Supporting Information For

Correlating Crack Onset Strain and Cohesive Fracture Energy in Polymer Semiconductor Films

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1. Polymer film preparation conditions

Table S1. Processing conditions and resulting thickness for the different polymer films

Material	Solvent*	Concentration (mg/ml)	Spin Speed / Time (RPM/s)	Thickness (nm)
LMw-P3HT	DCB	15	1500 / 60	57
	DCB	15	800 / 60	84
	DCB	20	800 / 60	137
	DCB	25	600 / 60	222
PTB7-TH	CB	16	800 / 30	156
	CB	16	1200 / 30	132
	CB	20	800 / 30	184
	CB	10	1000 / 30	77
	CB	10	1500 / 30	51
pBTTT	CF	25	2000 / 60	64
	CF	25	500 / 60	167
	CF	25	1000 / 60	108
	CF	30	500 / 60	290
P(NDI2OD-T2)	CF	7	1750 / 60	66
	CF	7	1000 / 60	88
	CF	10	600 / 60	116
	CF	10	1000 / 60	76
DPP-DTT	CF:DCB(7.5%)	7	1000 / 60	165
	CF:DCB(7.5%)	7	600 / 60	133
	CF:DCB(7.5%)	7	1500 / 60	80
	CF:DCB(7.5%)	7	2000 / 60	110
PCDTPT	CF	10	1500 / 60	104
	CF	14	1000 / 60	185
	CF	14	1500 / 60	156
	CF	14	600 / 60	270
HMw-P3HT	DCB	15	1500 / 60	87
	DCB	15	800 / 60	148
	DCB	20	800 / 60	177

*Solvents: 1,2-dichlorobenzene (DCB), Chlorobenzene (CB), Chloroform (CF)

2. Four-point bending measurements

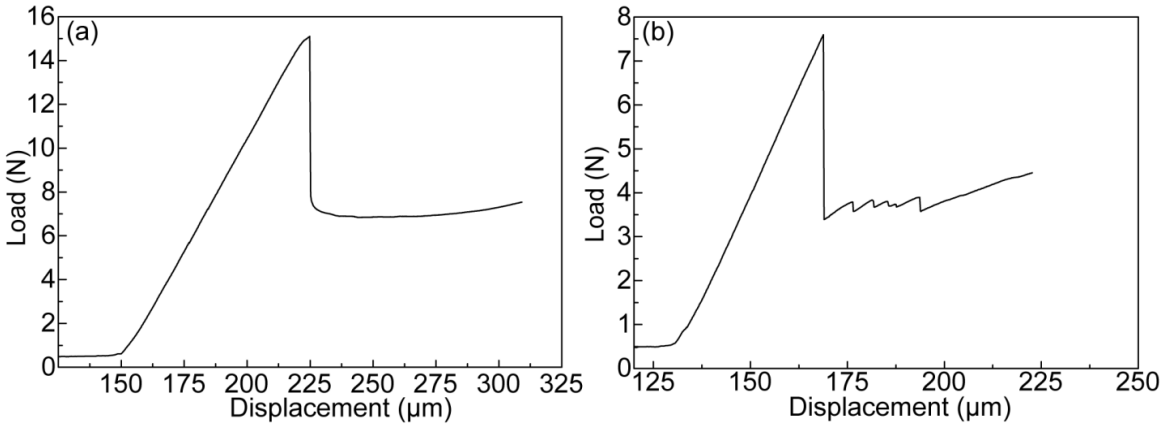

Figure S1. Load vs. displacement profile exhibiting (a) a smooth plateau corresponding to PTB7-TH indicative of stable crack propagation and (b) a saw-tooth profile in the plateau corresponding to PCDTPT indicative of unstable crack propagation.

3. Additional AFM images of PCDTPT and P(NDI2OD-T2) films

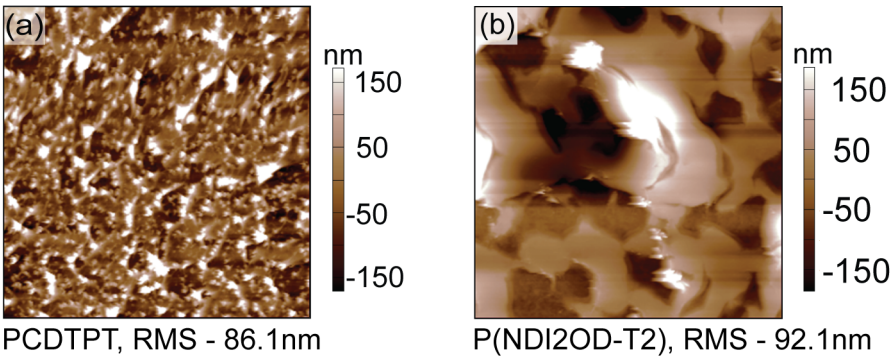

Figure S2. AFM height images for the fractured film surfaces. The films are (a) 268 nm thick PCDTPT film which exhibited fracture energy of 1.09 J/m^2 and (b) 116 nm thick P(NDI2OD-T2) film which exhibited fracture energy of 5.89 J/m^2.

4. Optical microscope images crack onset in polymer films

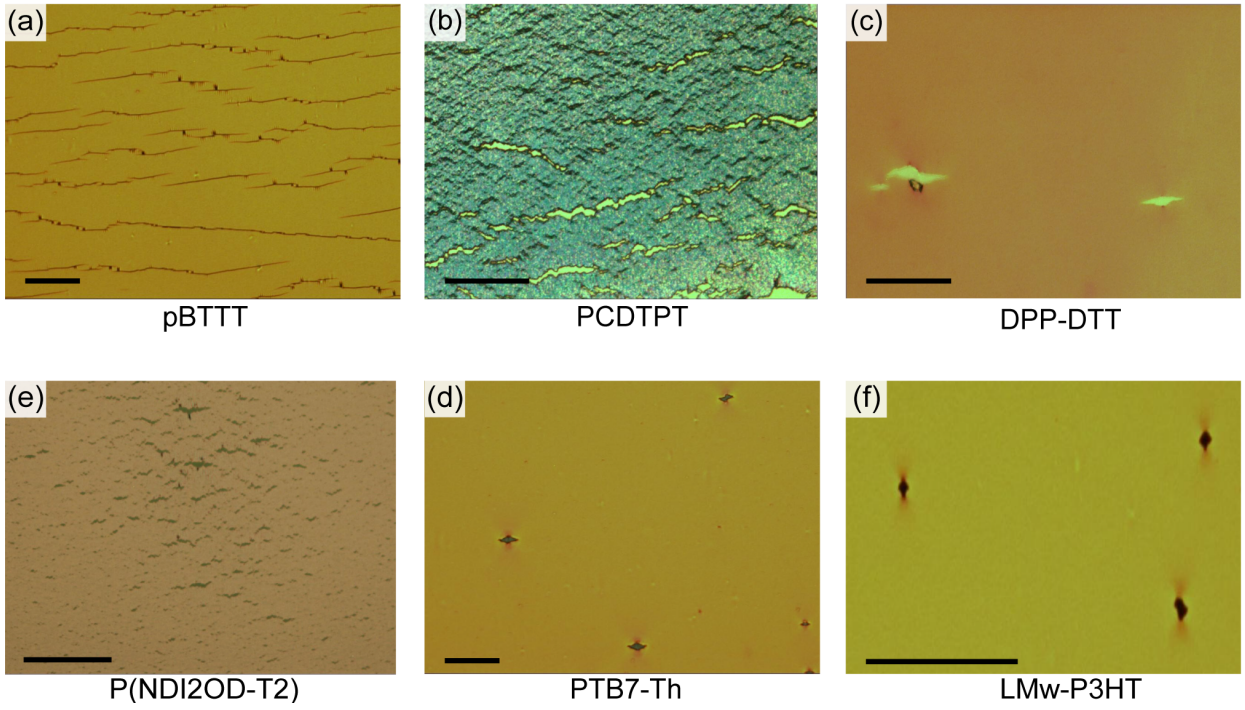

Figure S3. Optical microscopic images of characteristic crack features observed in the COS measurements for (a) PBTTT, (b) PCDTPT, (c) DPP-DTT, (d) P(NDI2OD-T2), (e) PTB7-Th, and (f) LMw-P3HT films. All images were captured near their respective crack onset strains. In all films, the strain was applied along the long axis of the page. The scale bar for all images is 50 μm.

5. Glass transition temperature of the polymers considered

The glass transition temperatures (T_g) of the polymers are estimated from literature reports where possible. P3HT has been reported to have a T_g of approximately 15 °C,[1,2] pBTTT T_g has been reported to be approximately 140 °C,[3,4] and P(NDI2OD-T2) is reported to be ~70 °C.[5] No clear T_g of PTB7-Th has been reported in literature, but is estimated to be above 100 °C, estimated

from unpublished measurements. The T_g of PCDTPT and DPP-DTT have not been clearly identified in DSC measurements.[6,7] DPP-DTT may have a T_g below room temperature, but requires further testing. The estimated T_g of the polymer is plotted against Gc and COS in Figure S4.

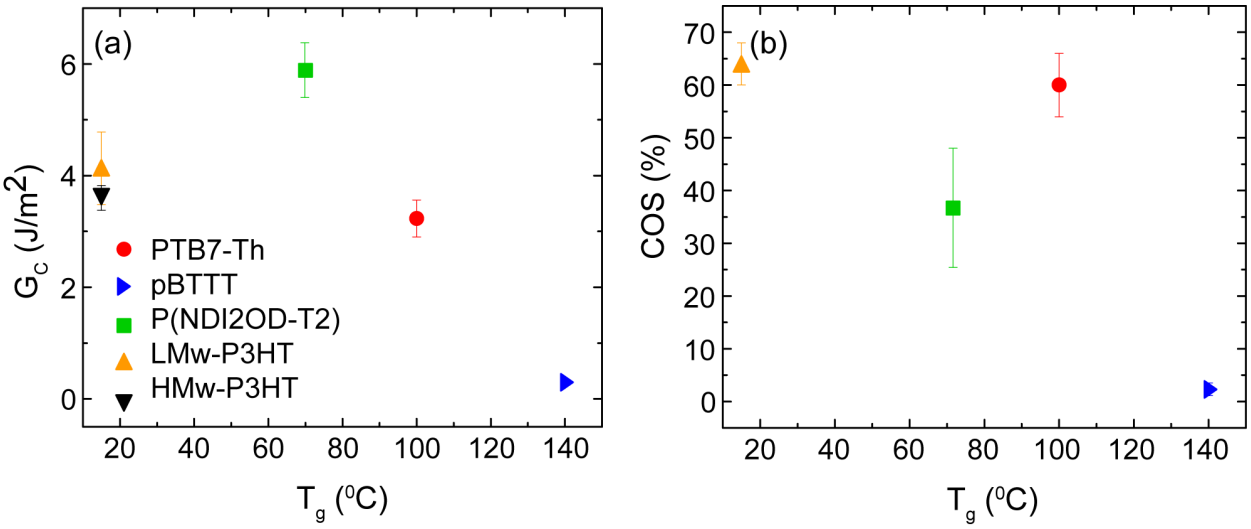

Figure S4. (a) Cohesive fracture energy and (b) crack onset strain (COS) of the polymer films at their estimated glass transition temperatures (Tg). All properties are reported for 100 ± 25 nm thick films.

References

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