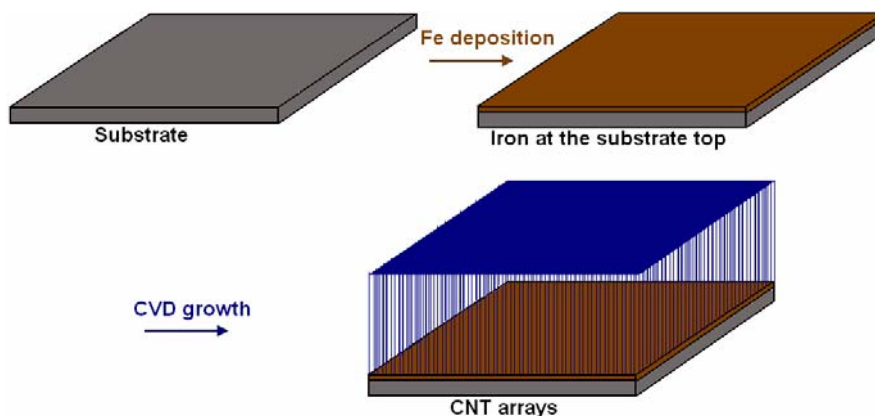


## Electrochromatic carbon nanotube/polydiacetylene nanocomposite fibres

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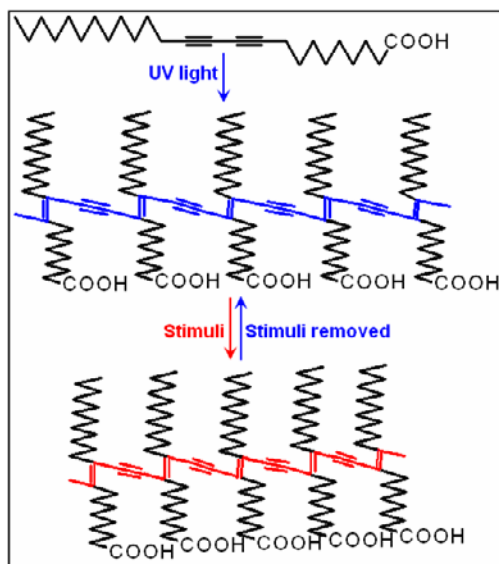
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1. Synthesis of carbon nanotube (CNT) arrays

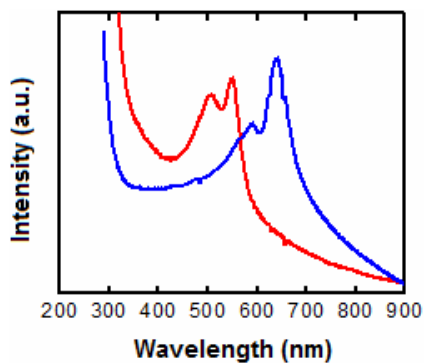


**Figure S1** Schematic illustration of the synthesis of nanotube arrays through chemical vapor deposition.

2. Topochemical polymerizations of diacetylenic building molecules and colour changes of resultant PDA molecules.

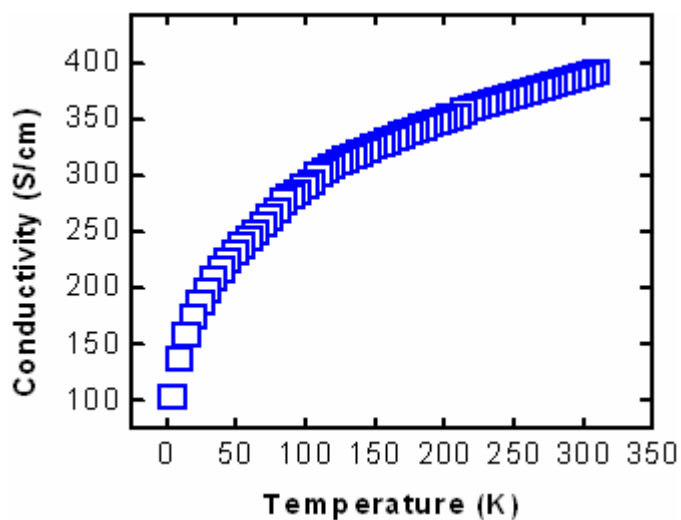


**Figure S2** Schematic illustration of topochemical polymerization and colour changes of resultant PDA.

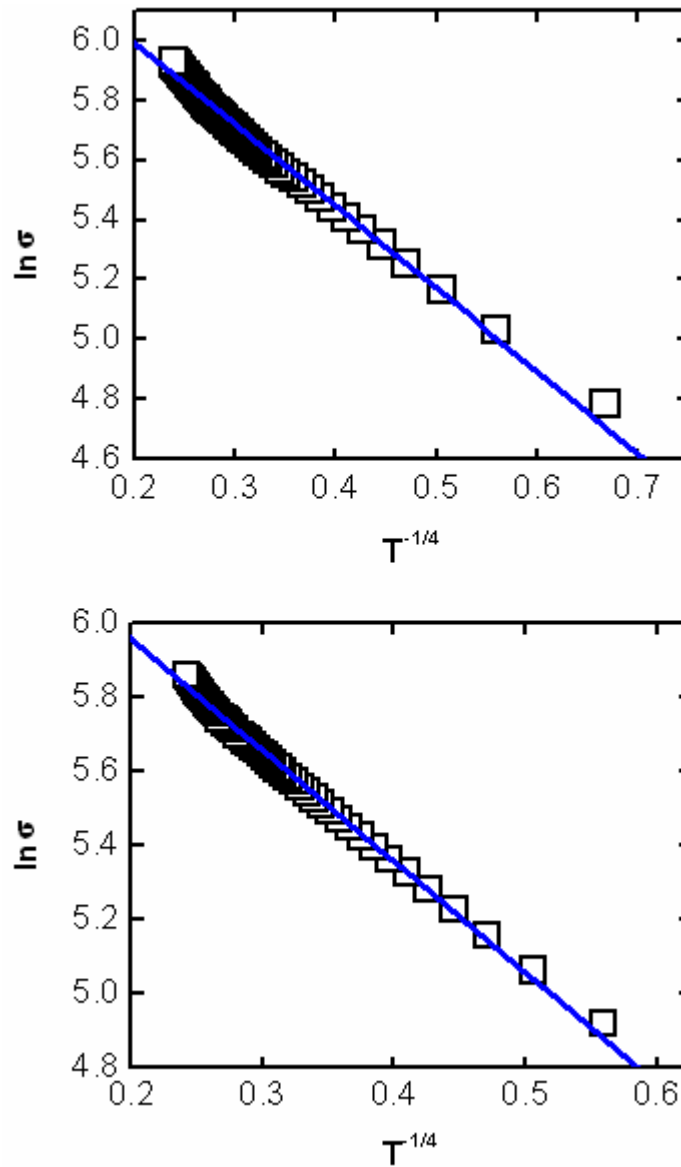


**Figure S3** Typical UV-vis spectra for blue (blue line) and red (red line) PDA.

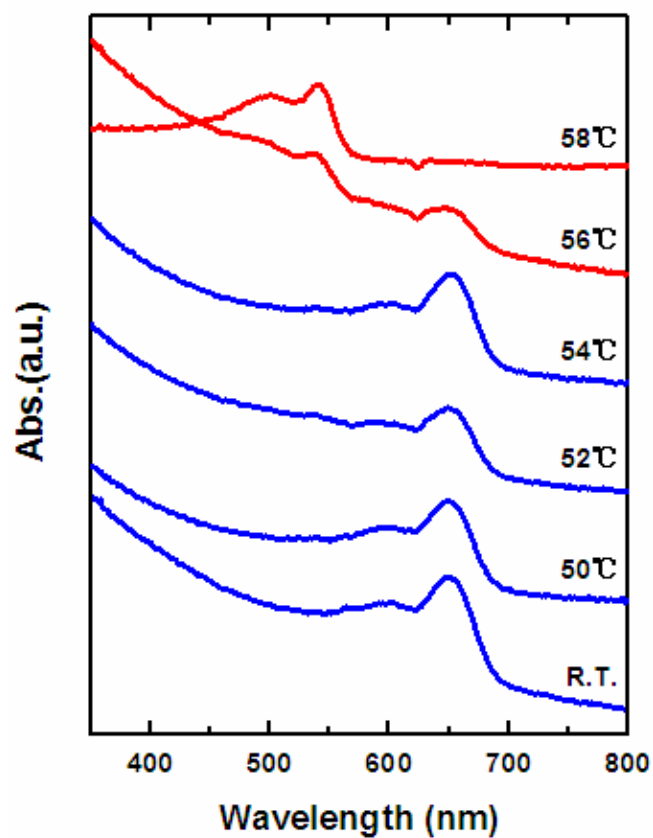
### 3. Electrical properties of CNT/PDA fibres



**Figure S4** Another measurement for temperature dependence of conductivity in CNT/PDA fiber made by a four-probe method.



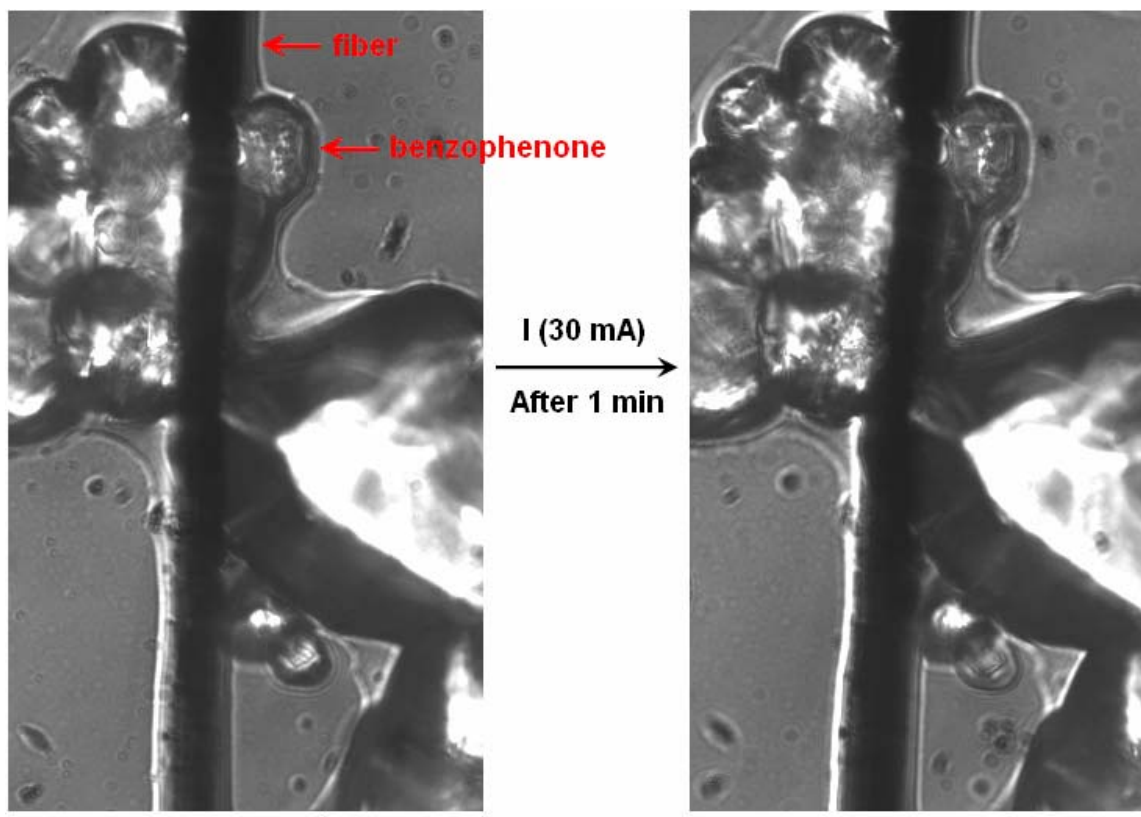
**Figure S5** Scaling of the conductivity with three-dimensional hopping model on a plot of  $\ln \sigma$  vs.  $T^{-1/4}$ . The top graph is derived from Figure 3, while the bottom graph is derived from Figure S4.

4. Thermochromatism of PDA derived from  $\text{CH}_3(\text{CH}_2)_{11}\text{CCCC}(\text{CH}_2)_8\text{COOH}$ 

**Figure S6** PDA starts to change colours at  $\sim 56$  °C confirmed by UV-vis spectra. The thermochromatism was not reversible, i.e., PDA material remained red after cooled to room temperature.

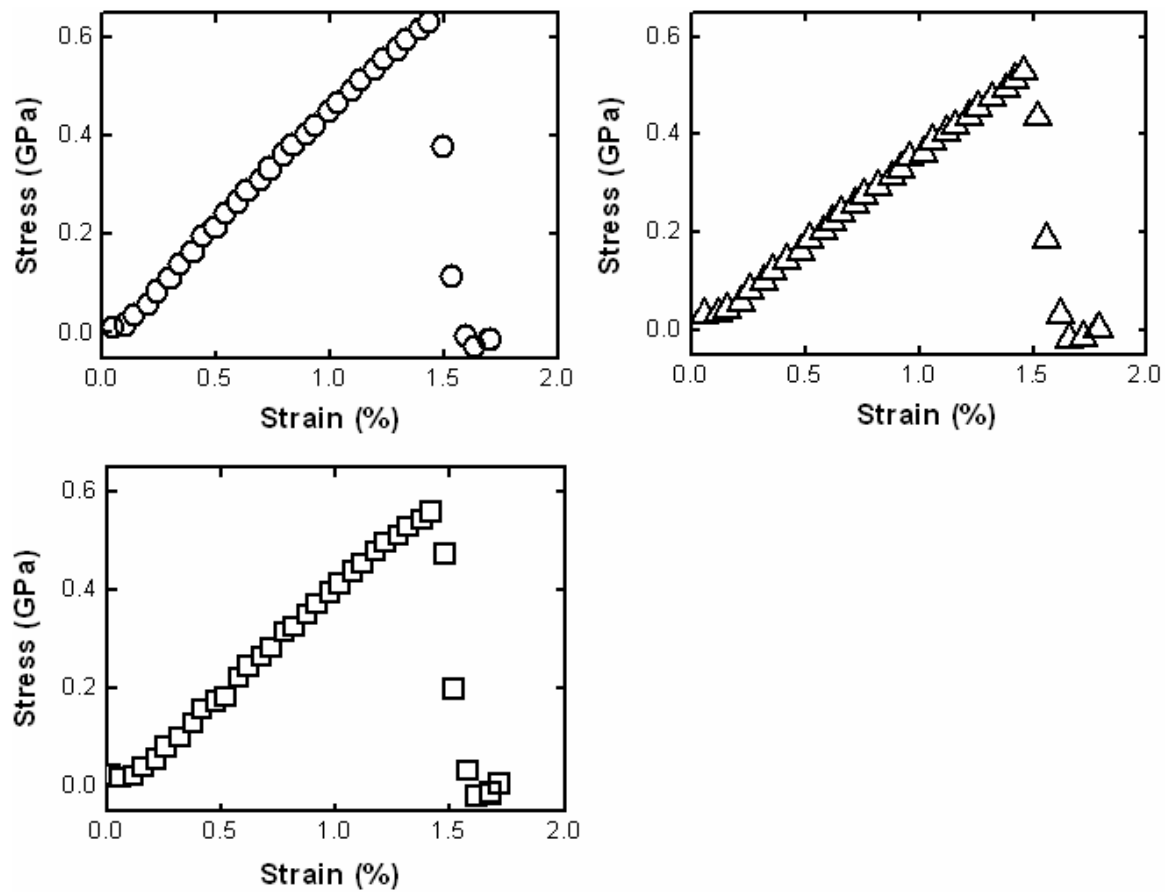
## 5. Characterization on temperature change of nanotube fibre when passed with current

As shown in Figure S7, benzophenone was coated on the outer surface of a nanotube fibre. When passed with current of 30 mA for 1 min, no melting had been observed for benzophenone closely touched to the fibre under optical microscopy (Olympus FV300). As a comparison, benzophenone was melted when heated at  $\sim 44$  °C or higher under the same conditions.



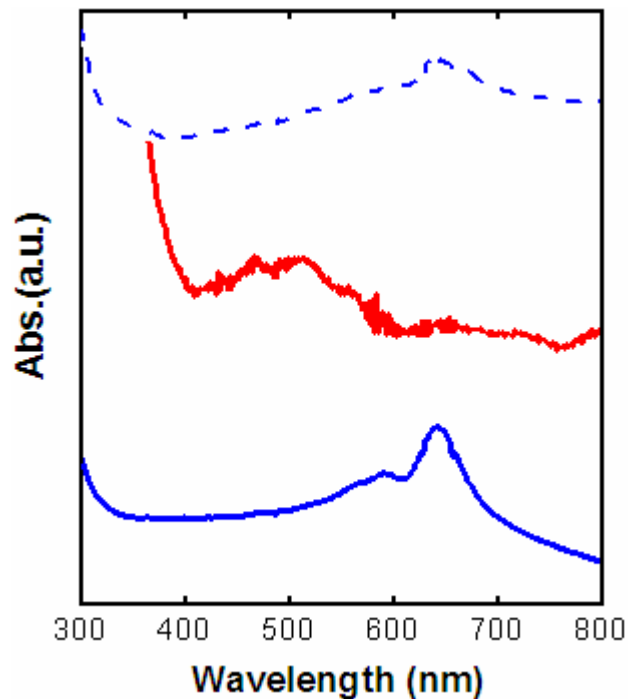
**Figure S7** Optical microscopy images before and after passed with current of 30 mA for 1 min. Scale bar corresponds to 30  $\mu\text{m}$ .

## 6. Mechanical properties of CNT/PDA fibres



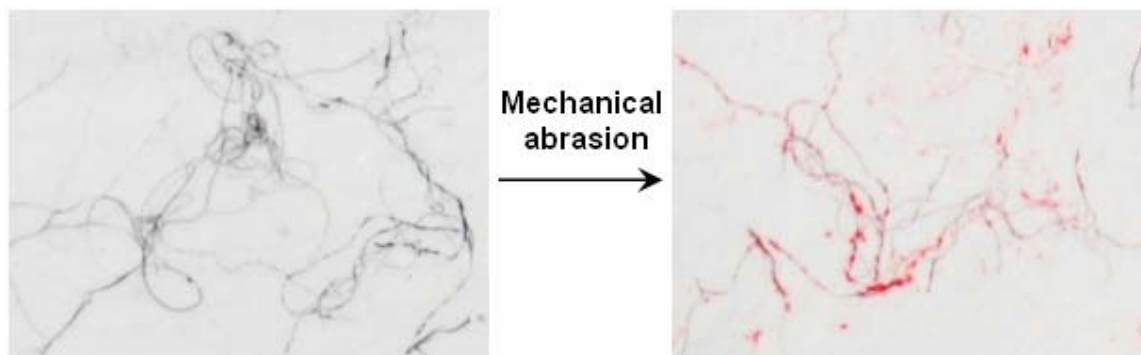
**Figure S8** Stress-strain curves of three CNT/PDA fibres with neglectable elongation.

### 7. Colour changes of CNT/PDA fibres under mechanical stress, mechanical abrasion, chemical, and vapor

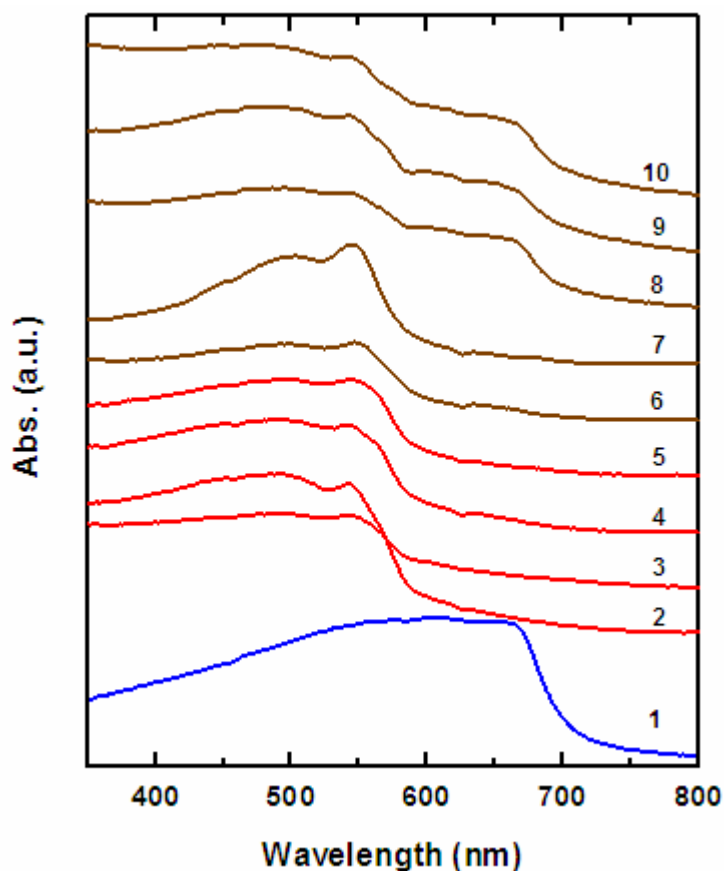


**Figure S9** UV-vis spectra of CNT/PDA fibres under mechanical stress. Solid blue line stands for as-synthesized blue material, solid red line stands for red material under mechanical stress of 0.48 GPa, and dashed blue line stands for the recovery of red material to blue after removal of stress.

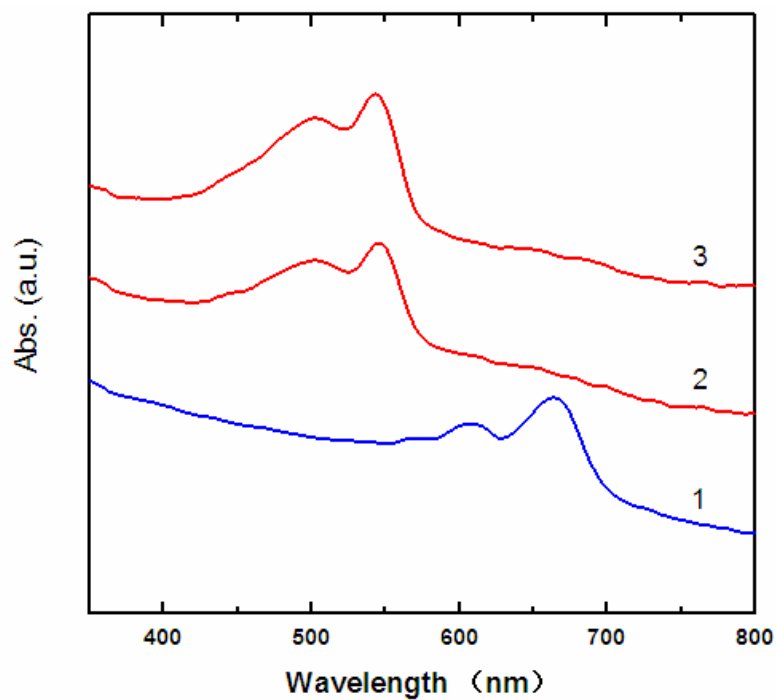




**Figure S10** Photographs of colour change of CNT/PDA fibres from blue to red under mechanical abrasion.



**Figure S11** UV-vis spectra of CNT/PDA composite before and after exposed to chemicals. (1) As-synthesized fibre; (2) exposed to tetrahydrofuran; (3) exposed to 1-methyl-2-pyrrolidinone; (4) exposed to N, N-dimethyl formamide; (5) exposed to N, N-dimethyl acetamide; (6) exposed to styrene; (7) exposed to methyl sulfoxide; (8) exposed to benzene; (9) exposed to toluene; (10) exposed to methylacrylate.



**Figure S12** UV-vis spectra of CNT/PDA composite before and after exposed to vapors. (1) As-synthesized composite; (2) exposed to tetrahydrofuran vapor; (3) exposed to N, N-dimethyl formamide vapor.