2FT does not greatly affect the absorption in the solid state.

3. *PCE* vs. E_f of polymers (including 100:1 PDPP2FT:PT2T physical blend)

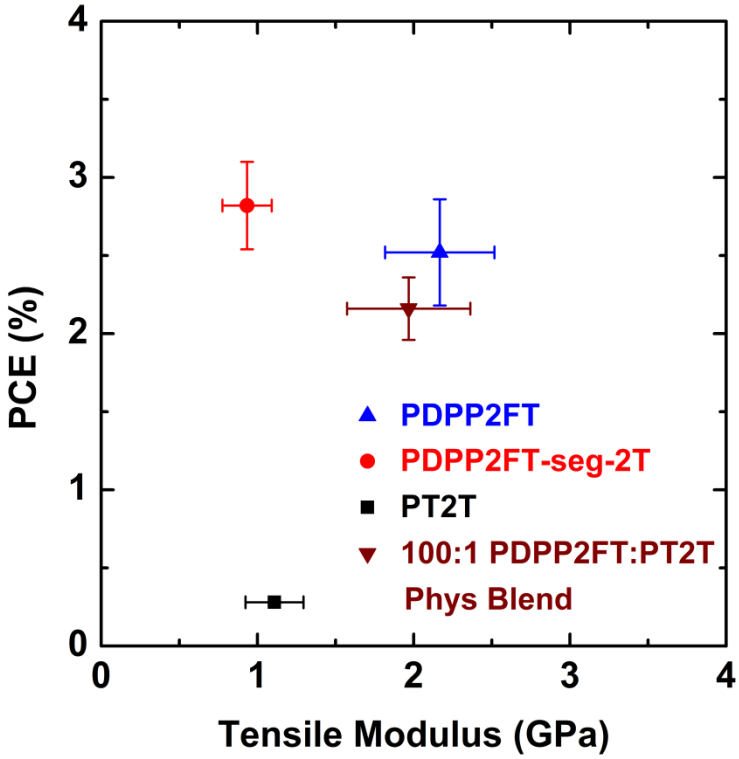

Figure S4. Plot of the power conversion efficiency of 1:2 blends of the polymer:$PC_{61}BM$ as a function of the tensile modulus of the pure polymer. The PCE of the physical blend is 2.16 ± 0.2 % and the tensile modulus is 1.97 ± 0.39 GPa.

Table S1. Tensile moduli of pure polymer films spin-coated from chloroform and 1:2 polymer:$PC_{61}BM$ films spin-coated from 4:1 $CHCl_3$:ODCB. The tensile modulus of the physical blend is within error of the pure PDPP2FT.

Polymer	Tensile Modulus (GPa)	
	Pure polymer ($CHCl_3$)	1:2 Polymer:$PC_{61}BM$ (4:1 $CHCl_3$:ODCB)
PDPP2FT	2.17 ± 0.35 GPa	2.76 ± 0.77 GPa
PDPP2FT-seg-2T	0.93 ± 0.16 GPa	1.60 ± 0.14 GPa
PT2T	1.11 ± 0.19 GPa	1.60 ± 0.36 GPa
100:1 PDPP2FT:PT2T physical blend	1.97 ± 0.39 GPa	-

4. *J-V* curves of 1:2 polymer:$PC_{61}BM$ devices (including 100:1 PDPP2FT:PT2T physical blend)

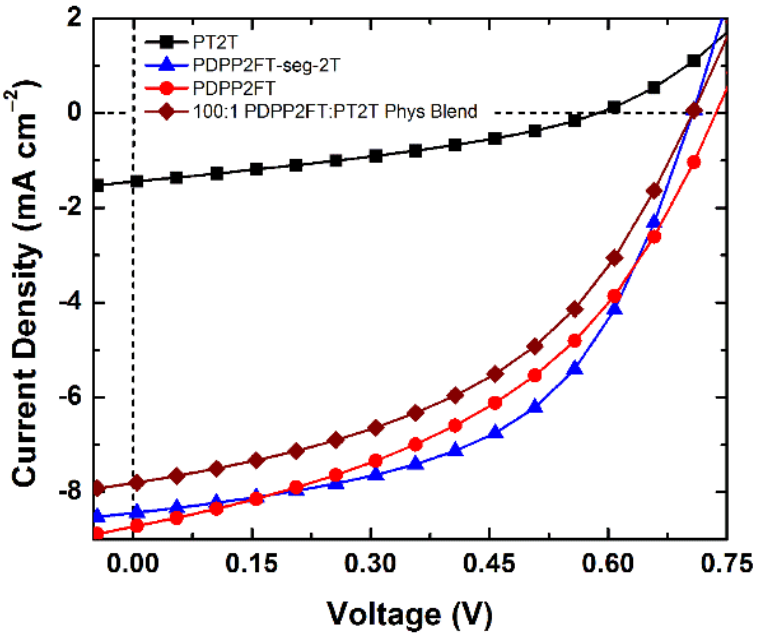

Figure S5. Photovoltaic characteristics of representative samples of polymer-fullerene blends including a device fabricated with an active layer of 100:1 PDPP2FT:PT2T (and fullerene) physical blend. The *J-V* curve of the physical blend is most similar to the curve of pure PDPP2FT:$PC_{61}BM$.

Table S2. Summary of the figures of merit for the solar cells fabricated in this work. The photoactive layers comprised a 1:2 polymer:$PC_{61}BM$ blend. In addition to the devices shown in **Table 2** of the manuscript, we have also included the figures of merit for solar cells fabricated with an active layer of 100:1 PDPP2FT:PT2T (and fullerene) physical blend. The J_{sc} and η_{ε} are lower than the PDPP2FT:$PC_{61}BM$, although the V_{oc} and *FF* are comparable.

	n	J_{sc} [mA cm^{-2}]	V_{oc} [mV]	*FF* [%]	η_{ε} [%]
PT2T	3	1.5 ± 0.1	579 ± 21	32.9 ± 1.1	0.28 ± 0.01
PDPP2FT-seg-2T	6	8.4 ± 0.5	699 ± 23	48.2 ± 3.3	2.82 ± 0.28
PDPP2FT	7	8.3 ± 0.5	715 ± 25	42.5 ± 3.6	2.52 ± 0.34
100:1 PDPP2FT:PT2T Phys Blend	7	6.8 ± 0.5	710 ± 4	44.6 ± 1.5	2.16 ± 0.20