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Supplementary Materials for

Morphology controls the thermoelectric power factor of a doped semiconducting polymer

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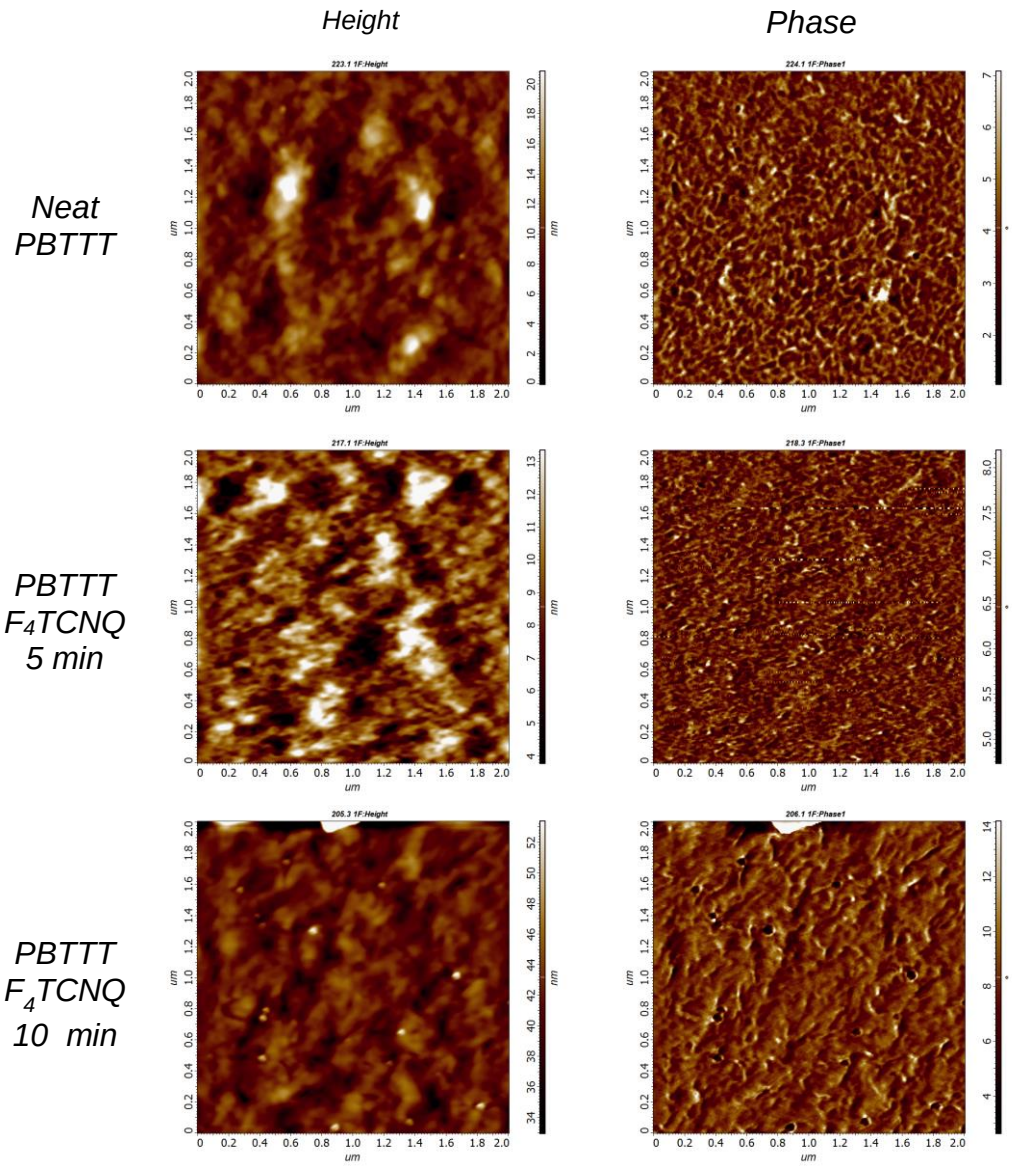

fig. S1. AFM height and phase images of neat annealed PBTTT and F_4TCNQ vapor-doped films at 5 and 10 min.

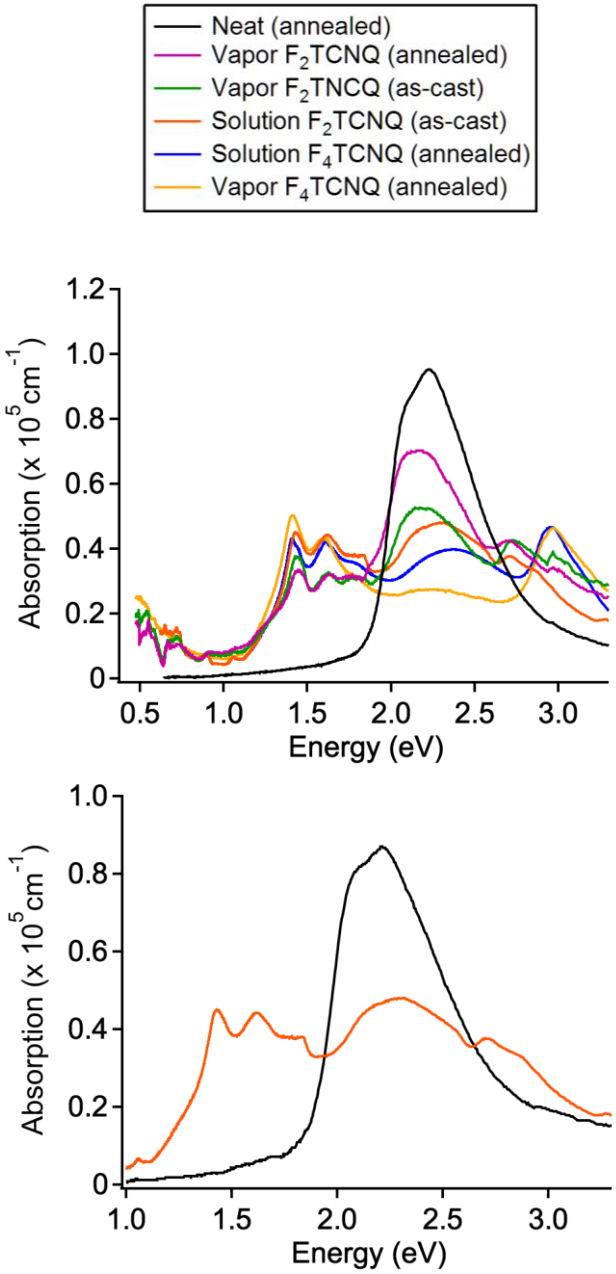

fig. S2. Absorption spectra showing the NIR regime for doped PBTTT films and the thermal stability of F2TCNQ-doped films. The curves near in the NIR regime are similar for all the doped films. Bottom graph: as-cast solution-doped PBTTT:F_2TCNQ film (orange) and after thermally annealing at 150°C in N_2 environment for 10 min (black), which returns to the neutral PBTTT film absorption spectrum. The absorption is normalized by thickness.

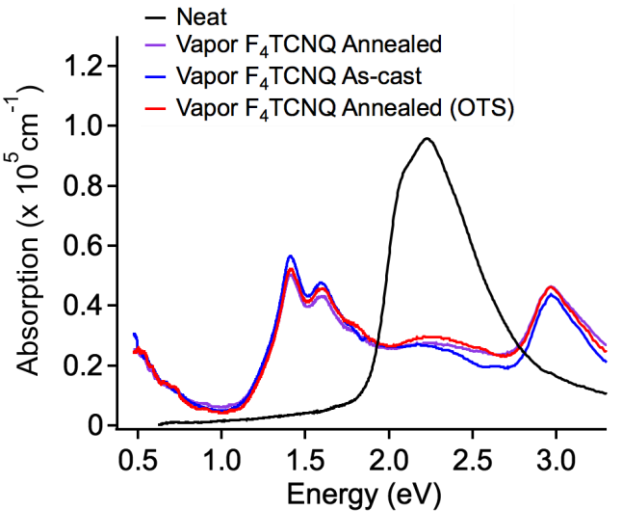

fig. S3. Additional UV-vis-NIR spectra of F4TCNQ vapor-doped films relative to a neat film. As-cast and annealing yield nearly identical spectra. Vapor-doped PBTTT:F4TCNQ annealed film on an octyldecyltrichlorosilane (OTS) functionalized quartz substrate is consistent with films on bare quartz substrates. The absorption is normalized by thickness.

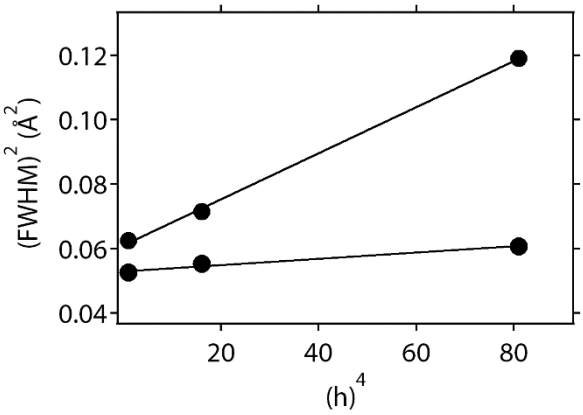

fig. S4. Williamson-Hall plot for neat (black circle) and F4TCNQ vapor-doped film. Full-width-half-max (FWHM) were determined using Lorentzian peak fits on (*h*00) scattering peaks obtained from high resolution specular scattering (Beamline 2-1, SSRL). The increase in slope in the above figure corresponds to increase in disorder along the alkyl stacking direction (*h*00).

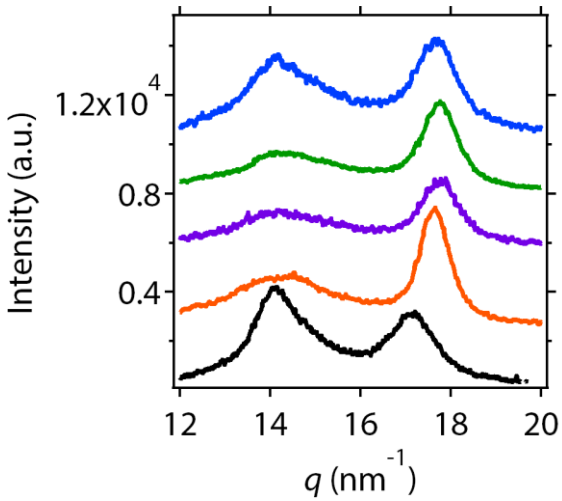

fig. S5. In-plane scattering profiles of as-cast neat and doped films. Black = neat, orange = F4TCNQ solution doping, purple = F4TCNQ vapor doping, green = F2TCNQ solution doping, and blue = F2TCNQ vapor doping.

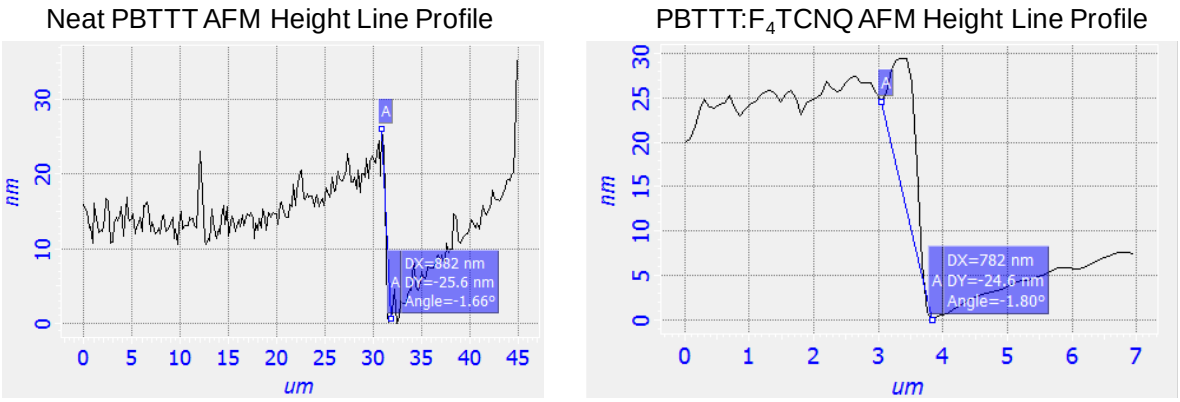

fig. S6. Thin-film thickness profile of neat and vapor-doped PBTTT:F₄TCNQ film.

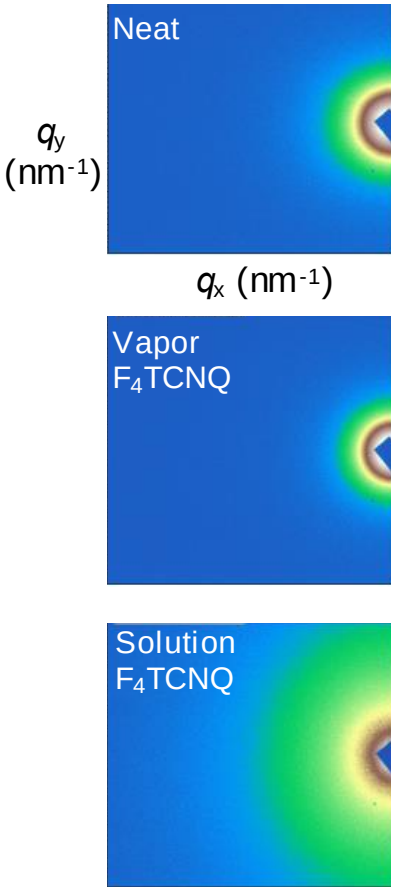

fig. S7. Representative 2D RSoXS images for neat PBTTT, F₄TCNQ vapor-doped, and F₄TCNQ solution-doped thin films (all thermally annealed).

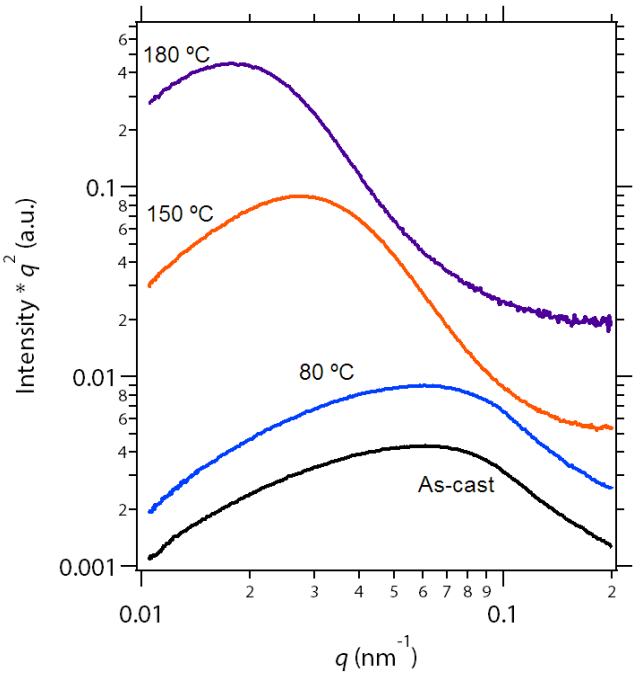

fig. S8. Lorentz-corrected scattering profiles of neat PBTTT for different annealing temperatures. As-cast neat PBTTT thin film and annealed at elevated temperatures for 10 minutes. 150 °C and 180 °C are above the liquid crystalline transition temperature. The corresponding orientational correlation length (OCLs) are summarized in table S3.

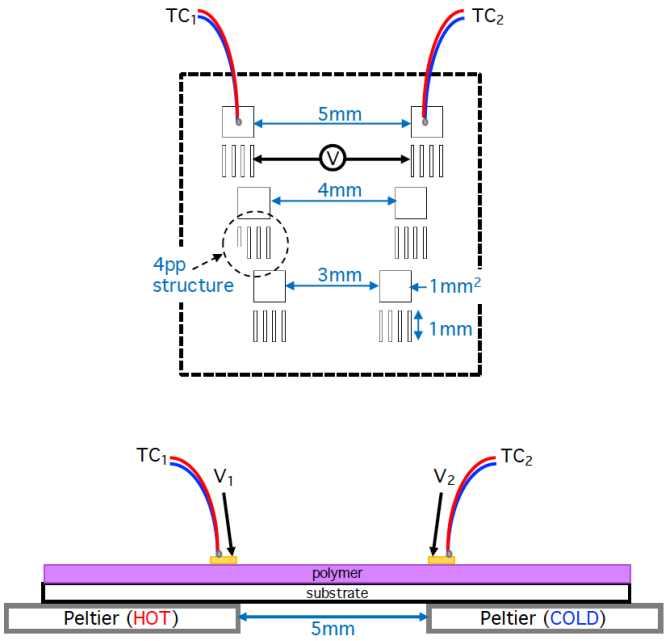

fig. S9. Schematic of the geometry of the contacts for electronic conductivity and Seebeck measurements on thin films of doped polymers.

table S1. X-ray reflection peaks of annealed PBTTT thin films from GIWAXS.

PBTTT film Condition	Index	Peak Position (***q***) (nm^{-1})	domain spacing (*d*) (nm)	FWHM (nm^{-1})
Neat	(100)	2.95	2.12	
	(200)	5.89	1.07	0.312
	(300)	8.90	0.706	0.467
	(110)	17.1	0.367	0.8363
Solution F_4TCNQ (10 wt%)	(100)	2.67	2.35	
	(200)	5.33	1.18	0.455
	(300)	8.09	0.777	0.626
	(110)	17.7	0.355	0.627
Vapor F_4TCNQ	(100)	2.66	2.36	
	(200)	5.32	1.18	0.415
	(300)	8.08	0.777	0.678
	(110)	17.8	0.353	0.696
Vapor F_2TCNQ	(100)	2.88	2.18	
	(200)	5.75	1.09	0.471
	(300)	8.58	0.732	0.817
	(110)	17.4	0.361	0.845

table S2. X-ray reflection peaks of as-cast PBTTT thin films from GIWAXS.

PBTTT film Condition	Index	Peak Position (***q***) (nm^{-1})	domain spacing (*d*) (nm)	FWHM (nm^{-1})
Neat	(100)	2.95	2.20	
	(200)	5.69	1.10	0.698
	(300)	8.59	0.731	1.34
	(110)	17.16	0.366	1.37
Solution F_4TCNQ (10 wt%)	(100)	2.53	2.48	
	(200)	5.06	1.24	0.825
	(300)	7.78	0.808	1.32
	(110)	17.6	0.357	0.779
Vapor F_4TCNQ	(100)	2.57	2.44	
	(200)	5.14	1.22	0.612
	(300)	7.89	0.96	1.17
	(110)	17.7	0.355	1.02
Solution F_2TCNQ (10 wt%)	(100)	2.56	2.45	
	(200)	5.12	1.23	0.854
	(300)	7.82	0.803	1.47
	(110)	17.8	0.353	0.928
Vapor F_2TCNQ	(100)	2.74	2.30	
	(200)	5.47	1.15	0.602
	(300)	8.30	0.757	0.855
	(110)	17.6	0.357	1.21

table S3. Summary of OCLs for doped films.

PBTTT film Condition	As-cast or Annealing Temperature	OCL (nm)
Neat	As-cast	70
	80 °C	70
	150°C	140
	180°C	180
Solution F_4TCNQ (10 wt%)	As-cast	40
	150 °C	44
Vapor F_4TCNQ (10 min)	As-cast	130
	180 °C	220
Solution F_2TCNQ (10 wt%)	As-cast	130
	150 °C	100
Vapor F_2TCNQ (10 min)	As-cast	60
	180 °C	210

Note: Thermal annealing step is done after casting a film from doped solution, while for vapor-doped samples are prepared by first thermal annealing a neat film.