Supplementary Information (SI) for Journal of Materials Chemistry C.

Supplementary Information

Functionalizing Poly(3-hexylthiophene) as a Naked-eye Discharge Indicator for High Voltage Applications

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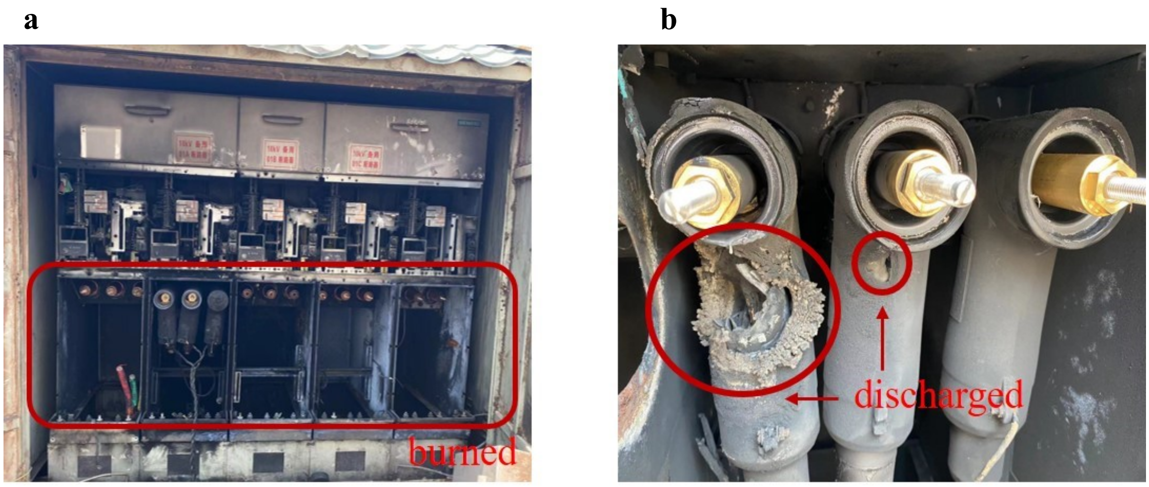

Fig. S1. Breakdown and burn of 10 kV power cable branch box, as a result of discharge induced insulation failure. The red box in Fig. S1a indicates the spread burn to the adjacent cable branch box. The red cycle in Fig. S1b indicates the discharged positions on separable cable connectors, which is triggered by partial discharges.

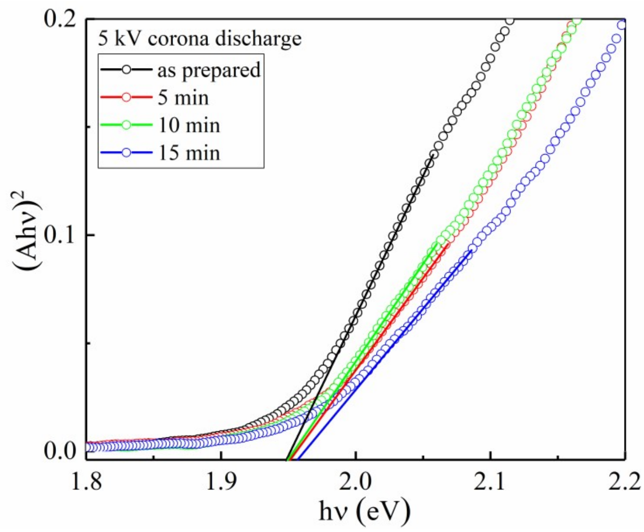

Fig. S2. Energy band gap calculations of P3HT after 5 kV discharge, based on UV-Vis spectra.

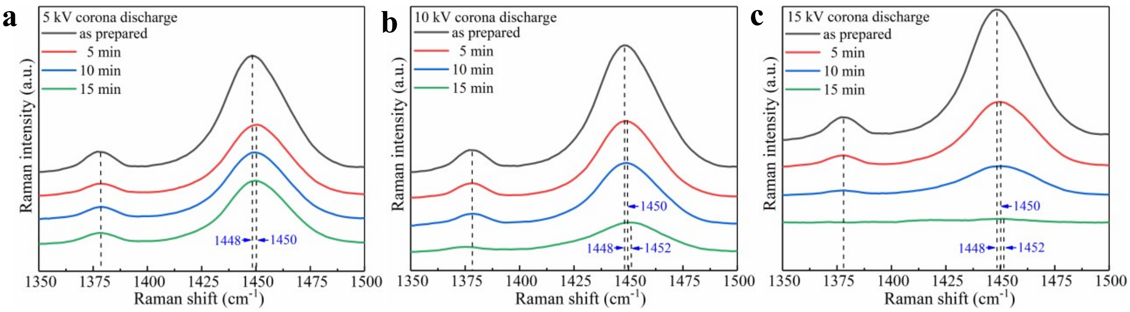

Fig. S3. Enlarged Raman spectra of P3HT films with discharge voltages of a) 5kV, b) 10 kV, and c) 15 kV.

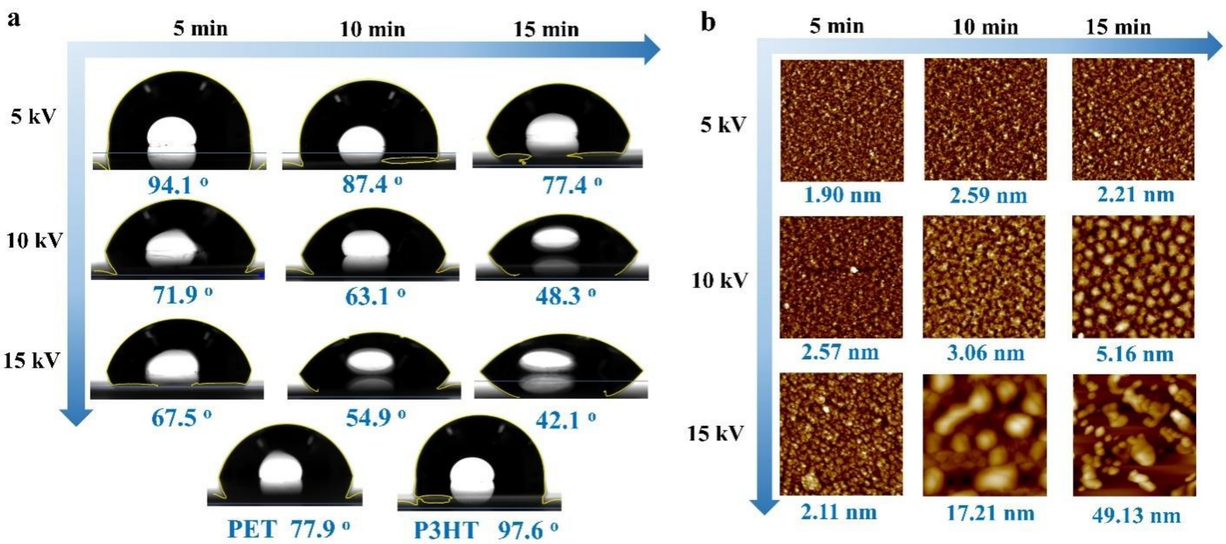

Fig. S4. Surface state variations of discharged P3HT films. a) Static water contact angles of P3HT films under discharges of 5-15 kV, and 5-15 min duration. b) AFM images of P3HT films under discharges of 5-15 kV, and 5-15 min duration. The scanning region is 5 × 5 μm^2.

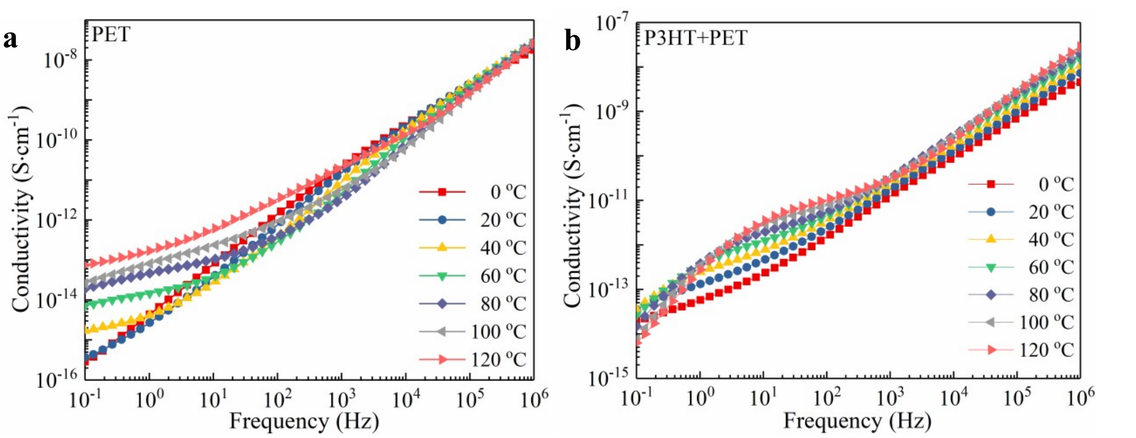

Fig. S5. Electrical conduction of a) PET, and b) P3HT/PET films in frequencies from 10^{-1} to 10^{6} Hz.

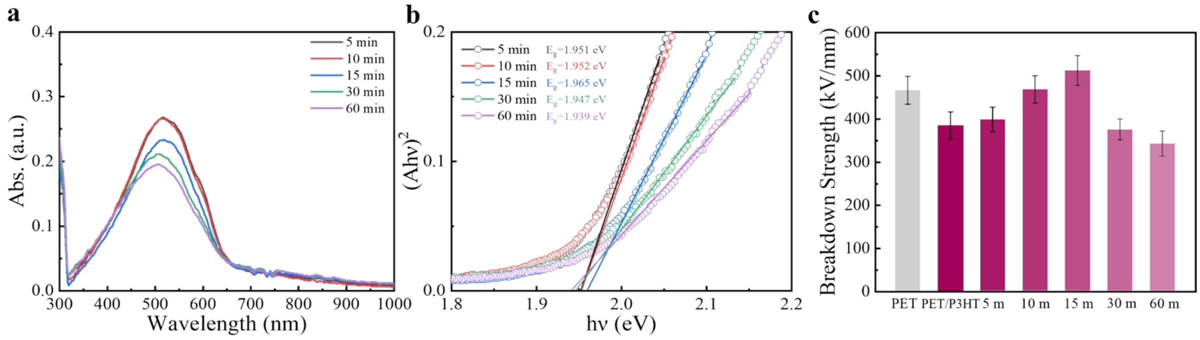

Fig. S6. (a) UV-Vis absorption spectra of P3HT/PET films with discharge voltages of 5 kV for 5 min, 10 min, 15 min, 30 min and 60 min. (b) Energy band gap calculations of P3HT with discharge voltages of 5 kV for 5 min, 10 min, 15 min, 30 min and 60 min, based on UV-Vis spectra. (c) DC breakdown performance of P3HT/PET films with discharge voltages of 5 kV for 5 min, 10 min, 15 min, 30 min and 60 min. "m" represents minute.

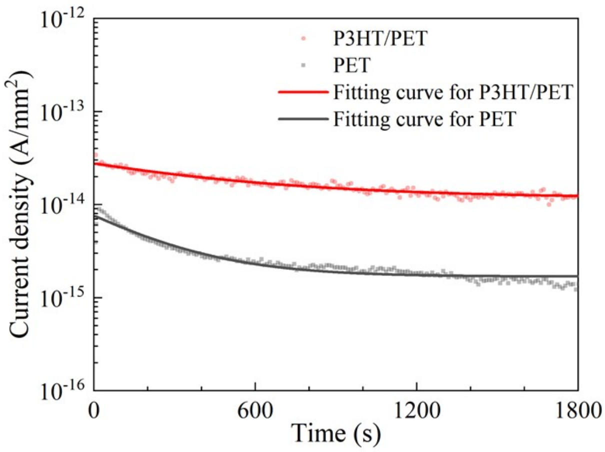

Fig. S7. Current density of PET and P3HT/PET films in DC electrical conductivity test.

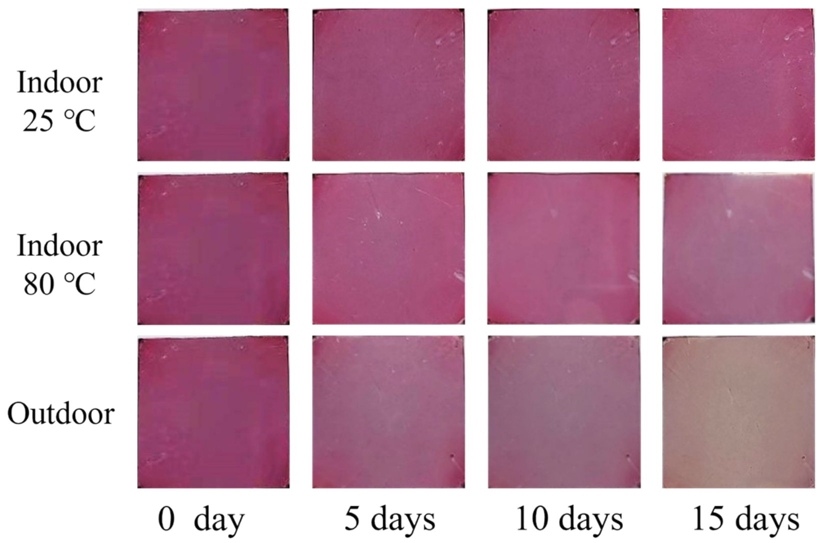

Fig. S8. Observable color changes of P3HT film under indoor and outdoor environment for 5 days, 10 days and 15 days.

Table S1. Comparison on dielectric parameters of PET and P3HT/PET films in eigenfrequencies of quasi-DC (10^{-1} Hz), power supply (50 Hz) and power electronics high-frequency range (10^6 Hz), at room temperature of 20 ^oC.

	ε_r			$\tan\delta$			σ (S·cm^{-1})		
	10^{-1} Hz	50 Hz	10^6 Hz	10^{-1} Hz	50 Hz	10^6 Hz	10^{-1} Hz	50 Hz	10^6 Hz
PET	3.06	3.04	2.82	0.002	0.004	0.014	3.7×10^{-16}	2.6×10^{-13}	2.5×10^{-8}
PET/P3HT	4.02	3.15	2.99	0.161	0.015	0.004	9.5×10^{-15}	1.5×10^{-12}	7.2×10^{-9}

Table S2. DC electrical conductivity of PET and P3HT/PET films.

Samples	PET	PET/P3HT
σ (S·cm^{-1})	3.4×10^{-15}	3.1×10^{-14}