Electronic Supplementary Material (ESI) for Materials Horizons.
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Supplementary Information for

Distinguishing Thermoelectric and Photoelectric Modes Enables Intelligent Real-Time Detection of Indoor Electrical Safety Hazards

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Supplementary Figures and Table

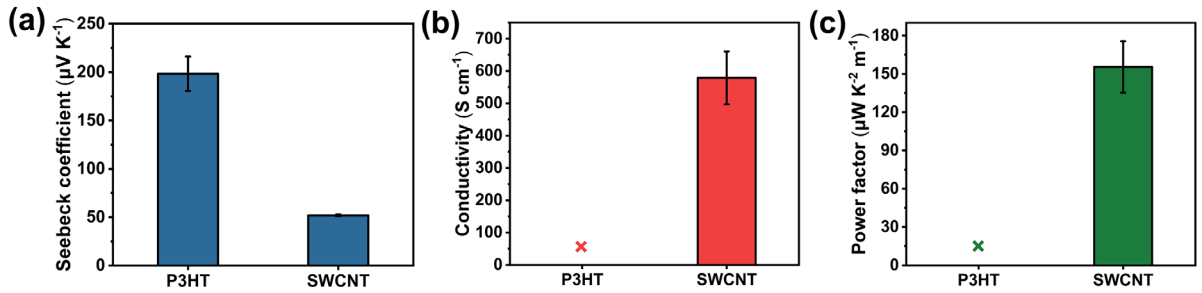

Figure S1 Thermoelectric performance of P3HT and SWCNT.

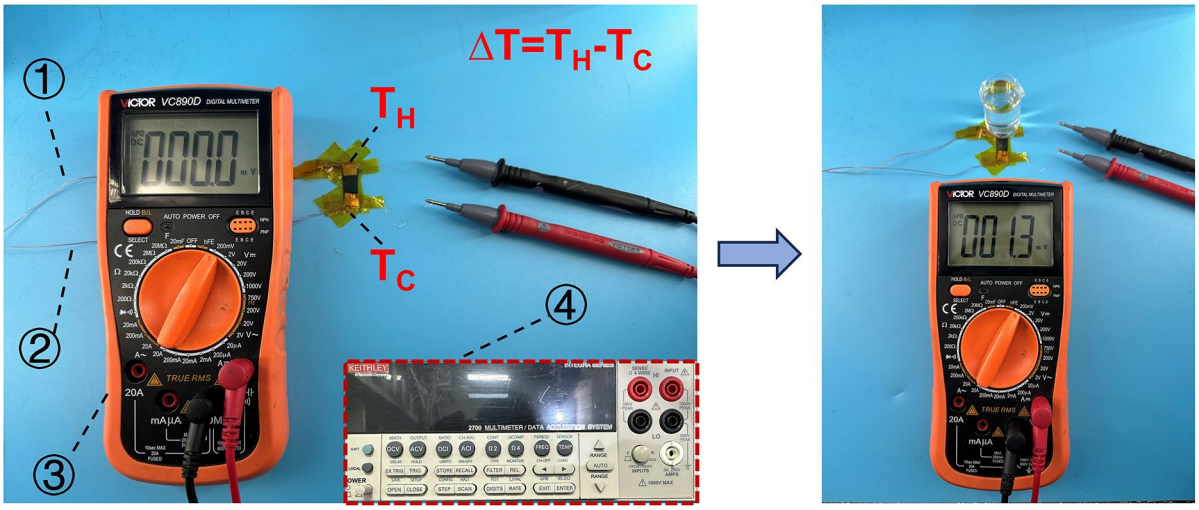

Figure S2 Measurement of the P3HT Seebeck coefficient. The temperature difference between the two ends of the film was measured using thermocouples and collected in real time using 2700 Multimeter/data acquisition system. The voltage at both ends of the film was measured using a Digital multimeter. The Seebeck coefficient was calculated using equation $S = \Delta U / \Delta T$.

① Thermocouples

② Thermocouples

③ Digital multimeter

④ 2700 Multimeter/data acquisition system

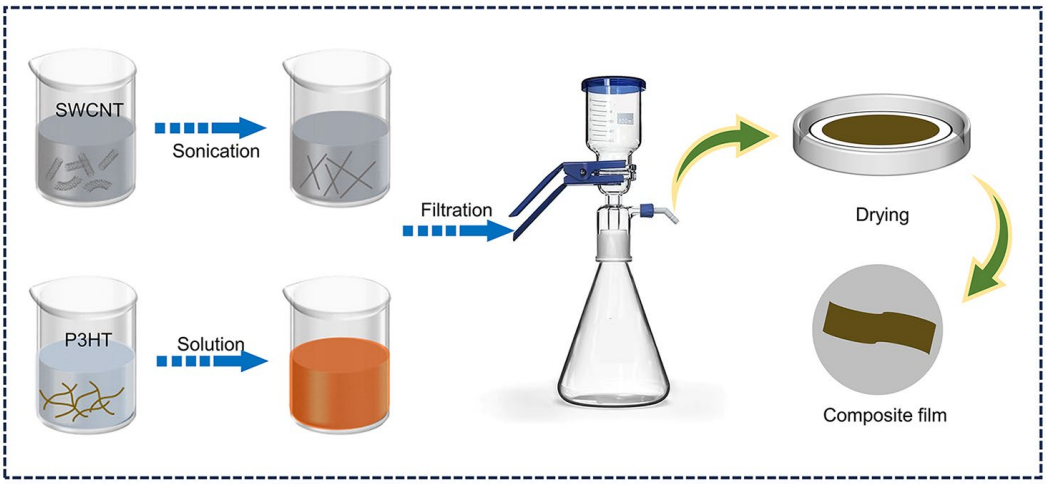

Figure S3 Schematic diagram of the preparation process of flexible SWCNT/P3HT composite films.

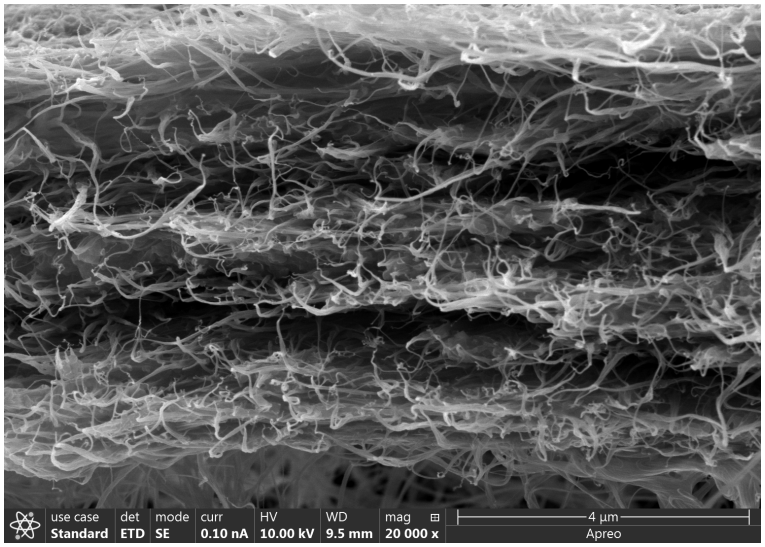

Figure S4 The cross-sectional scan of the composite film.

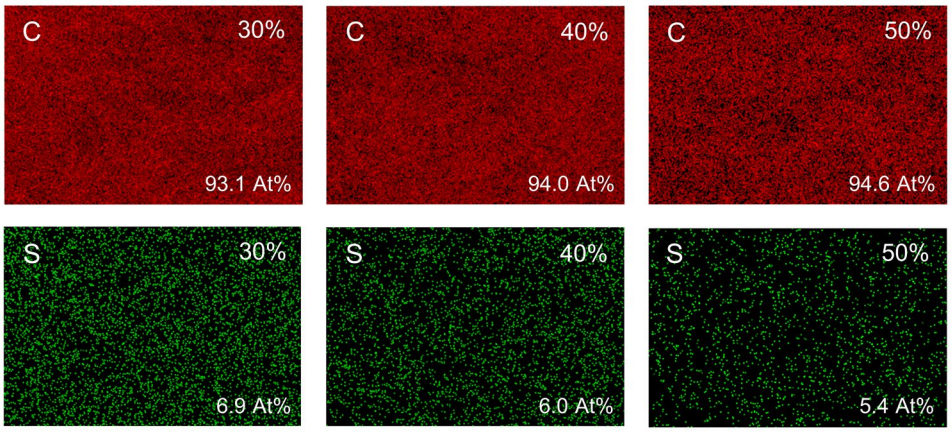

Figure S5 EDS of 30%, 40%, 50% SWCNT content of SWCNT/P3HT composite films.

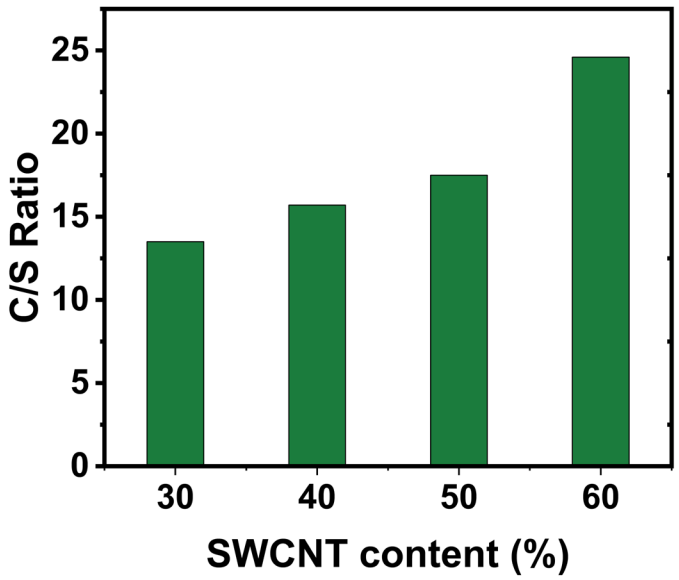

Figure S6 C/S ratio of 30%, 40%, 50%, 60% SWCNT content of SWCNT/P3HT composite films.

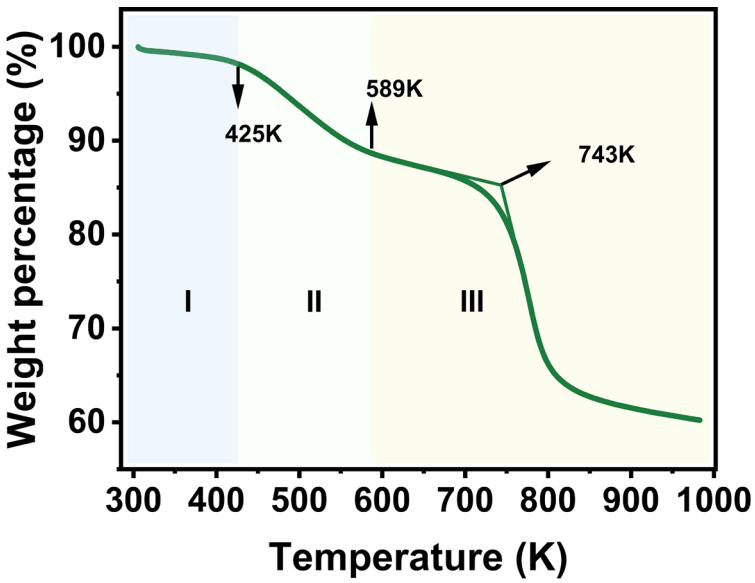

Figure S7 TGA curve of SWCNT/P3HT.

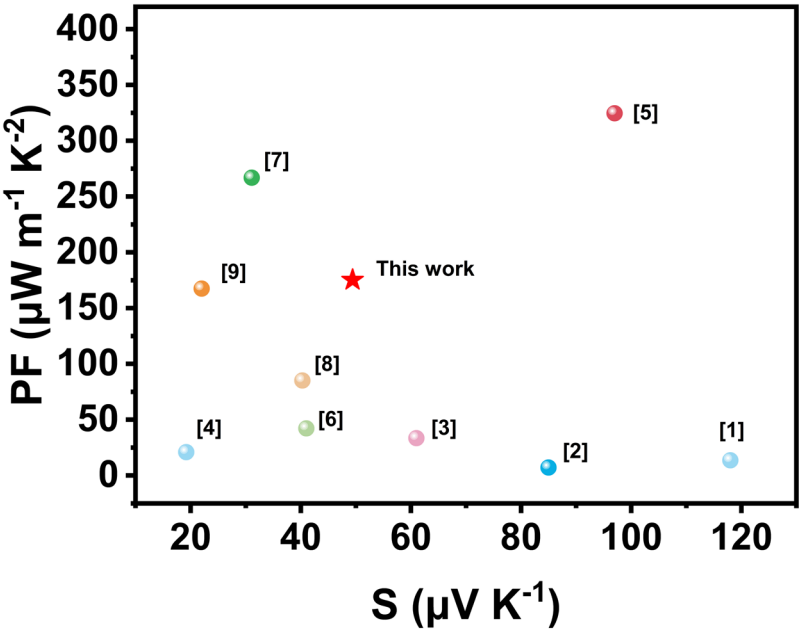

Figure S8 Power factor and Seebeck coefficient of P3HT system materials.

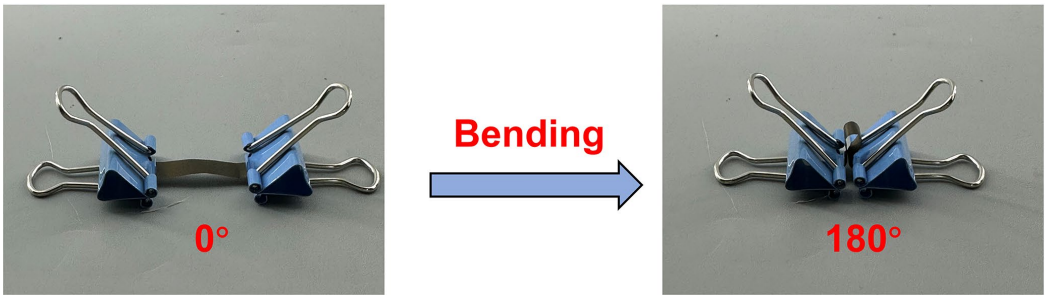

Figure S9 The thermoelectric properties of SWCNT/P3HT composite films under cyclic bending were tested by folding the composite films from 0° to 180°.

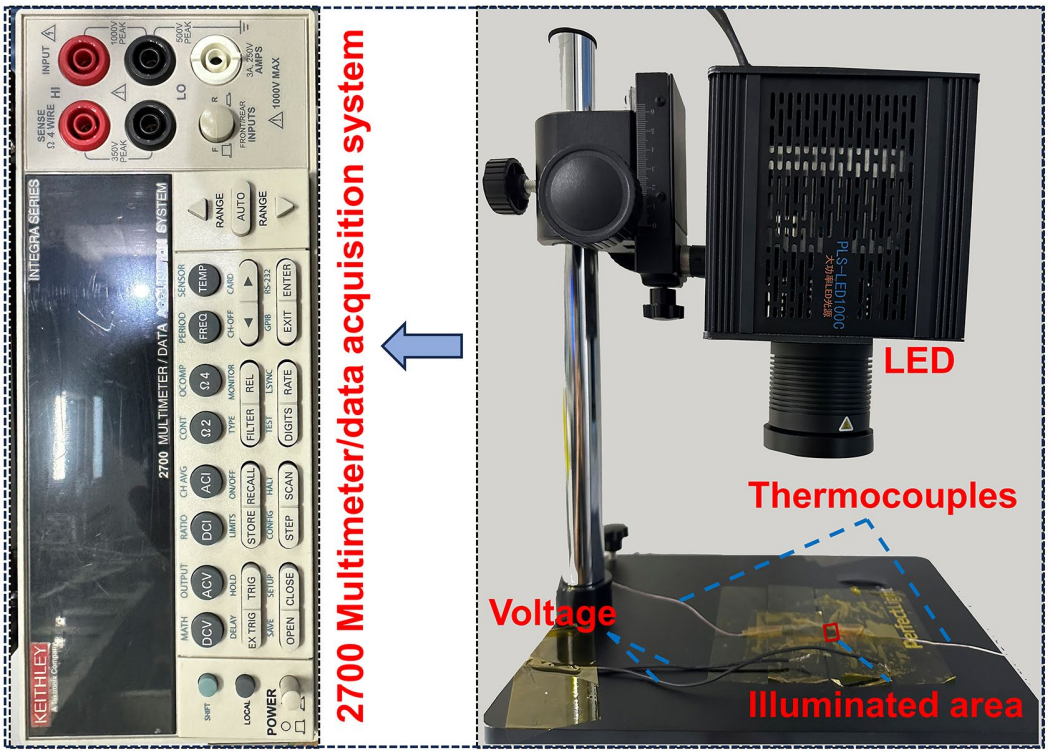

Figure S10 Test Method for ΔU -Time curve and ΔT -Time curve of SWCNT/P3HT Composite Films under Light Exposure.

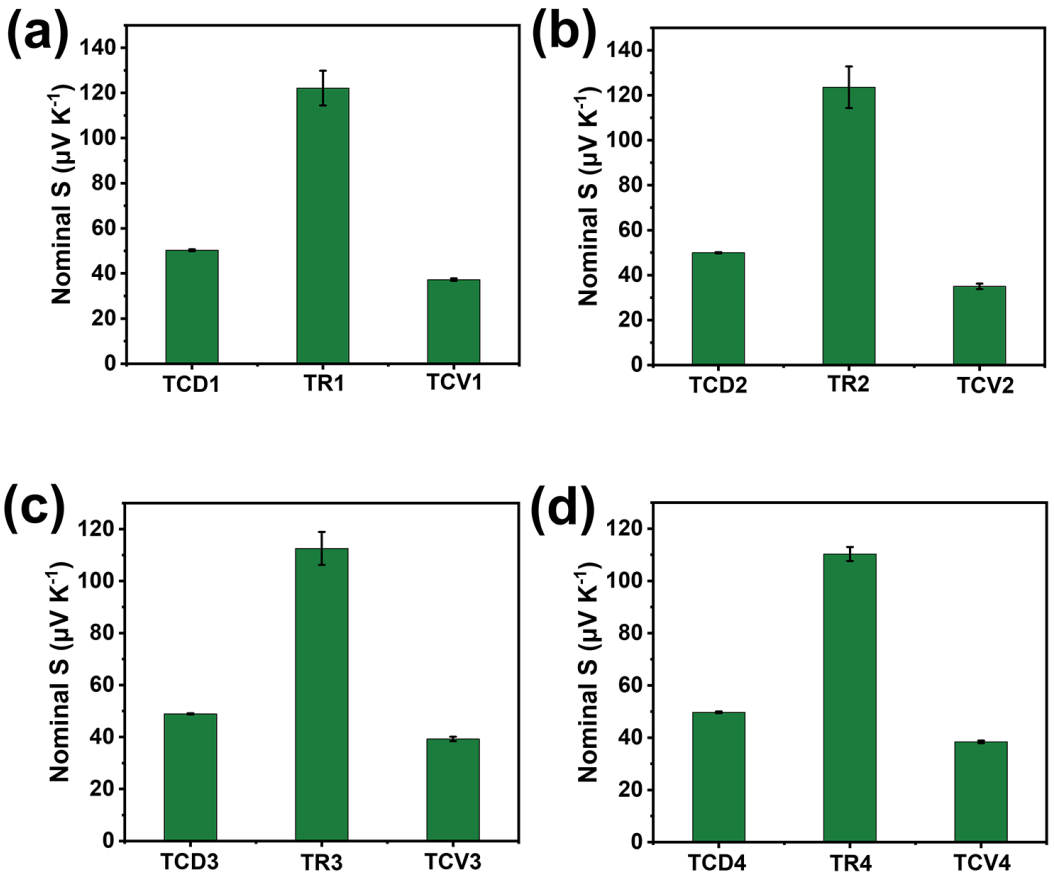

Figure S11 Nominal Seebeck coefficient calculated from Figure. 5.

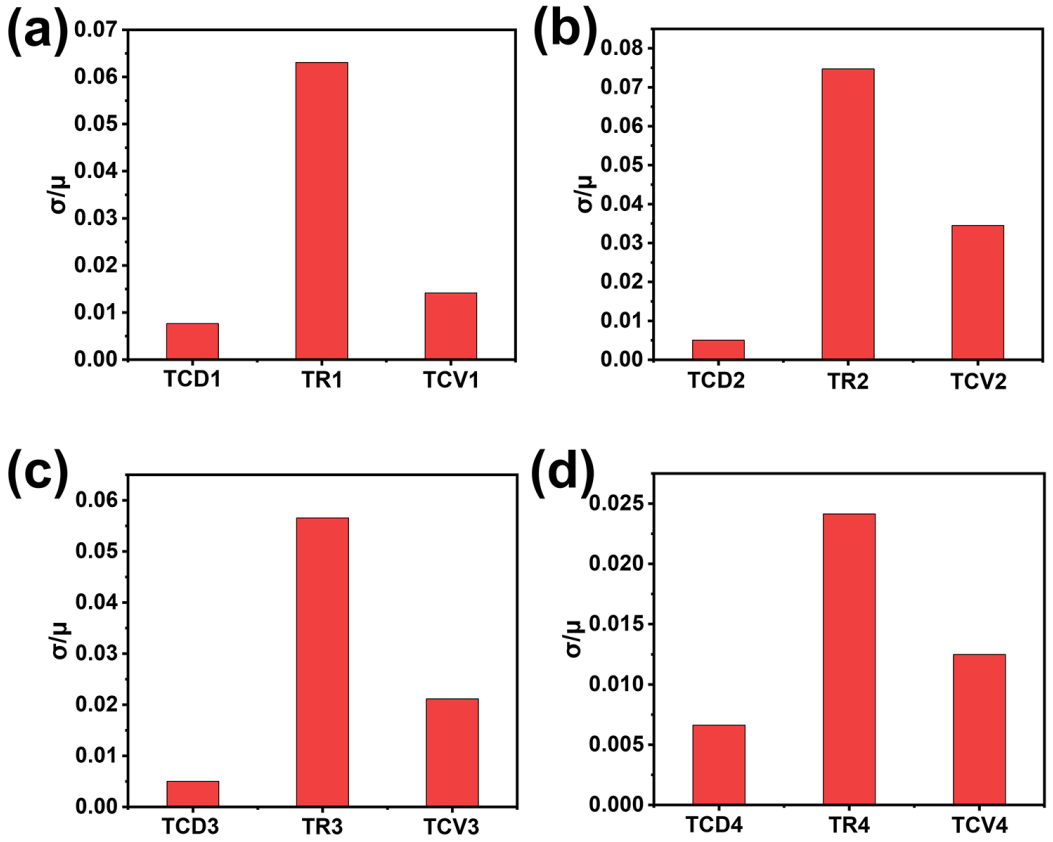

Figure S12 Stability of the nominal Seebeck coefficients for different forms of heat transfer.

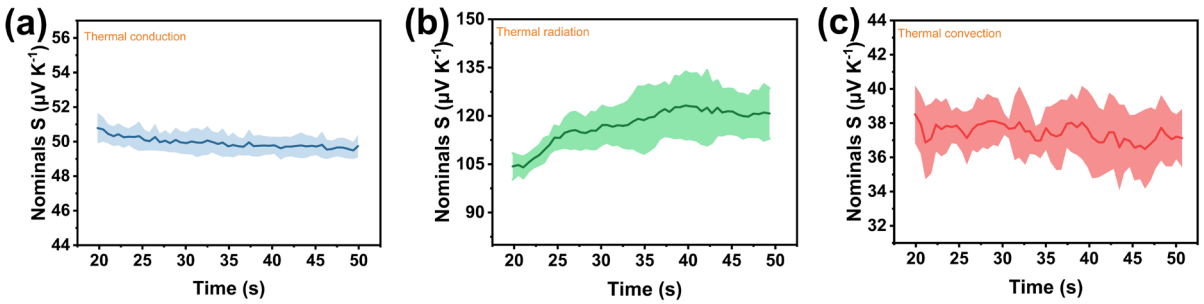

Figure S13 Variation of nominal Seebeck coefficients with time for different forms of heat transfer.

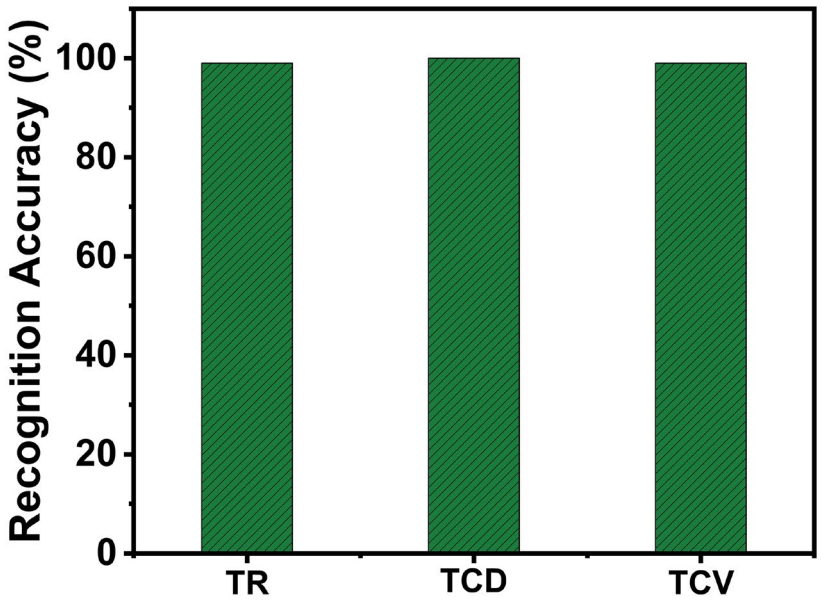

Figure S14 Recognition accuracy for different forms of heat transfer.

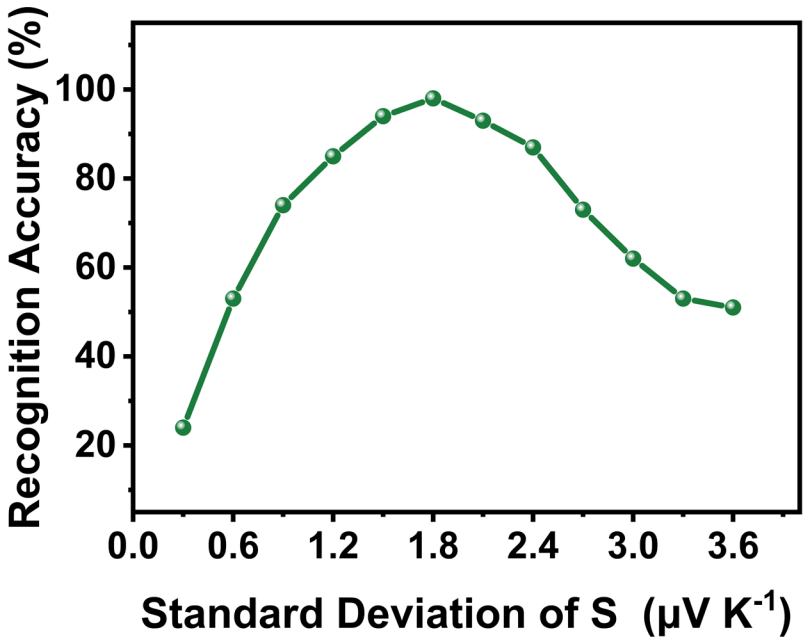

Figure S15 The recognition accuracy of heat conduction form when different Standard Deviation of Seebeck Coefficient values are set.

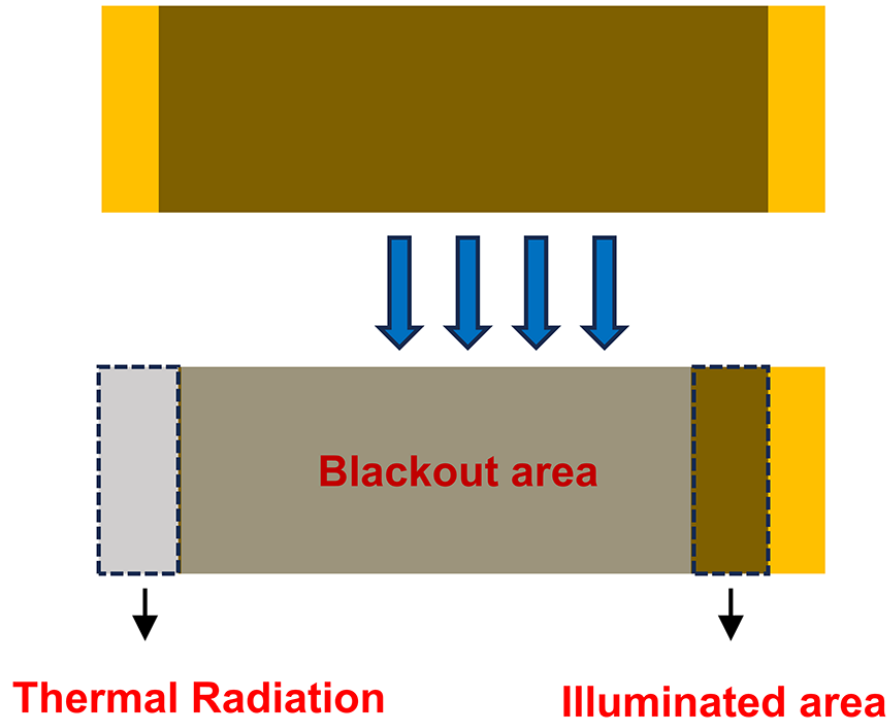

Figure S16 Encapsulation of SWCNT/P3HT composite film devices in application.

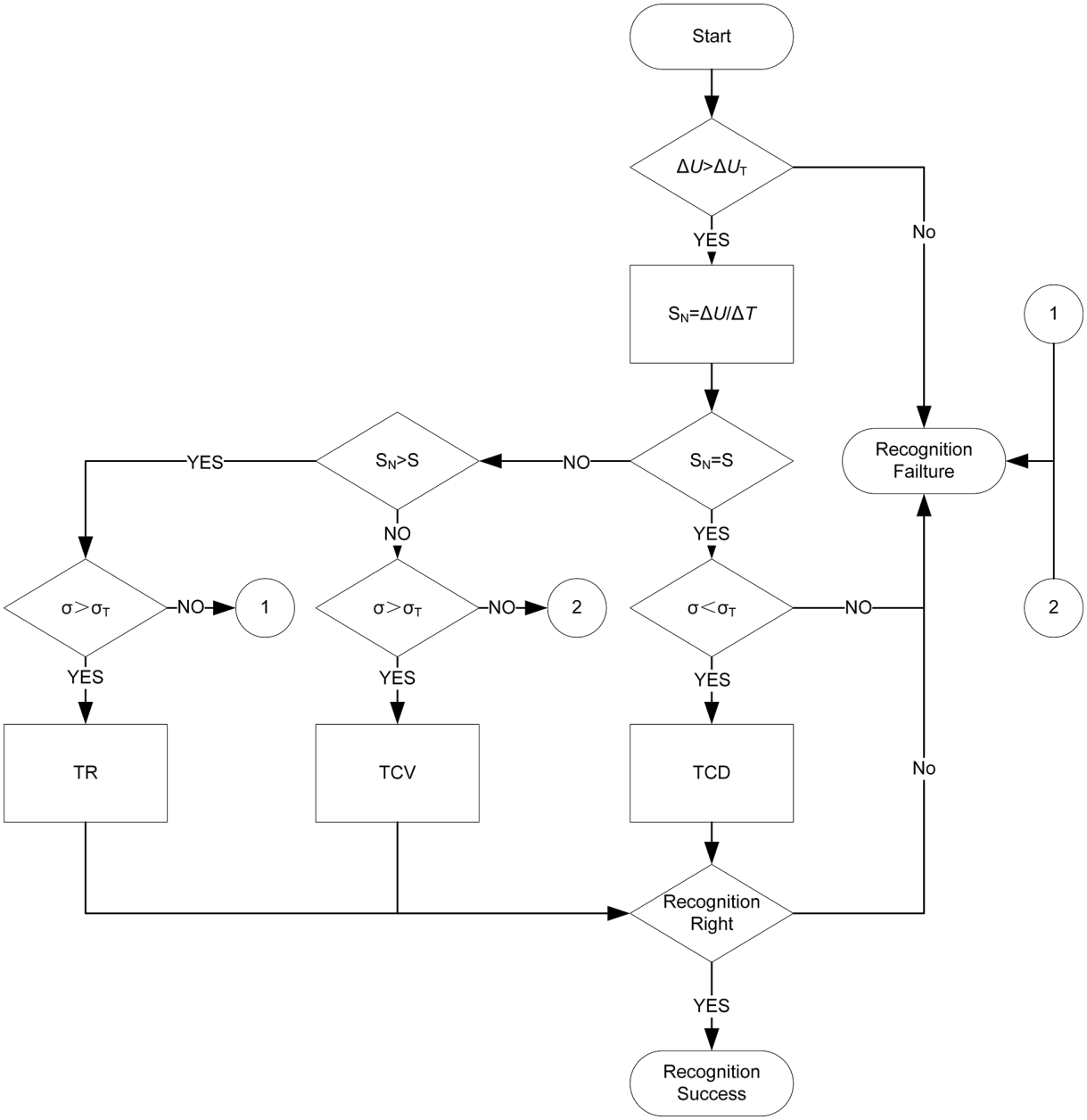

Figure S17 Flowchart for recognizing a scene by a sensing system based on SWCNT/P3HT composite film.

Table S1 Comparison of thermoelectric properties of P3HT system materials.

Constituent	Dopant	σ (S cm^{-1})	S (μV K^{-1})	PF (μW m^{-1} K^{-2})	Ref.
P3HT-Bi_2Te_3	$FeCl_3$	9.77	118	13.6	[1]
P3HT	F4TCNQ	10	85 ± 10	10	[2]
P3HT	$TFSI^-$	90	61	33.5	[3]
P3HT	$FeCl_3$	570 ± 100	19.4 ± 0.5	21 ± 6	[4]
CNT/P3HT	None	345 ± 88	97 ± 11	325 ± 101	[5]
P3HT	TCB	251	41	42.2	[6]
CNT/P3HT	$FeCl_3$	2760 ± 170	31.1 ± 2.1	267 ± 38	[7]
CNT/P3HT	None	524 ± 56	40.3 ± 1.5	86.6 ± 16.2	[8]
P3HT	MB	3460 ± 300	22	170±30	[9]
This work	None	718±45	48.5±0.8	169±13	

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