

## Supporting Information

### **An Implantable Transparent Conductive Film with Water Resistance and Ultrabendability for Electronic Devices**

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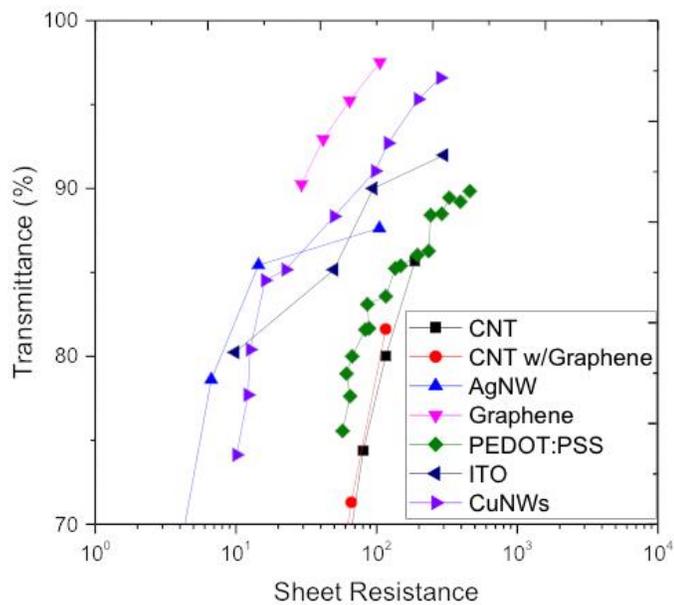
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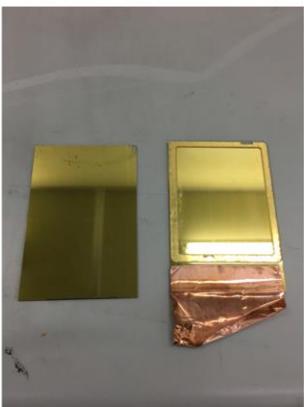
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**Figure S1.** Sheet resistance of transparent electrodes using conductive materials. Reproduced with permission from reference 13. Copyright 2011 John Wiley and Sons. Reproduced with permission from reference 54. Copyright 2011 Cambridge University Press.

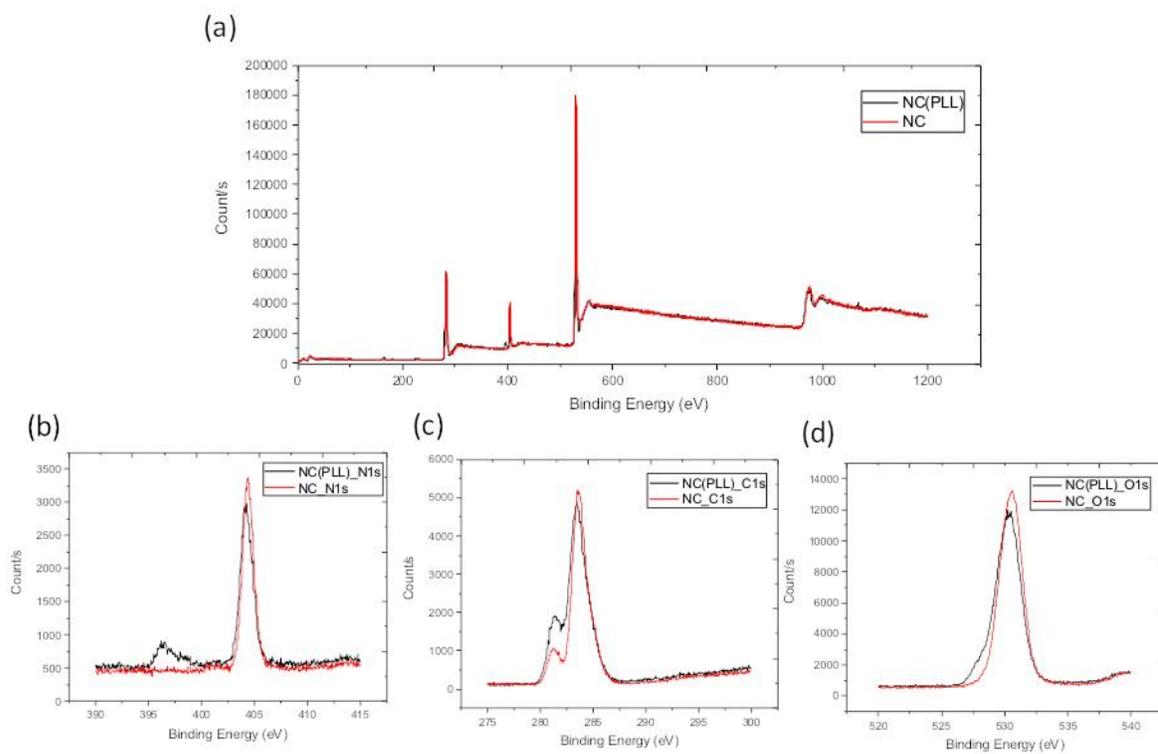
(a)



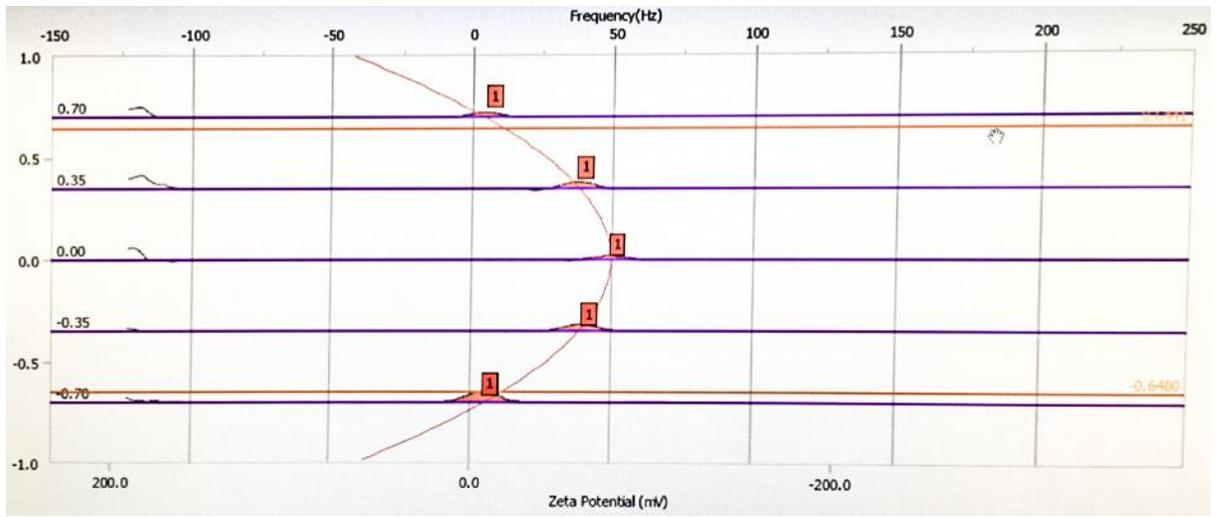
(b)



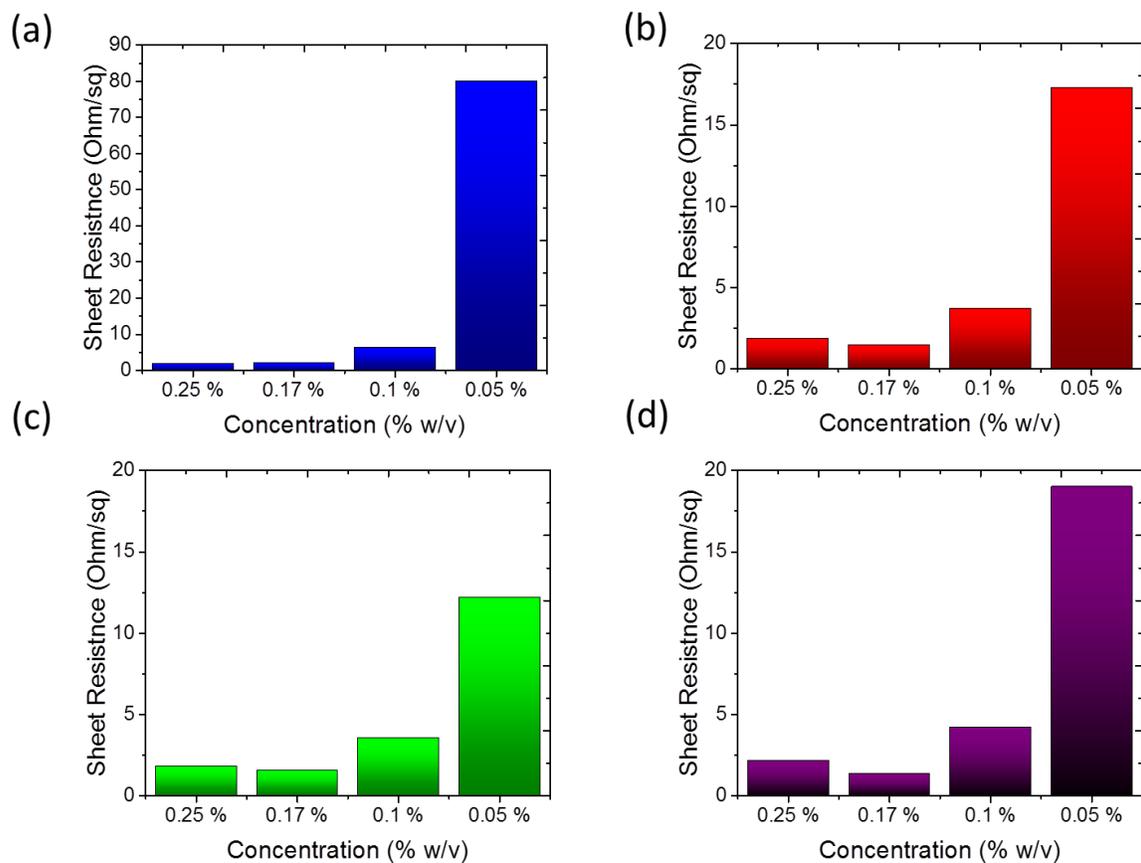
**Figure S2.** The optical images of EPD chamber. (a) left: top electrode, right: bottom chamber electrode, (b) EPD chamber, which is connected with wires (the top electrode is applied positive voltage and the bottom chamber is applied ground.)



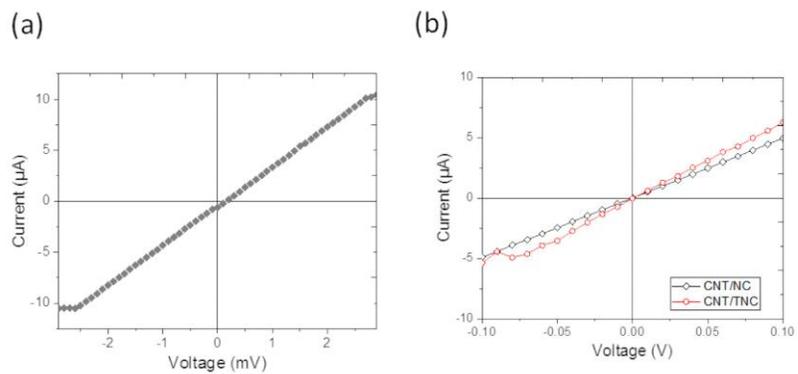
**Figure S3.** XPS data of nitrocellulose with and without coating PLL (a) whole bands, (b) N band (c) C band, (d) O band



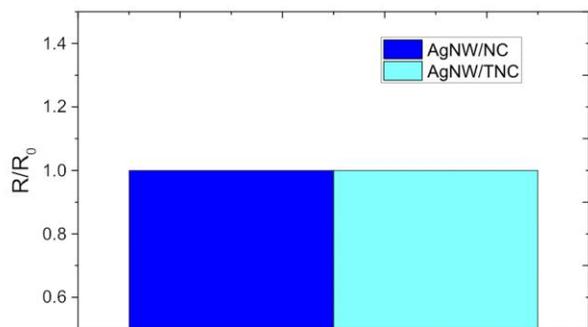
**Figure S4.** Zeta potential of AgNW suspension



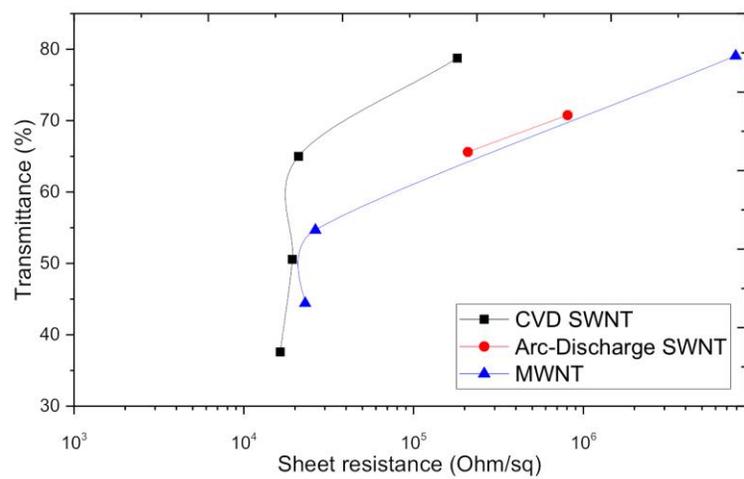
**Figure S5.** The sheet resistance by deposition times: (a) 10 seconds, (b) 20 seconds, (c) 30 seconds and (d) 60 seconds



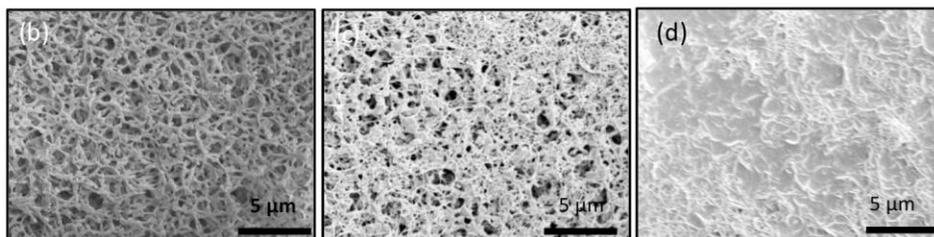
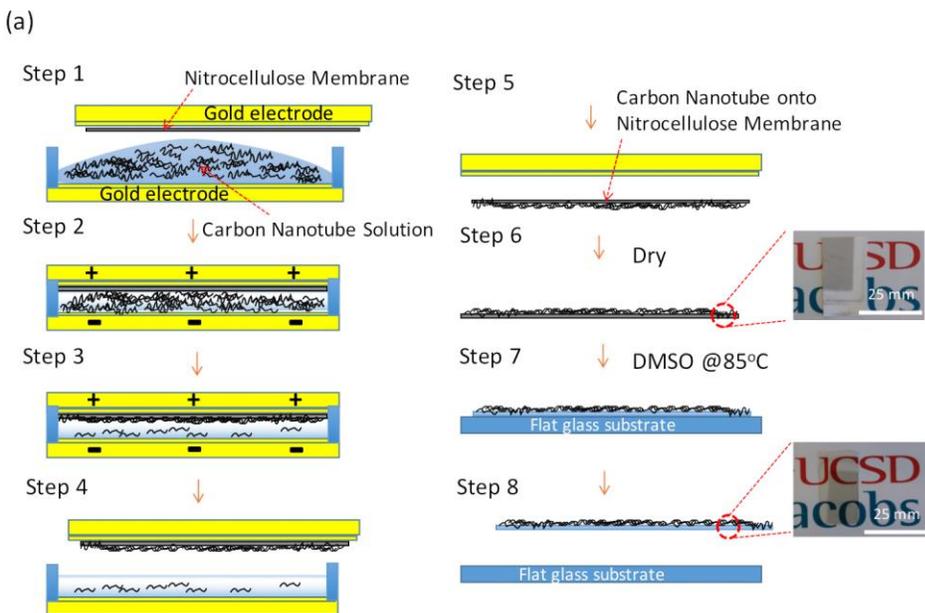
**Figure S6.** The current-voltage (IV) curves: (a) AgNW/NC (b) carbon nanotubes/NC and TNC (CNT/NC and CNT/TNC)



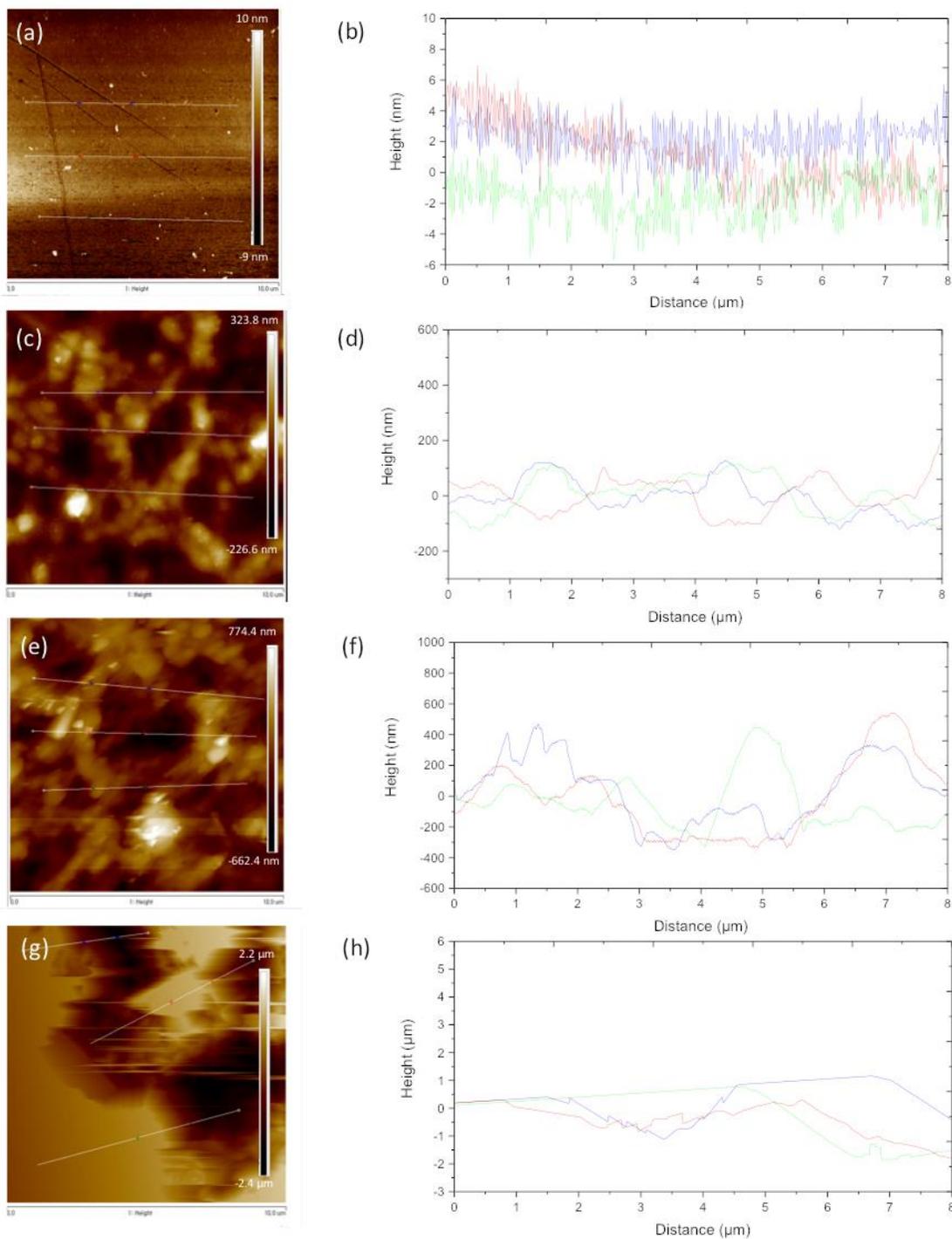
**Figure S7.** The change of sheet resistance ( $R/R_0$ ) for AgNW/NC and AgNW/TNC



**Figure S8.** Sheet resistance of transparent electrodes carbon conductive materials fabricated by our EPD method



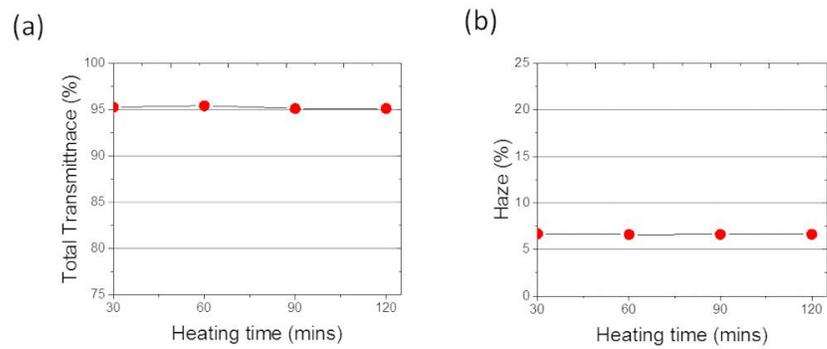
**Figure S9.** The fabrication of carbon nanotubes/TNC: (a) Process and optical images, (b) SEM image of pristine nitrocellulose, (c) SEM image of carbon nanotube deposited nitrocellulose and (d) SEM image after DMSO treatment



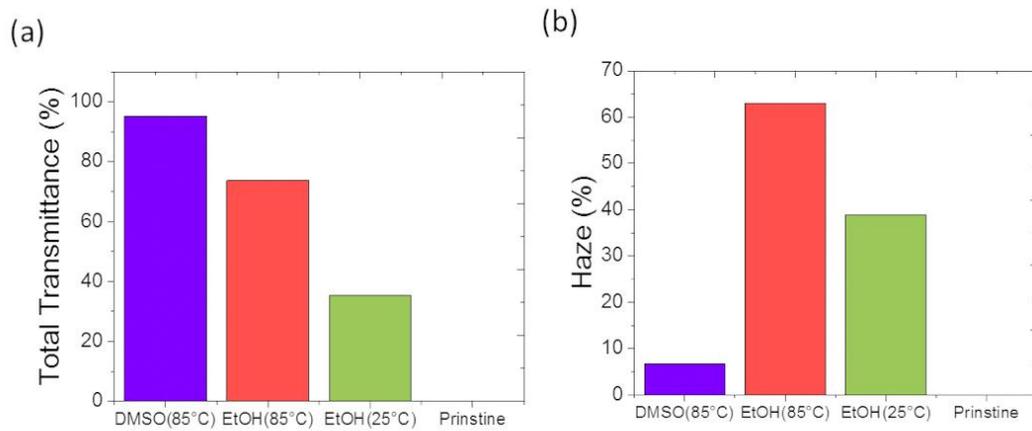
**Figure S10.** AFM images and surfaces roughness ( $R_{rms}$ ) of TNCs and NC values of AFM images: (a)-(b)TNC by DMSO (85°C), (c)-(d)TNC by EtOH (85°C), (e)-(f)TNC by EtOH (25°C), (g)-(h)pristine NC. For calculating average of  $R_{rms}$ , 3 represent lines (red, green and blue lines) of each images are selected.



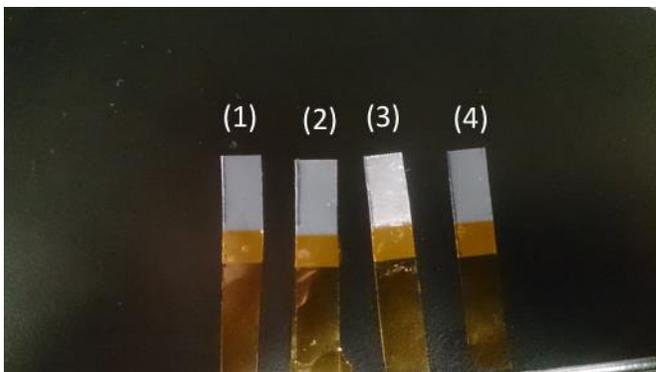
**Figure S11.** Optical images of 95 % EtOH evaporation process (a) before the process, (b) during the process and (c) after the process



**Figure S12.** Total transmittance and haze at 85°C for 2 hours (a) Total transmittance of TNC fabricated by DMSO, (b) Haze of TNC fabricated by DMSO

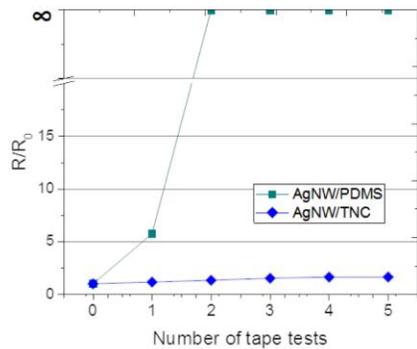


**Figure S13.** Total transmittance and haze of TNC fabricated by diverse solvents (a) Total transmittances, (b) Hazes

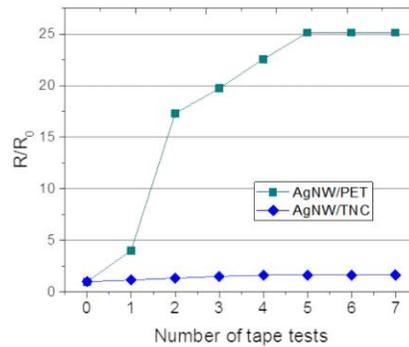


**Figure S14.** Optical images of 3M tape test (1), (4) 3M tape before the test, (2) 3M tape after AgNWs/TNC peel-off and (3) 3M tape after AgNWs/NC peel-off

(a)



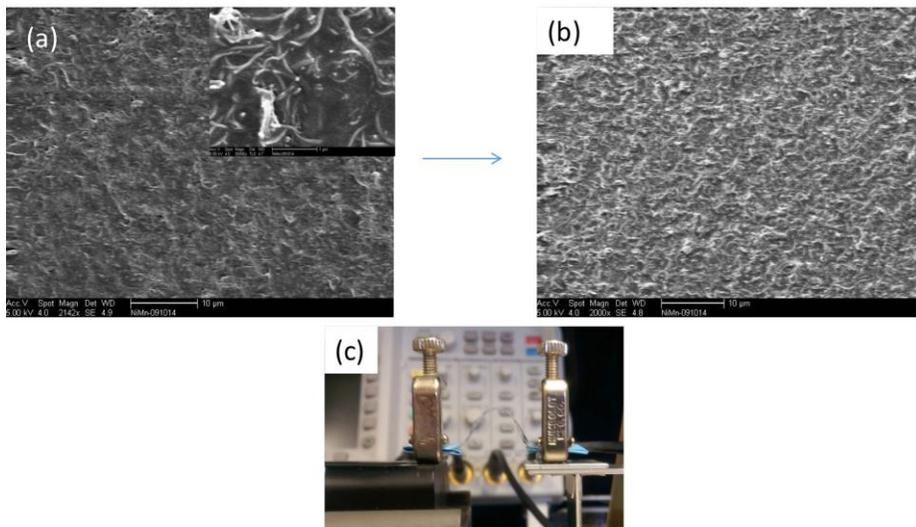
(b)



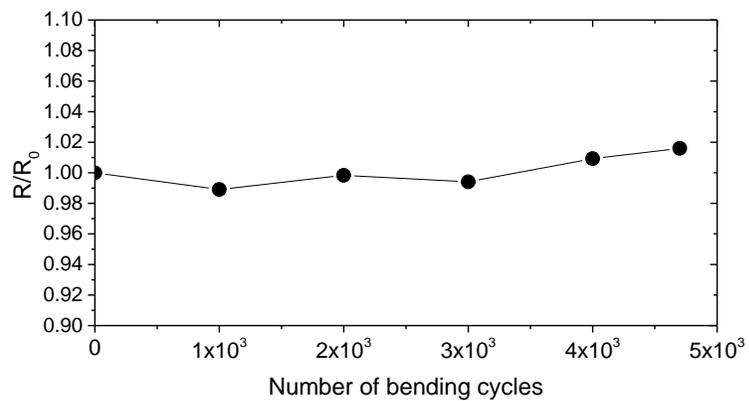
**Figure S15.** The change of resistances by 3M tape peel-off test of (a) AgNW/PDMS and (b) AgNW/PET, which are fabricated by spray (Model S622, Master Airbrush, Co.).

**Table S1** Comparison of mechanical test

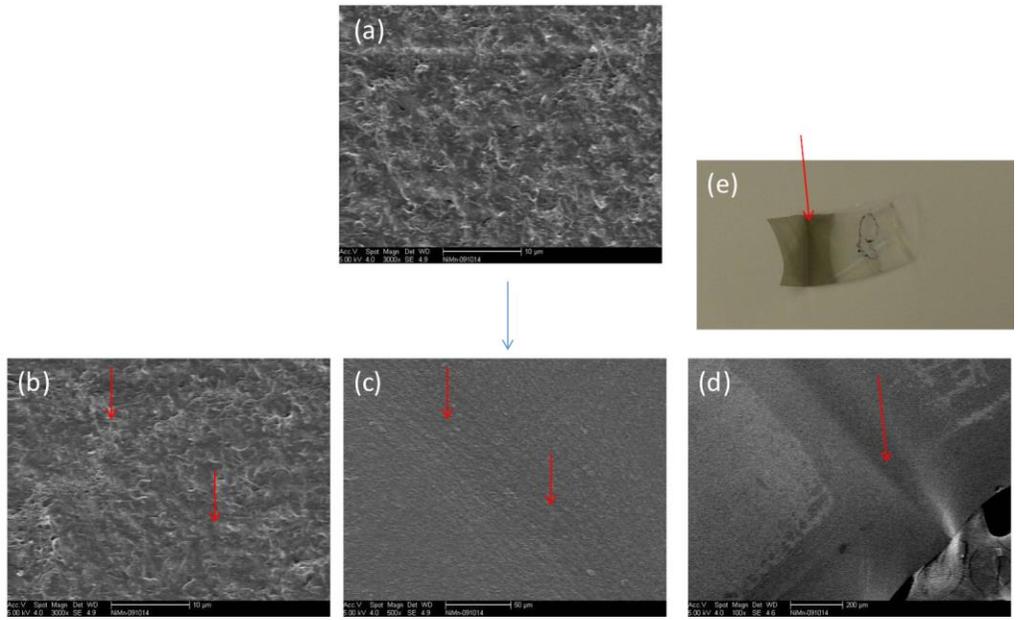
Test	Test condition	R/R <sub>0</sub> of AgNW/TNC	R/R <sub>0</sub>	Reference
Bending	-180°	0.85	0.85 (G/G <sub>0</sub> )	Ref 56
Folding	-180° (inside)	1.13	0.4 (G/G <sub>0</sub> )	Ref 56
Compressive strain	100%	0.83	1.4	Ref 57
Twist angle	90°	0.97	1.7	Ref 57
3M tape peel-off	9 times	1.7	1.4	Ref 35



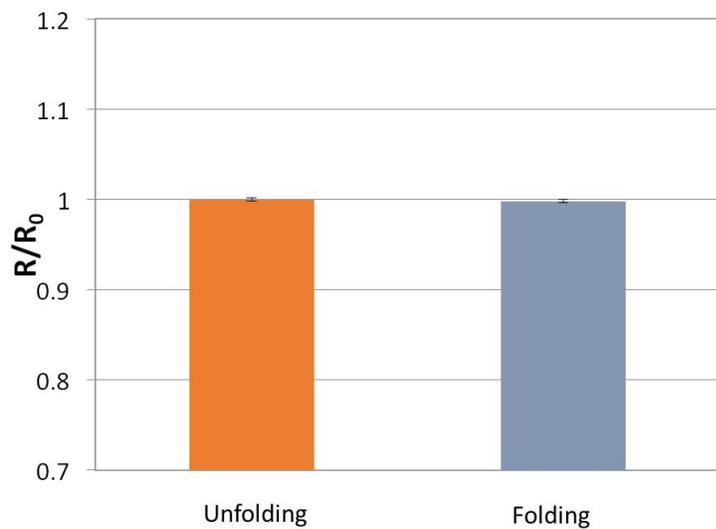
**Figure S16.** Bending test of carbon nanotubes/TNC: (a) SEM image before bending, (b) SEM image after bending (4.7K times) and (c) Optical image of bending test. (300°)



**Figure S17.** The ratio of change for resistance( $R/R_0$ ) for bending cycles of carbon nanotubes/TNC



**Figure S18.** (a)-(d) SEM images of carbon nanotube/TNC and (e) optical image of carbon nanotubes/TNC under folding (red arrow: folded line)



**Figure S19.** The change of sheet resistance before/after folding of carbon nanotubes/TNC