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Supporting Information

69451 Weinheim, Germany

Electric Current Test Paper Based on Conjugated Polymers and Aligned Carbon Nanotubes**

*Xuemei Sun, Zhitao Zhang, Xin Lu, Guozhen Guan, Houpu Li, and Huisheng Peng**

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Supporting Information

Experimental Section

Trimethyl[4-(phenylethynyl)phenyl]-silane (p-Me_3SiDPA, 99%) was obtained from Alfa Aesar, and the other chemicals were ordered from Sinopharm Chemical Reagent Co., Ltd. Aligned multi-walled carbon nanotube (MWCNT) sheets with lengths of up to meters were spun from a MWCNT array, which was synthesized by a chemical vapor deposition. The growth conditions of MWCNT arrays were summarized as below: thickness of 1.2 nm for Fe and thickness of 3 nm for Al_2O_3 (the Fe and Al_2O_3 catalyst system was coated on silicon substrate by electron beam evaporation with rates of 0.5 and 2 Å/s for Fe and Al_2O_3, respectively), flow rate of 400 standard cm^3/min for argon, flow rate of 30 standard cm^3/min for hydrogen, flow rate of 90 standard cm^3/min for ethylene, growth temperature of 740 ^oC, and growth time of 10 min.

Mechanical tests were performed on a Hengyi Table-Top Universal Testing Instrument. The composite samples were mounted onto sample holders with a gauge length of 5 mm, and their cross-sectional sizes were determined by SEM. The measurement typically included three steps: (1) fixing two ends of a composite film or fiber onto the sample hold with silver paste; (2) cutting the two shoulders of the sample holder; (3) starting the testing procedure to obtain a stress-strain curve. Electrical conductivities were obtained by a two-probe method. The two ends of a composite sample were connected to two copper wires by conductive silver paste, and the copper wires were further connected to a digital Source-Meter for a measurement.

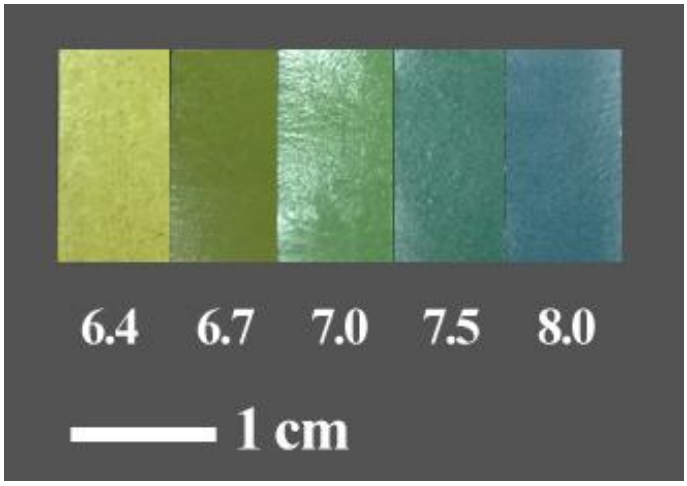

Figure S1. Photograph of colorimetric card of precision pH test paper.

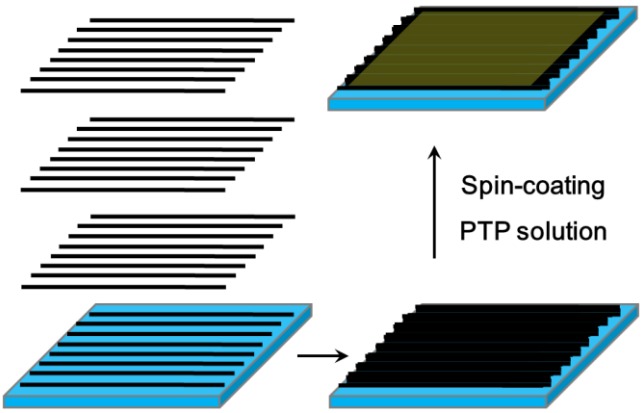

Figure S2. Schematic illustration to the preparation of an aligned MWCNT/PTP composite film by a spin-coating process.

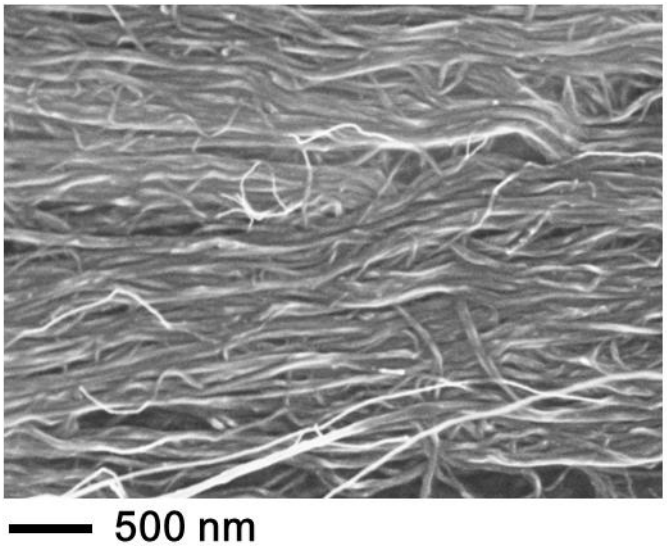

Figure S3. Scanning electron microscopy (SEM) image of an aligned MWCNT/PTP composite film.

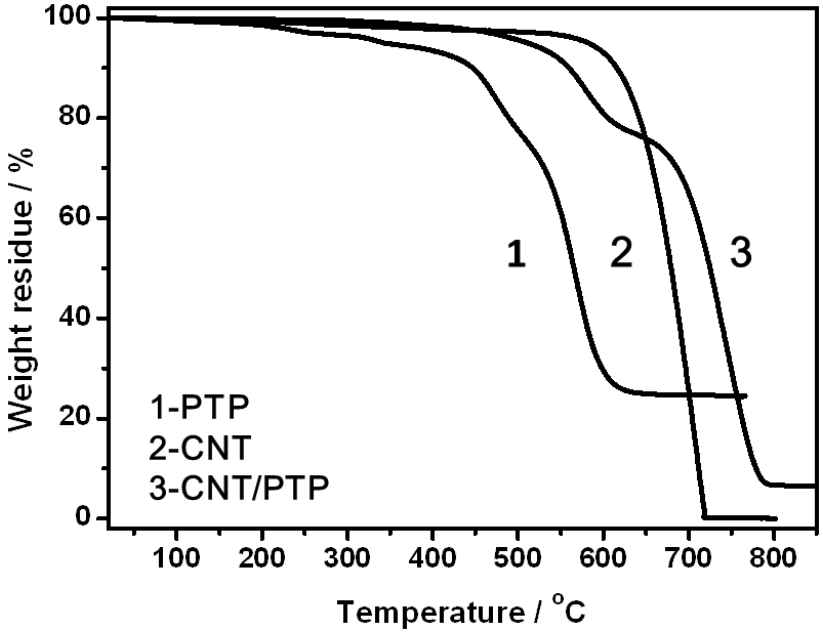

Figure S4. TGA curves of pristine MWCNTs, PTP and MWCNT/PTP composite film in air.

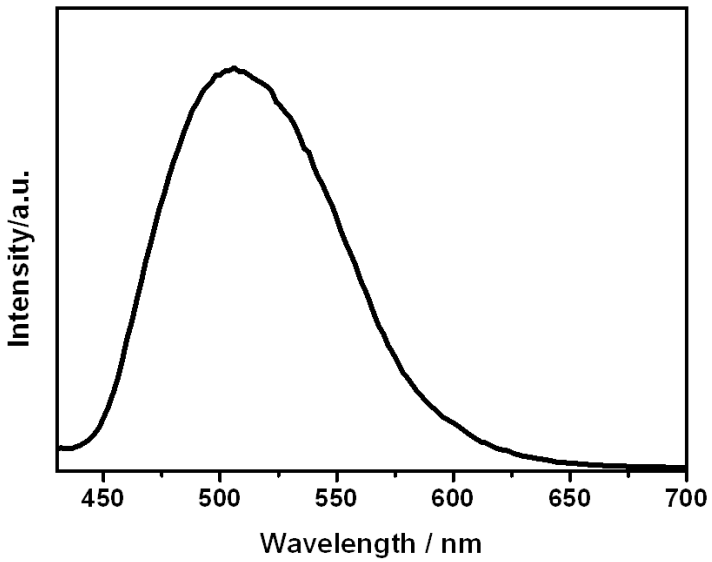

Figure S5. Typical fluorescent spectrum of a MWCNT/PTP composite film.

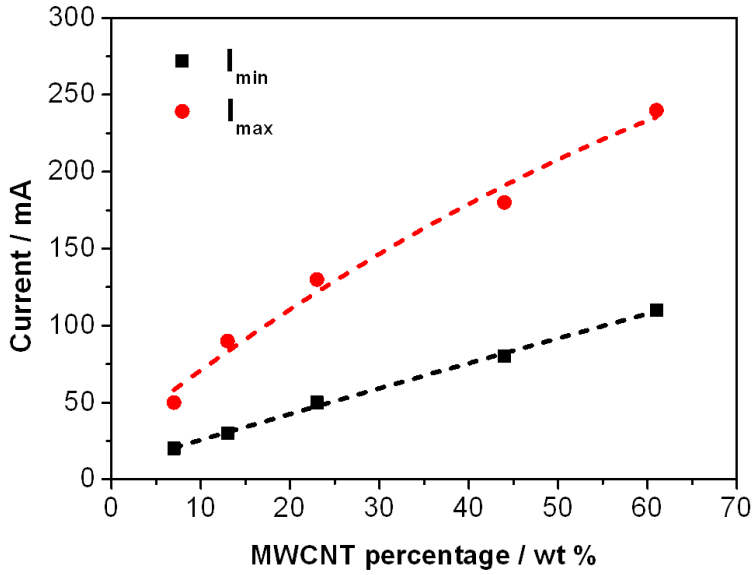

Figure S6. Dependence of the current range for the electrochromatic transition on the MWCNT weight percentage.

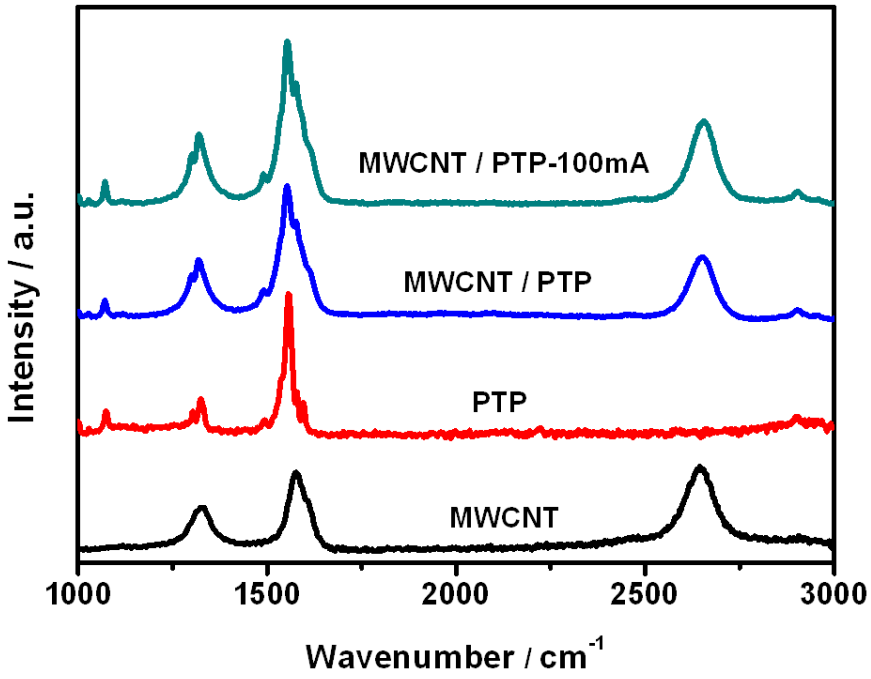

Figure S7. Raman spectra of bare MWCNT, bare PTP and MWCNT/PTP composite film before and after pass with a current of 100 mA.

Figure S8. Fluorescent micrographs of a pure PTP film being heated to different temperatures.

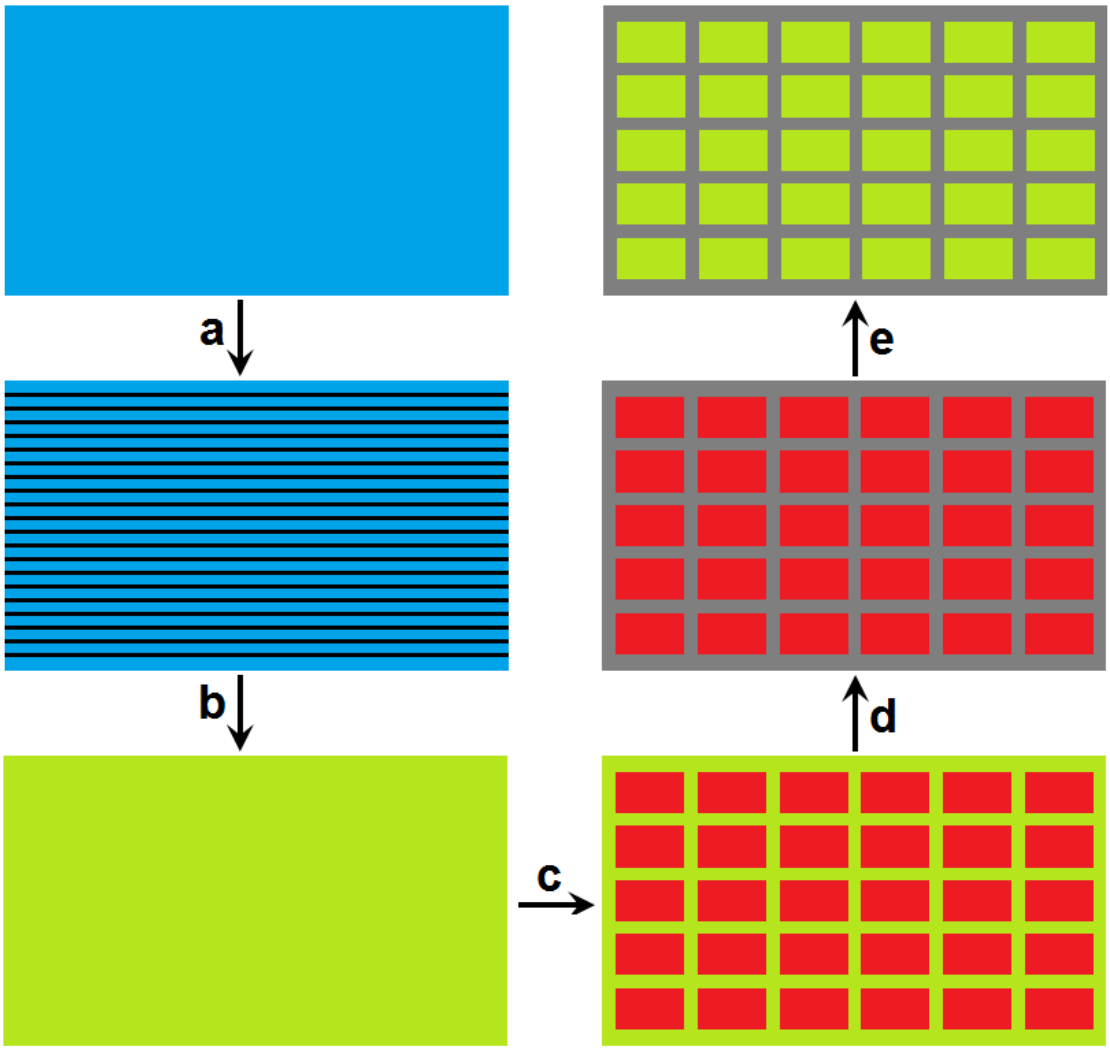

Figure S9. Schematic illustration to the fabrication of standard samples. **a.** Attaching aligned MWCNT sheet onto a substrate. **b.** Coating a PTP solution onto the MWCNT sheet. **c.** Covering a mask with rectangles that shared the same length and width and were separated with the same width on the composite film. **d.** Depositing a layer of metal that functions as electrodes for the standard samples. **e.** Removing the mask to produce standard samples.

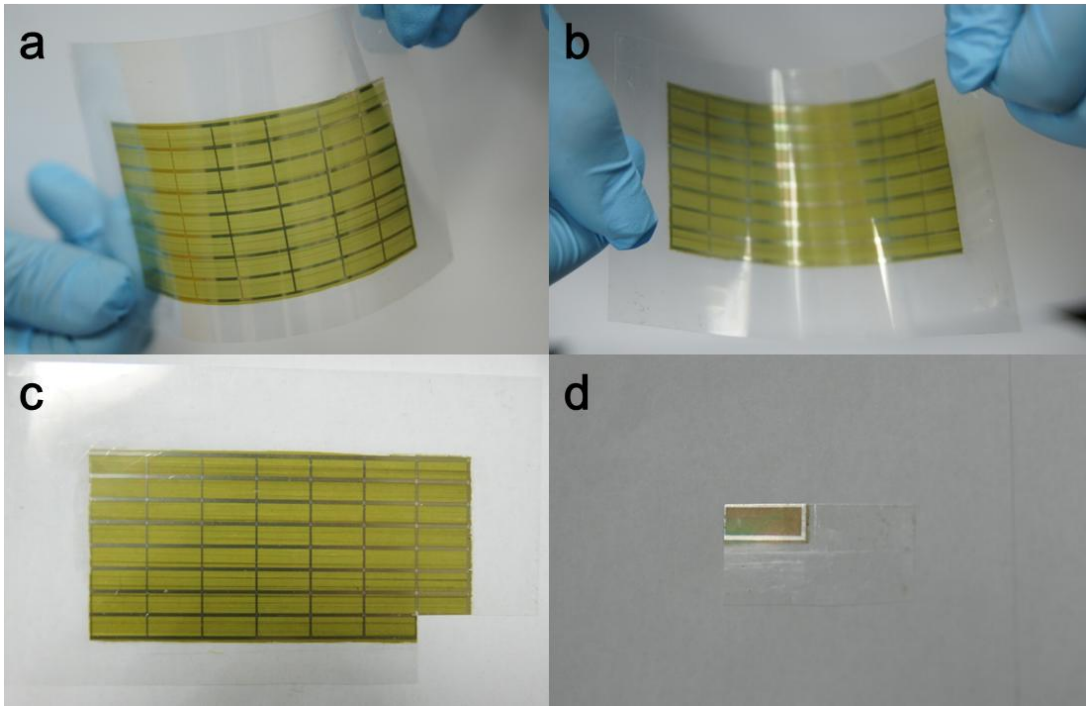

Figure S10. a and **b.** Photographs of flexible MWCNT/PTP composite films (56 standard units) on poly (ethylene terephthalate) substrate. **c** and **d.** Photographs for one standard unit of a MWCNT/PTP composite film being cut from **a**.

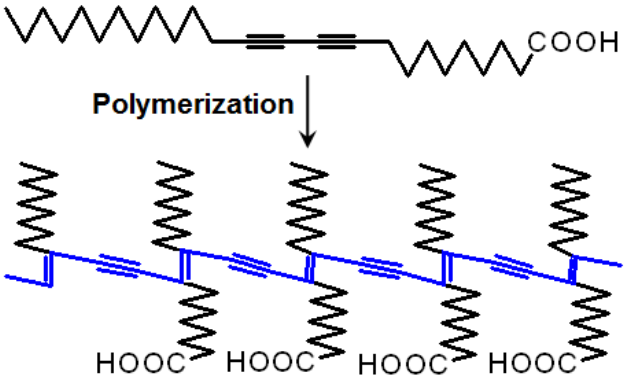

Figure S11. Synthesis of the conjugated polymer by topochemical polymerization of $CH_3(CH_2)_{11}CCCC(CH_2)_8COOH$ under UV light.

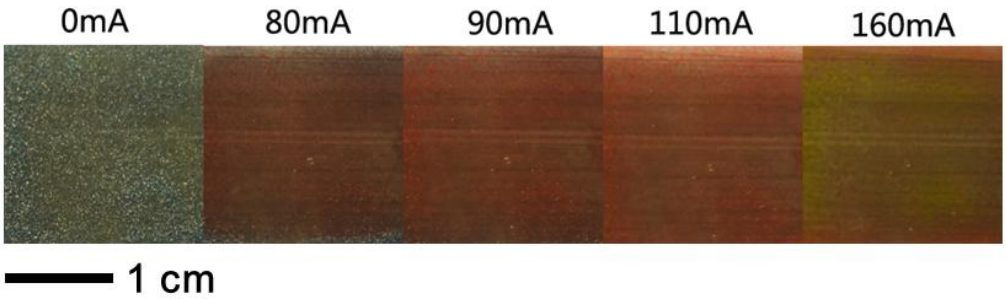

Figure S12. Photographs of an aligned MWCNT/polydiacetylene composite film when passed with increasing currents from 0 to 160 mA.