Electronic supplementary information

Photoconductivity enhancement and charge transport properties in a conjugated polyelectrolyte/carbon nanotube hybrid studied by scanning probe microscopy

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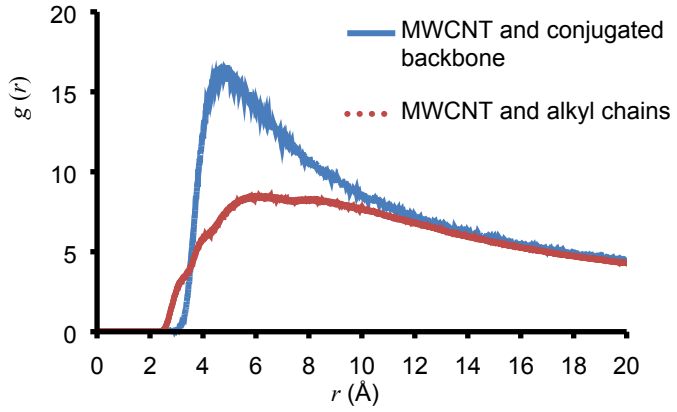

Fig. S1 The blue solid line is the RDF between the MWCNT and the conjugated backbone of PTETDA. The red dotted line is the RDF between the MWCNT and the alkyl chains.

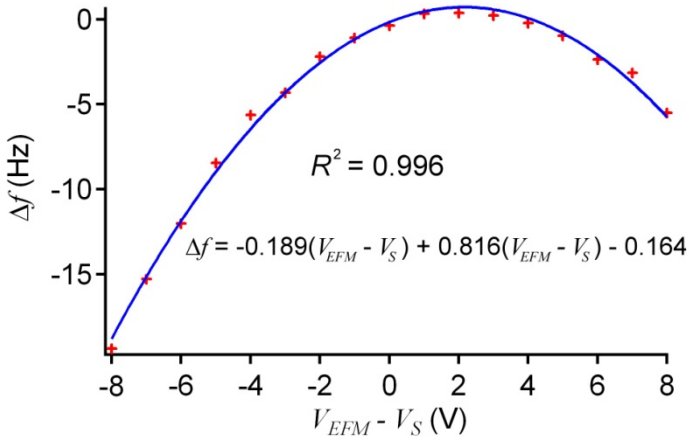

Fig. S2 Typical plot of Δf versus $V_{EFM} - V_S$ from EFM. The data points fit well to a quadratic function.

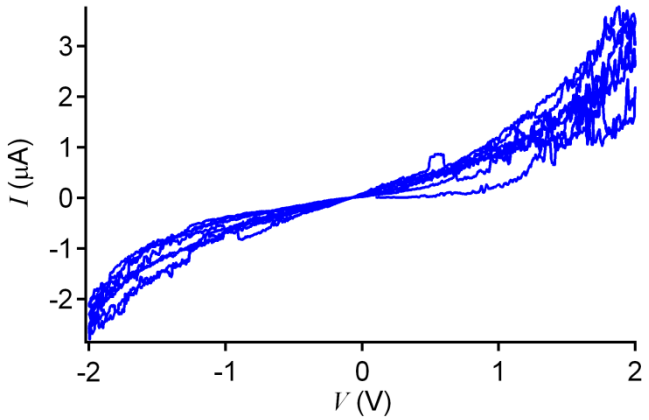

Fig. S3 Typical *I*-*V* plot from PCAFM. The results were repeatable and reversible.

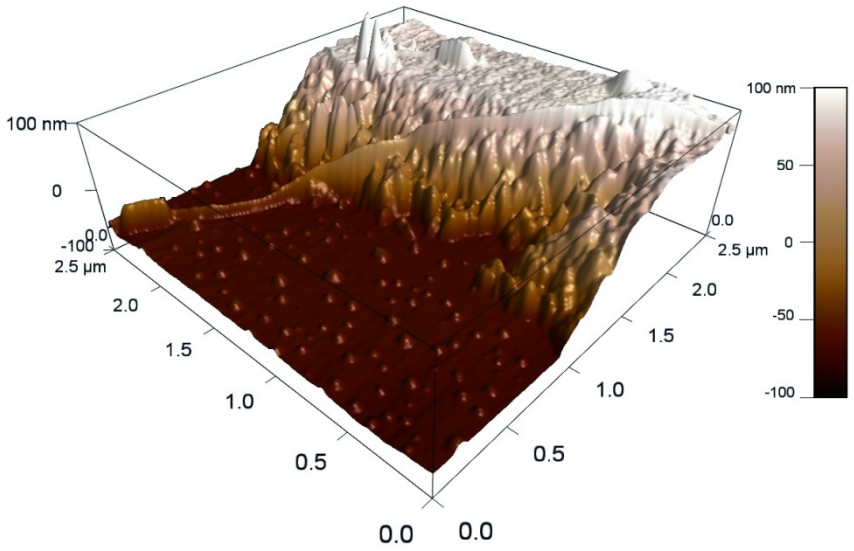

Fig. S4 Height image of the PTETDA/MWCNT sitting across the boundary between the ITO and the glass.

Table S1 Results of the Shapiro-Wilk tests of log R and R of PTETDA/MWCNT at 5% significance level. [a)]

Illumination Condition	Skewness[b)]	Excess Kurtosis[b)]	W[b)]	Skewness[c)]	Excess Kurtosis[c)]	W[c)]
460 nm	1.36	4.44	0.918	7.32	74.14	0.442
490 nm	1.05	1.17	0.932	4.57	29.23	0.551
520 nm	1.84	7.83	0.868	9.76	113.84	0.247
550 nm	0.88	2.20	0.952	3.61	19.55	0.687
580 nm	1.68	7.86	0.891	9.21	116.56	0.409
610 nm	1.66	3.92	0.868	4.31	23.32	0.542
640 nm	0.73	1.31	0.965	2.36	9.85	0.818
670 nm	0.88	2.33	0.942	3.44	16.34	0.687
Dark	1.36	3.27	0.916	7.37	73.40	0.105
White	1.51	4.03	0.901	11.79	171.78	0.266
Dark[d)]	1.09	1.47	0.933	3.27	15.18	0.682
White[d)]	1.83	5.75	0.901	8.53	92.65	0.296

[a)] All p-values (not shown) are smaller than 0.001, which means all the data do not follow normal distributions; [b)] it corresponds to the data of log R; [c)] it corresponds to the data of R; [d)] data of the pristine MWCNT.

Table S2 Results of the Shapiro-Wilk tests of log Γ and Γ of PTETDA/MWCNT at 5% significance level.

Illumination Condition	Skewness [a)]	Excess Kurtosis[a)]	W[a)]	p-Value [a), c), d)]	Skewness [b)]	Excess Kurtosis[b)]	W[b)]	p-Value [b), c)]	Normality[b), e)]
460 nm	-1.17	3.45	0.933	N/A	0.63	0.88	0.971	N/A	No
490 nm	-1.06	2.19	0.942	N/A	0.40	0.37	0.986	0.002	No
520 nm	-0.75	0.40	0.961	N/A	0.31	-0.30	0.987	0.003	No
550 nm	-0.72	1.56	0.957	N/A	1.27	6.66	0.931	N/A	No
580 nm	-1.10	2.67	0.938	N/A	0.04	0.82	0.990	0.015	No
610 nm	-1.05	2.30	0.935	N/A	0.66	3.49	0.958	N/A	No
640 nm	-1.24	3.69	0.934	N/A	-0.17	0.51	0.993	0.115	Yes
670 nm	-1.70	4.72	0.882	N/A	-0.17	1.22	0.994	0.221	Yes
Dark	-1.64	4.05	0.881	N/A	0.05	-0.39	0.994	0.148	Yes
White	-1.43	2.26	0.883	N/A	0.71	1.40	0.990	0.014	No
Dark[f)]	-1.02	3.23	0.952	N/A	0.17	0.48	0.993	0.116	Yes
White[f)]	0.34	0.84	0.990	0.019	2.12	9.04	0.860	N/A	No

[a)] It corresponds to the data of log Γ; [b)] it corresponds to the data of Γ; [c)] if the p-value is smaller than 0.001, it is shown as 'N/A'; [d)] all p-values (not shown) are smaller than 0.05, which means all the data do not follow normal distributions; [e)] if the p-value is larger than 0.05, the null hypothesis of normality cannot be rejected and 'Yes' is written in this column; otherwise, 'No' is written; [f)] data of the pristine MWCNT.

Table S3 Scheme of the rejection of H_0: $\hat{\theta} = 0$

ASL	Conclusion
< 0.10	Borderline evidence against H_0
<0.05	Reject H_0

Table S4 ASLs and results of the hypothesis tests of H_0 using the nonparametric BC_a method.[1] (a) H_0: Illumination does not have any effect on φ_0. (b) H_0: Illumination does not have any effect on L. Rejection of H_0 indicates that illumination decreases the corresponding physical quantities, unless otherwise specified. The scheme of the rejection of H_0 is shown in Table S3.

(a)

Illumination Wavelength [nm]	ASL [a]	Reject H_0? [a]	ASL [b]	Reject H_0? [b]
460	0.002	Yes	0.118	No
490	<0.001 [c]	Yes [c]	0.036 [c]	Yes
520	0.315	No	0.907	No
550	0.381 [c]	No [c]	0.03	Yes
580	0.353 [c]	No [c]	0.115	No
610	<0.001 [c]	Yes [c]	0.158	No
640	<0.001 [c]	Yes [c]	0.015	Yes
670	0.027	Yes	0.437	No

[a] Reverse bias data; [b] forward bias data; [c] rejection of H_0 indicates that illumination increases the corresponding physical quantities.

(b)

Illumination Wavelength [nm]	ASL [a]	Reject H_0? [a]	ASL [b]	Reject H_0? [b]
460	0.029	Yes	<0.001	Yes
490	0.246	No	0.021	Yes
520	0.067	Borderline	0.001	Yes
550	0.055	Borderline	<0.001	Yes
580	0.209	No	<0.001	Yes
610	0.232	No	<0.001	Yes
640	0.055	Borderline	<0.001	Yes
670	0.098	Borderline	0.003	Yes

[a] Reverse bias data; [b] forward bias data.

Table S5 Statistical analysis of the regression data of the PTETDA/MWCNT hybrid. It involves the comparison of the F statistic and the critical value F_C to perform hypothesis tests.[2] If F_1 is smaller than F_{1C}, the hypothesis that there is a linear dependence of the data on P is not rejected and 'Yes' is written in the 4th column. Then, if F_2 is larger than F_{2C}, the hypothesis that the slope is equal to zero is rejected and 'No' is written in the last column. If the former hypothesis is rejected, no further actions were carried out for the second hypothesis and 'N/A' is written in the last three columns.

The Percentage Change of Data	F_1	F_{1C}	Linear?	F_2	F_{2C}	Slope = 0?
G_0	9.17	3.00	No	N/A	N/A	N/A
Reverse bias φ_0	5.72	3.05	No	N/A	N/A	N/A
Reverse bias L	3.85	3.08	No	N/A	N/A	N/A
Forward bias φ_0	0.16	3.05	Yes	11.08	3.90	No
Forward bias L	0.69	3.07	Yes	5.50	3.92	No

Table S6 Illumination intensities at different wavelengths. The area of the circular light spot was 0.332 cm^2.

Illumination Wavelength [nm]	Intensity [μW cm^{-2}]
460	3.54
490	3.74
520	3.78
550	45.7
580	26.2
610	42.5
640	14.4
670	6.48

1. B. Efron and R. J. Tibshirani, *An Introduction to the Bootstrap*, Chapman & Hall, New York, NY, USA, 1993.
2. J. H. Zar, *Biostatistical Analysis*, Prentice Hall, Upper Saddle River, NJ, USA, 5th edn., 2010.