Supplementary Information

Orienting Polydiacetylene Using Aligned Carbon Nanotubes

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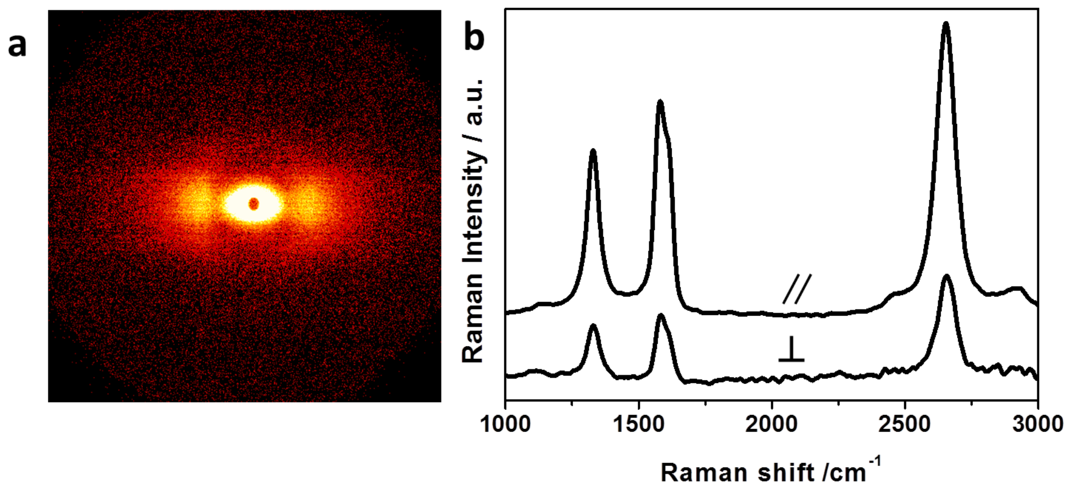

Figure S1. (a) Two-dimensional SAXS pattern and (b) typical polarized Raman spectra of the bare aligned CNT sheet. The pair of dense scattering areas in the equatorial direction of the SAXS pattern corresponds to the radical scattering of CNTs. // and ⊥ correspond to the directions being parallel and perpendicular to the CNT length, respectively.

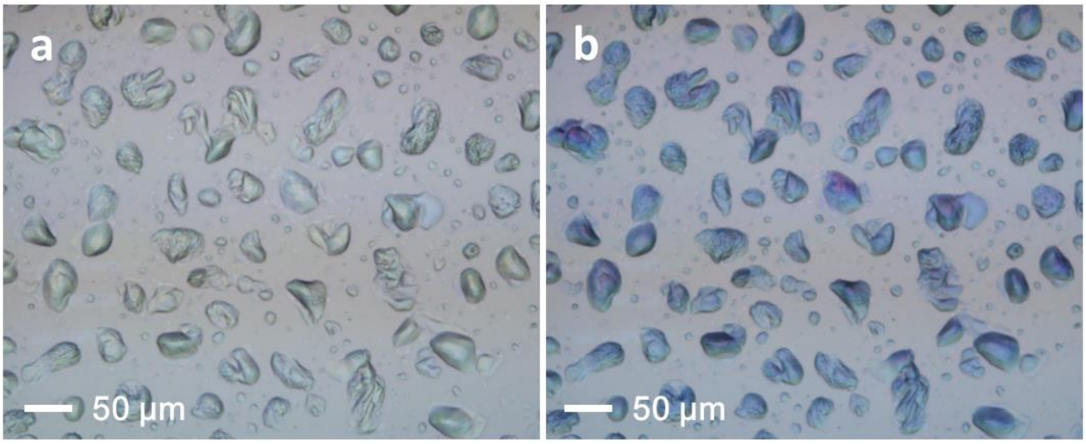

Figure S2. Optical micrographs of bare PDA films (a) before and (b) after polymerization.

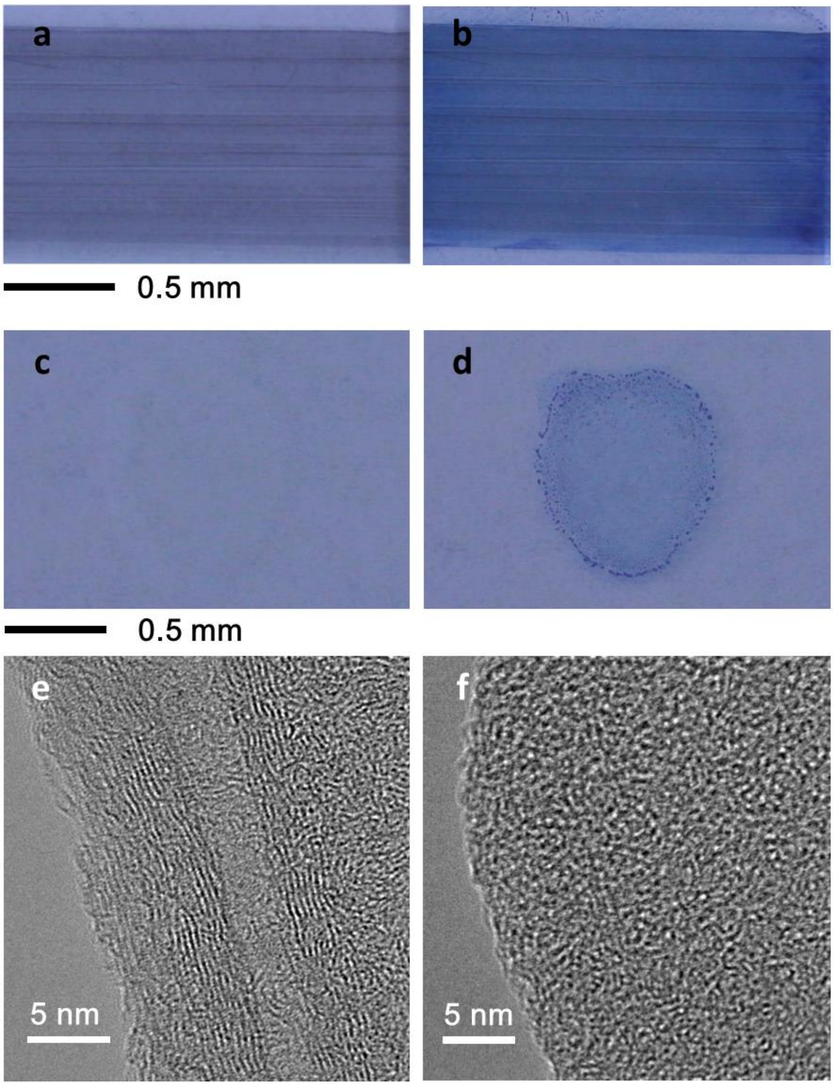

Figure S3. Photographs of the aligned CNT/diacetylenic-monomer composite (a) before and (b) after polymerization, photographs of the bare diacetylenic monomers (c) before and (d) after polymerization, and high-resolution transmission electron micrographs of (e) the aligned CNT/diacetylenic-monomer composite and (f) bare diacetylene.

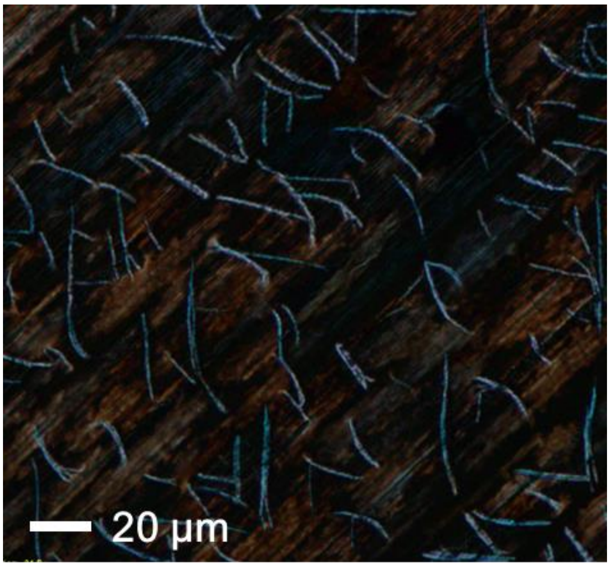

Figure S4. Polarized optical micrograph of an aligned CNT/PDA composite.

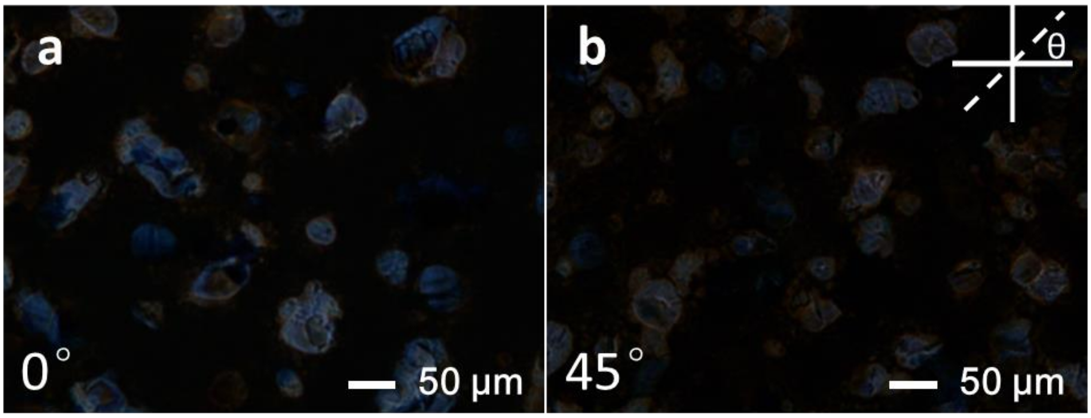

Figure S5. Polarized optical micrographs of bare PDA films at angles of (a) 0^o and (b) 45^o.

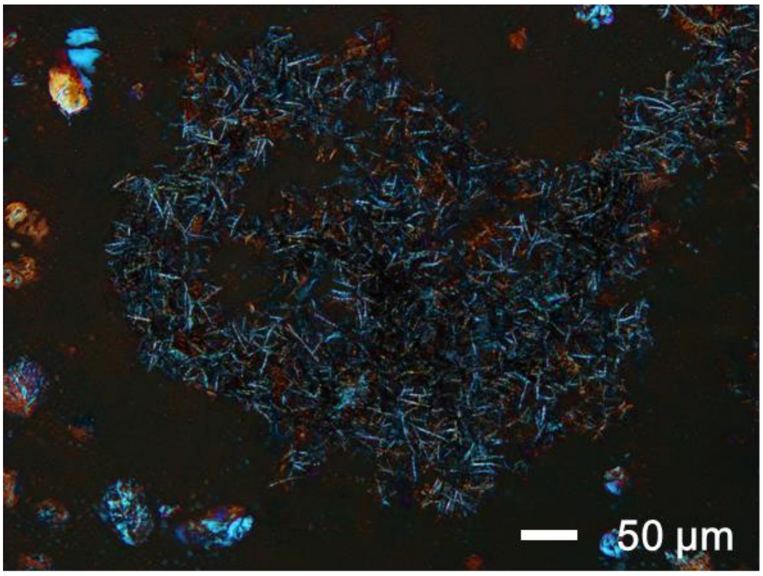

Figure S6. Polarized optical micrograph of a randomly dispersed CNT/PDA composite.

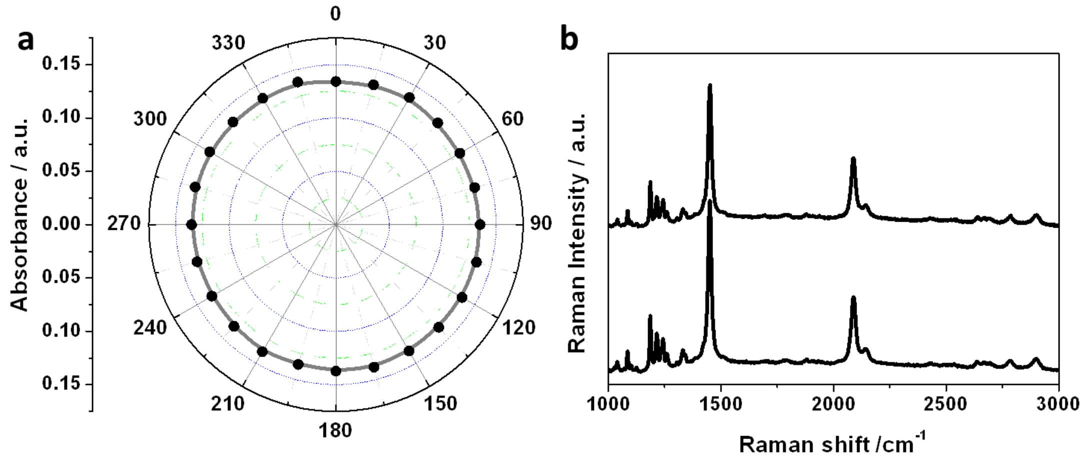

Figure S7. (a) Angle-dependent UV-Vis absorbance of a bare PDA film at ~640 nm. (b) Typical polarized Raman spectra of a bare PDA film obtained at an angle difference of 90 °.

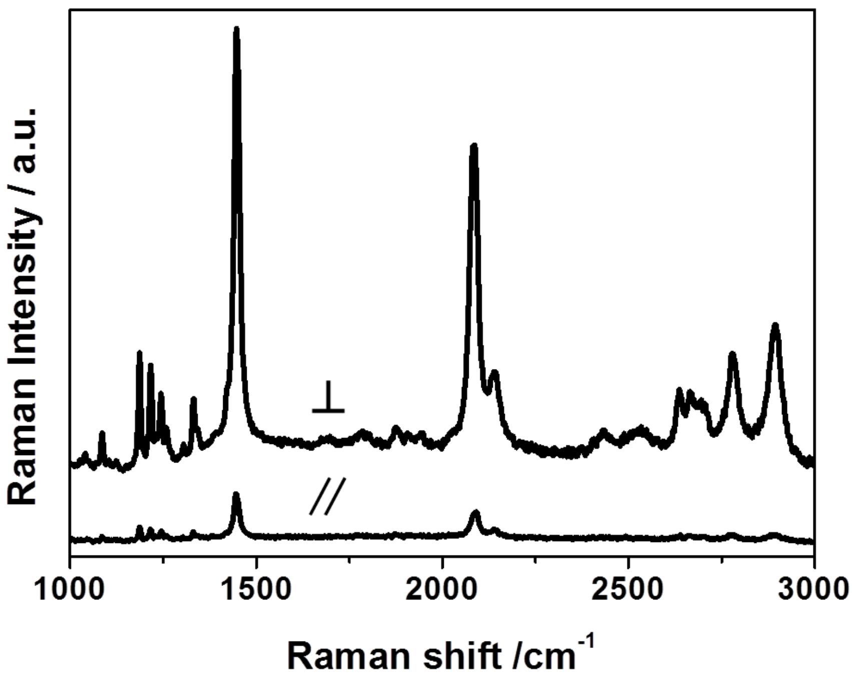

Figure S8. Typical polarized Raman spectra of a single PDA fiber in the composite film obtained at an angle difference of 90 °.

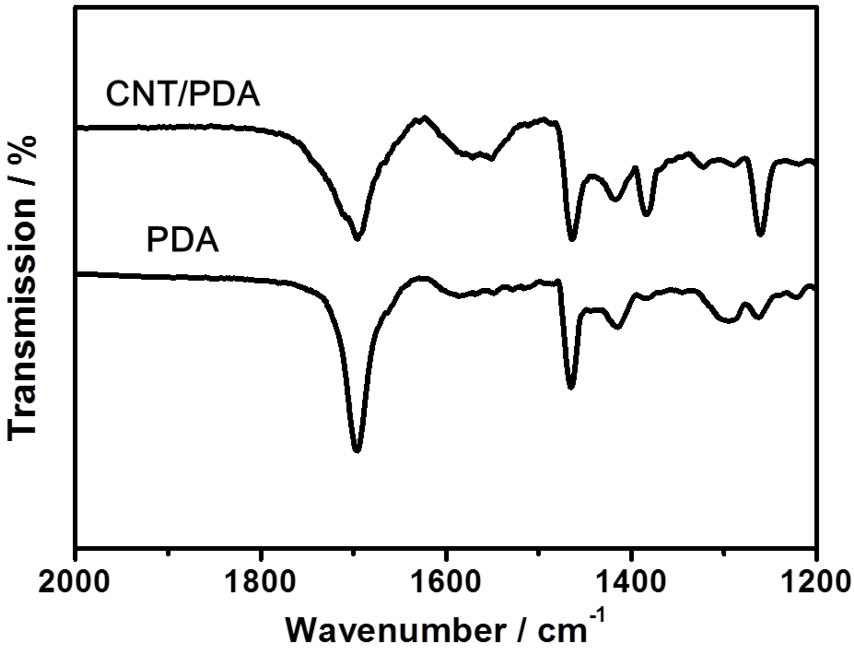

Figure S9. Fourier transform infrared spectra of the bare PDA film and the aligned CNT/PDA composite film.

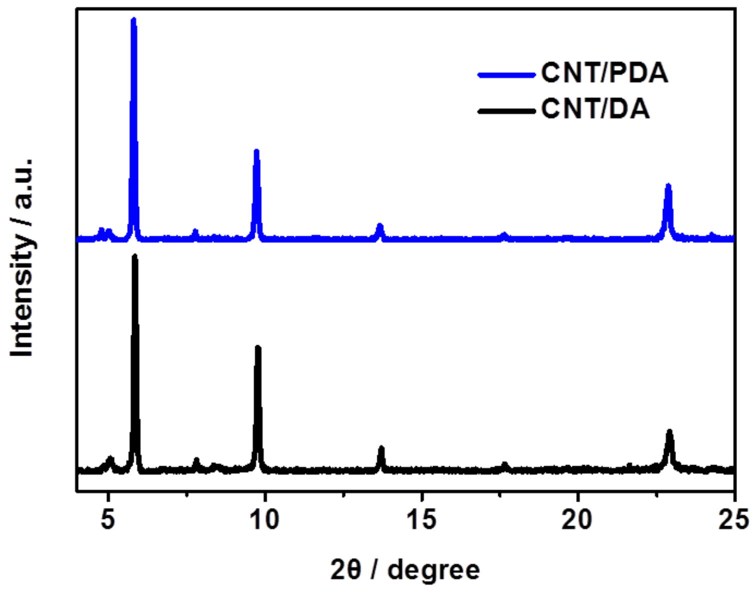

Figure S10. Powder XRD patterns of CNT/diacetylene (DA) and CNT/PDA composites.

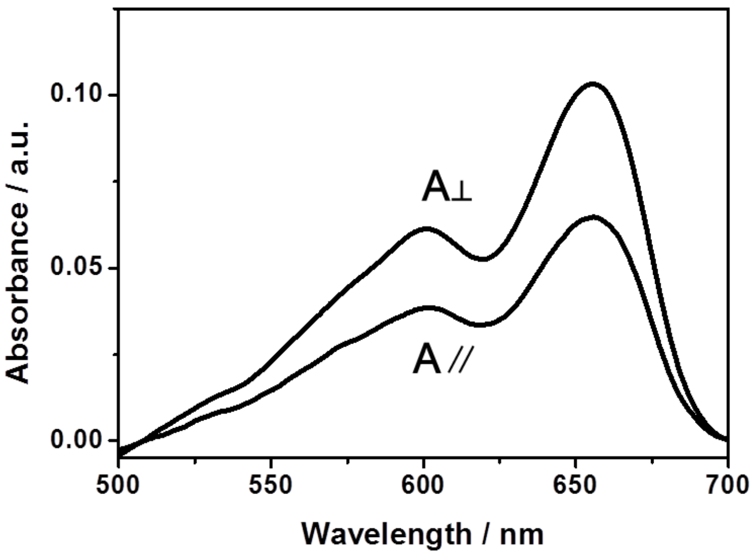

Figure S11. Polarized UV-Vis absorption spectra of PDA deposited on a rubbed polyimide substrate. // and ⊥ correspond to the directions being parallel and perpendicular to the rubbing direction, respectively.

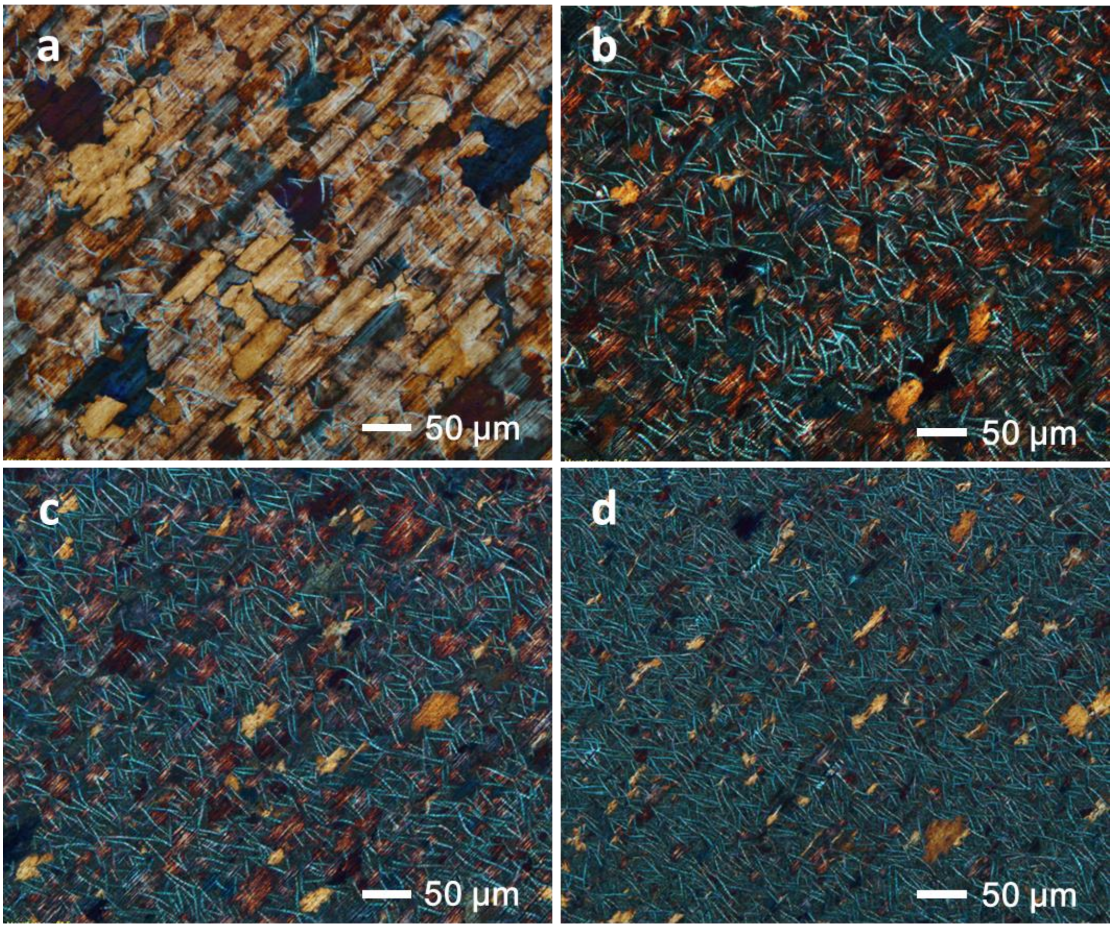

Figure S12. Polarized optical micrographs of aligned CNT/PDA composite films fabricated using CNT sheets with different thicknesses: (a) 20 nm, (b) 60 nm, (c) 80 nm and (d) 100 nm.

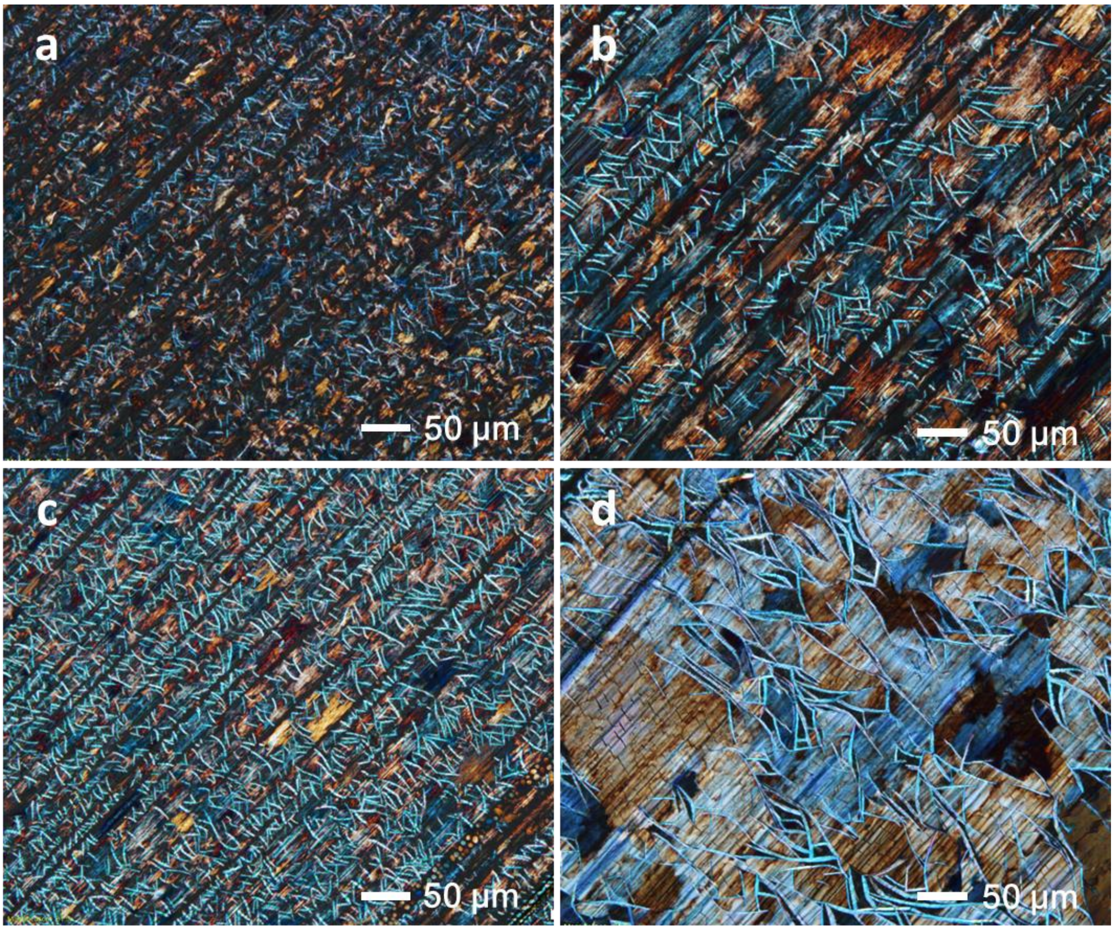

Figure S13. Polarized optical micrographs of aligned CNT/PDA composite films fabricated using diacetylenic monomer solutions of different concentrations: (a) 3 mg mL^{-1}, (b) 5 mg mL^{-1}, (c) 10 mg mL^{-1} and (d) 20 mg mL^{-1}.

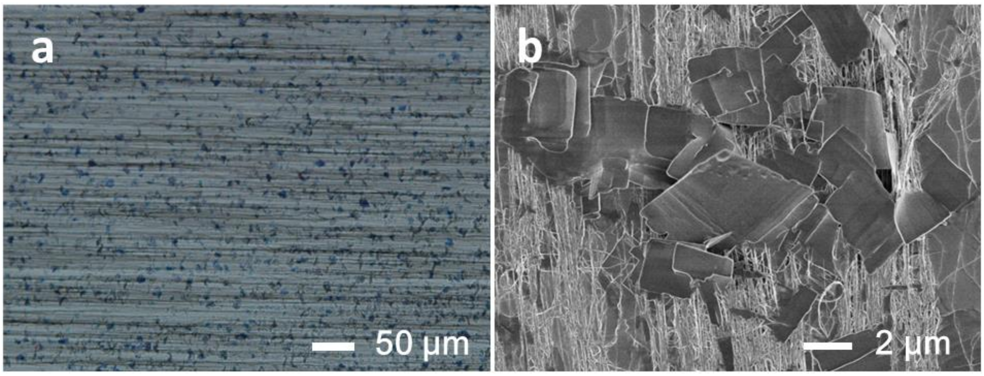

Figure S14. Aligned CNT/PDA composite films prepared by heating below the melting point of the monomer. (a) Optical micrograph. (b) SEM image.

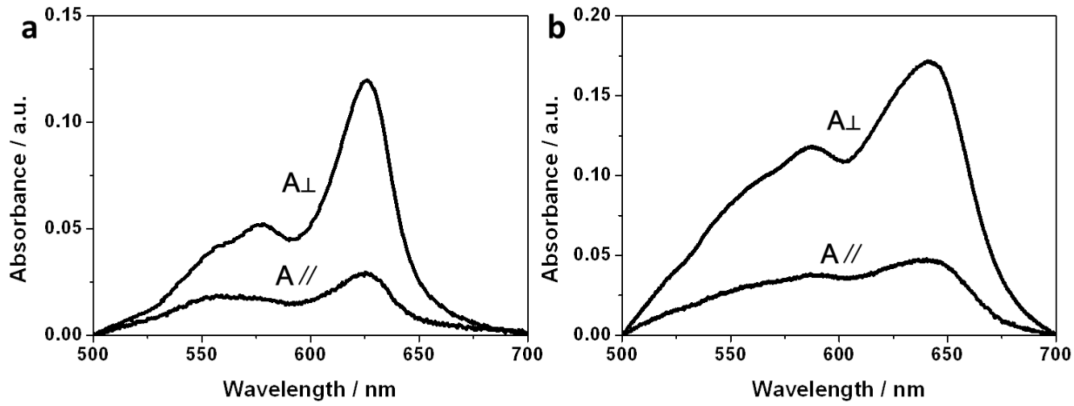

Figure S15. Polarized UV-Vis absorption spectra of aligned CNT/PDA composite films derived from (a) 5,7-octadecadiynoic acid and (b) 5,7-eicosadiynoic acid. $A_{//}$ and $A_{\perp}$ represent the absorbances in directions parallel and perpendicular, respectively, to the direction of CNT alignment.

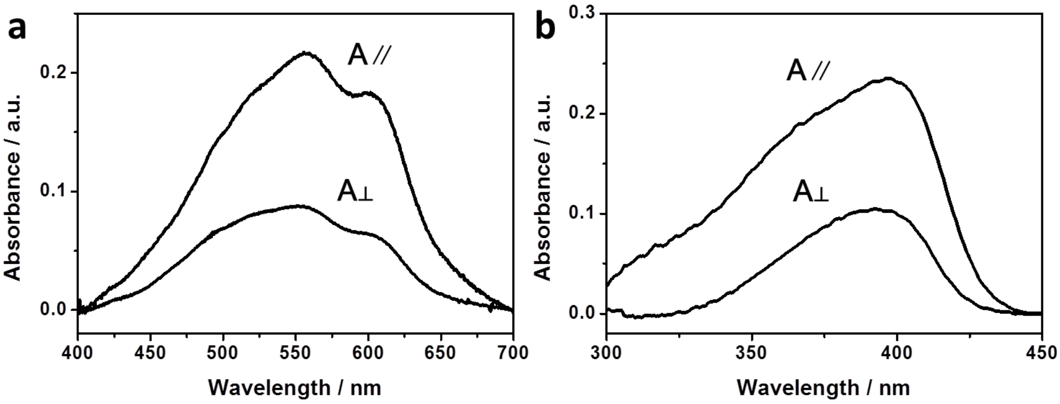

Figure S16. Polarized UV-Vis absorption spectra of aligned CNT/conjugated polymer composite films derived from (a) polythiophene and (b) polyfluorene derivatives. $A_{//}$ and $A_{\perp}$ represent the absorbance in the directions of being parallel along and perpendicular to the CNT, respectively.

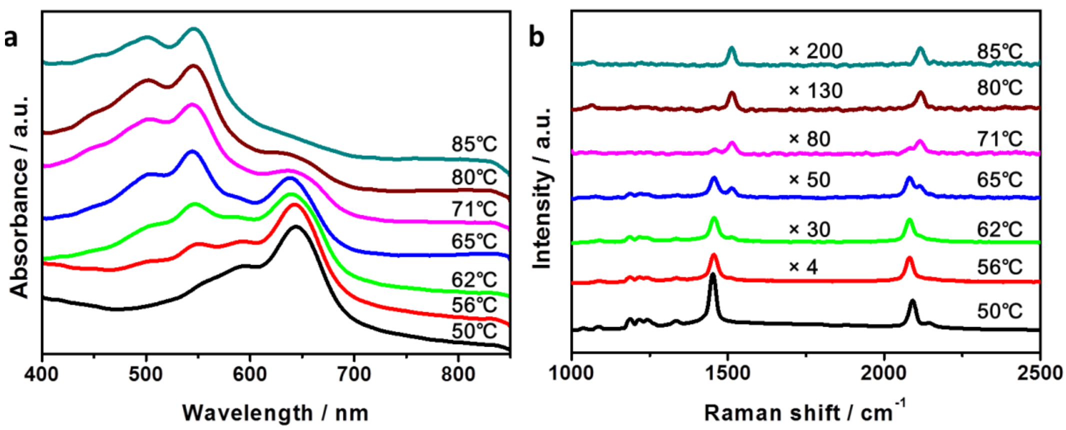

Figure S17. (a) UV−Vis absorption spectra and (b) Raman spectra of the bare PDA after being heated to various temperatures under the same conditions as in Figure 10.

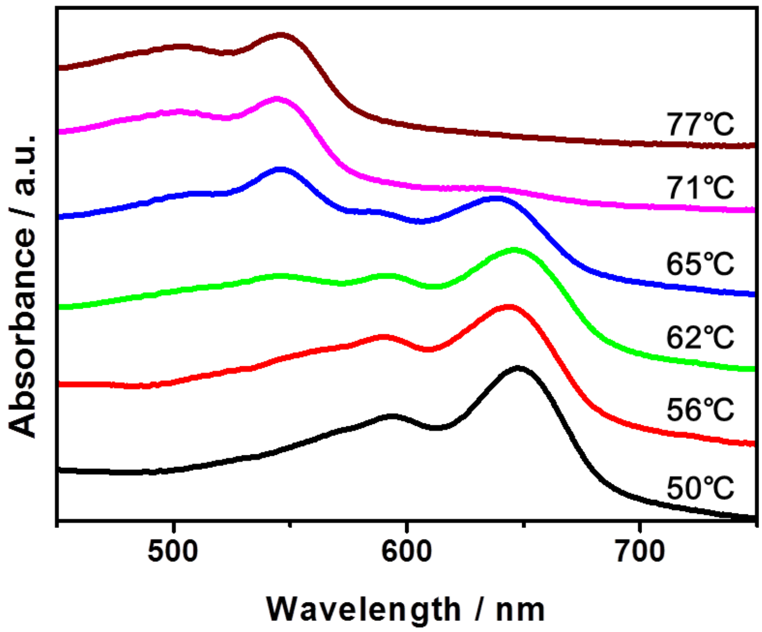

Figure S18. UV-Vis absorption spectra of the randomly dispersed CNT/PDA composite after being heated to various temperatures.

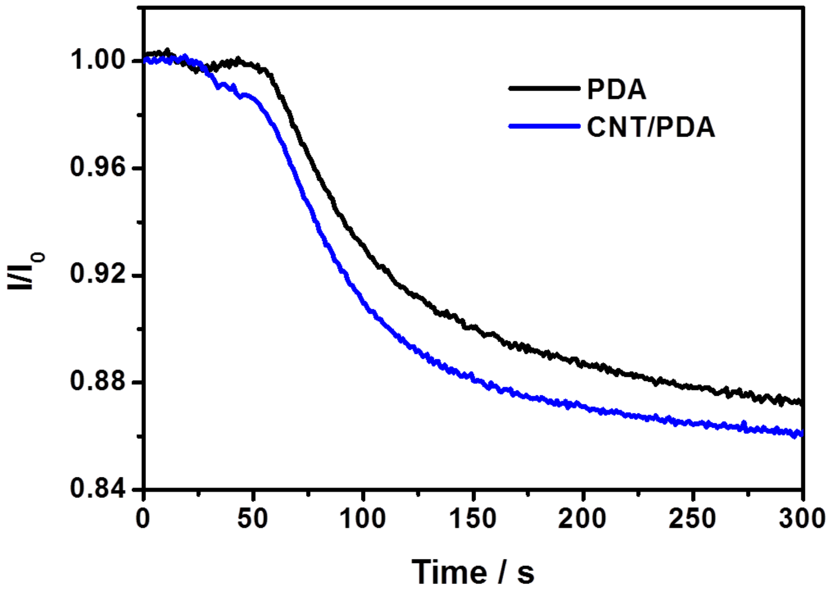

Figure S19. The change in the absorbance intensities at ~640 nm of bare PDA and the aligned CNT/PDA composite as a function of time under heating at the same temperature of 65 ℃. The spectra were acquired every 1 s. Here, I_0 and I correspond to the absorbance intensities before and after heating, respectively.

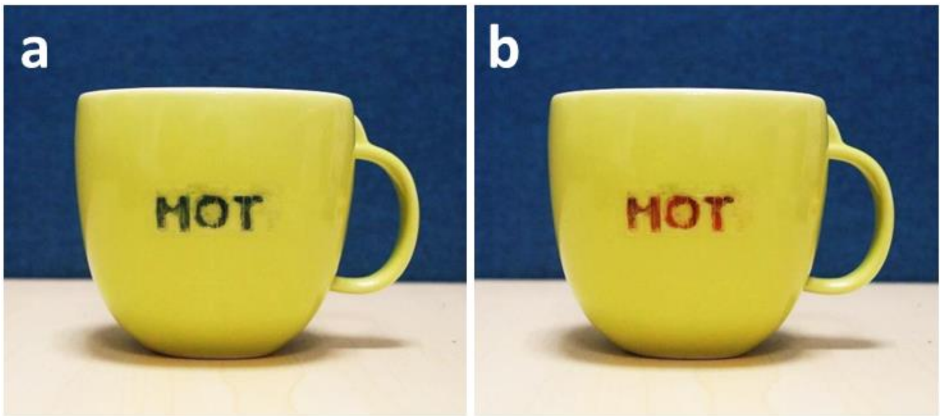

Figure S20. Photographs of a cup attached with a thermochromic warning label of "HOT" made by the aligned CNT/PDA composite film. (a) The cup filled with cold water. (b) The cup filled with hot water higher than 70 ℃.

Table S1. Properties of PDA and CNT/PDA materials from different monomers.

Material	Dichroic ratio (R)	Order parameter (S)	Color transition time / s
10,12-pentacosadiynoic acid			
PDA	/	/	~510
CNT/PDA	~10	0.75	~405
5,7-eicosadiynoic acid			
PDA	/	/	~335
CNT/PDA	~3.6	0.46	~250
5,7-octadecadiynoic acid			
PDA	/	/	~240
CNT/PDA	~4.7	0.55	~145