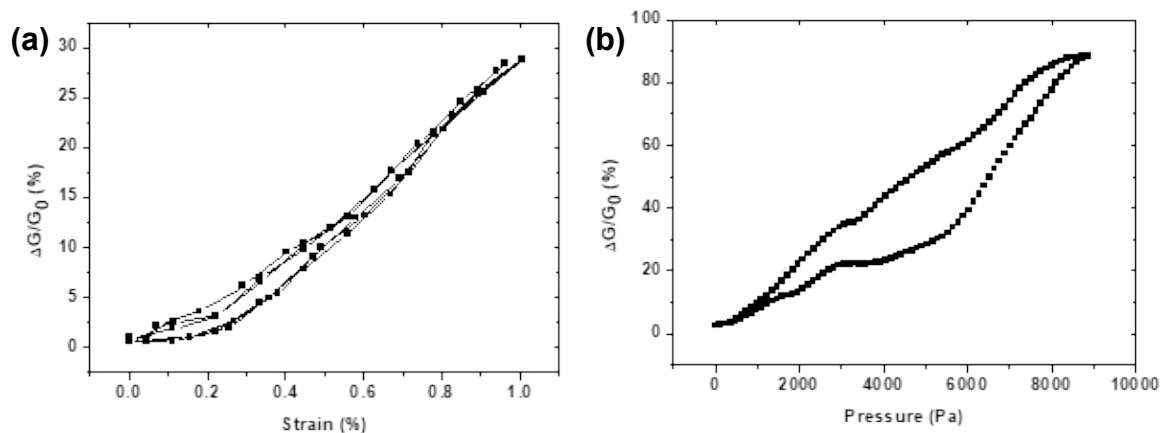


## Supporting Information

# Highly washable e-textile prepared by ultrasonic nanosoldering of carbon nanotubes onto polymer fibers

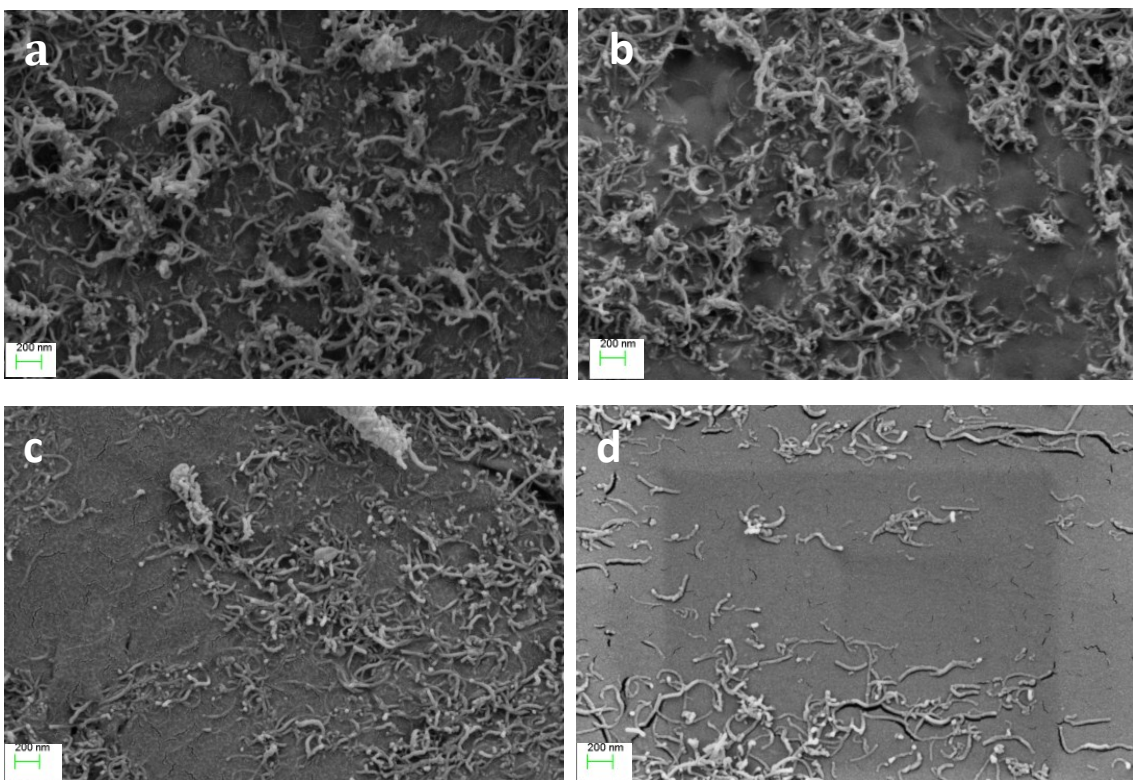
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117576.



**Figure S1.** Hysteresis loop of relative change in conductance of CNTs-NWF upon loading and unloading of (a) 1% of strain and (b) 8.86 kPa of pressure.

Figure S2a showed the surface of LDPE ( $T_g \sim -125$  °C) was densely soldered with CNTs. The surface SEM images of latex ( $T_g \sim -70$  to  $-40$  °C) and polypropylene (PP) ( $T_g \sim 0$  °C) were shown in Figure S2b and S2c, respectively. Both of their surfaces were partially covered by CNTs, yet the depth of penetration and amount of CNTs on latex was obviously more and deeper than that on PP. Moreover, there were some small cracks observed on PP surface. In Figure S2d, only small amount of CNTs were laying on the polyethylene terephthalate (PET) ( $T_g \sim 76$  °C) surface, and very few of them were shallowly submerged in the polymer matrix. It is noteworthy that there are many obvious cracks appeared almost directly beneath the laying CNTs. The surface SEM images clearly demonstrated that the polymer with lower  $T_g$  is more susceptible to the ultrasonic nanosoldering of CNTs.



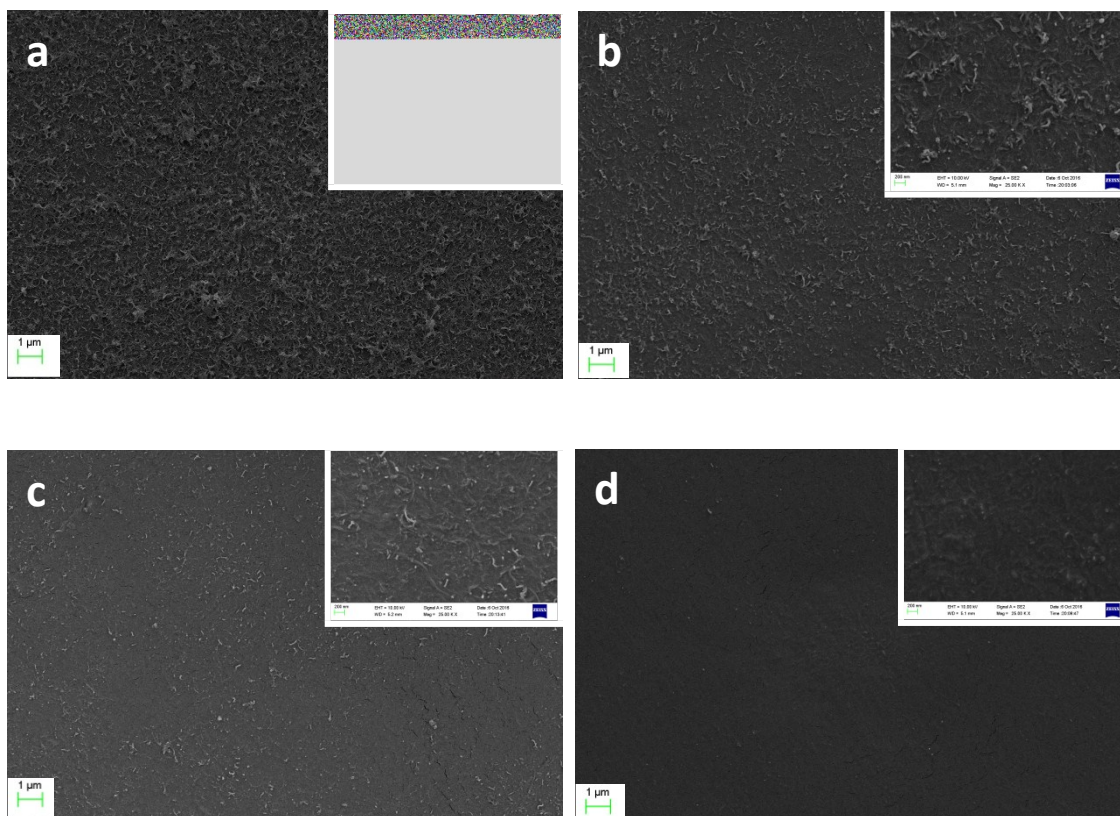
**Figure S2.** Surface SEM images of (a) LDPE, (b) latex, (c) PP and (d) PET substrates. Polymer substrates were subjected to ultrasonication in a 0.1 mg/mL MWCNTs water dispersion for 15 min. The temperature was maintained at 70 °C during ultrasonication.

The temperature of the MWCNTs dispersion was maintained at 0 °C, 25 °C, 40 °C, 55 °C and 70 °C respectively. LDPE films after ultrasonication were characterized by SEM in Figure S3a-e, and the sheet resistances of LDPE films after ultrasonication were measured by four-point probes method and the plotted in Figure S3f. With higher temperature, more CNTs are deposited on the polymer surface, and the sheet resistance is lower.

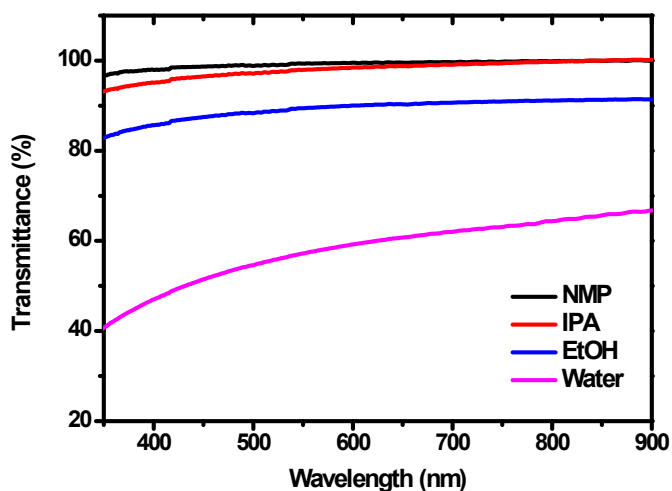




The ultrasonic nanosoldering of CNTs is occurred in liquid medium. The solvent used to disperse CNTs may play an important role. Four solvents were tested to prepare MWCNTs dispersion, namely water, ethanol, isopropyl alcohol (IPA) and N-Methyl-2-pyrrolidone (NMP). MWCNTs were dispersed in the four solvents with the same concentration of 0.1 mg/mL. LDPE films were put into the four MWCNTs dispersions respectively, and subjected to ultrasonication while other conditions remain constant. The LDPE films after ultrasonication were characterized by SEM (Figure S4) and UV-Visible spectrophotometer (Figure S5).

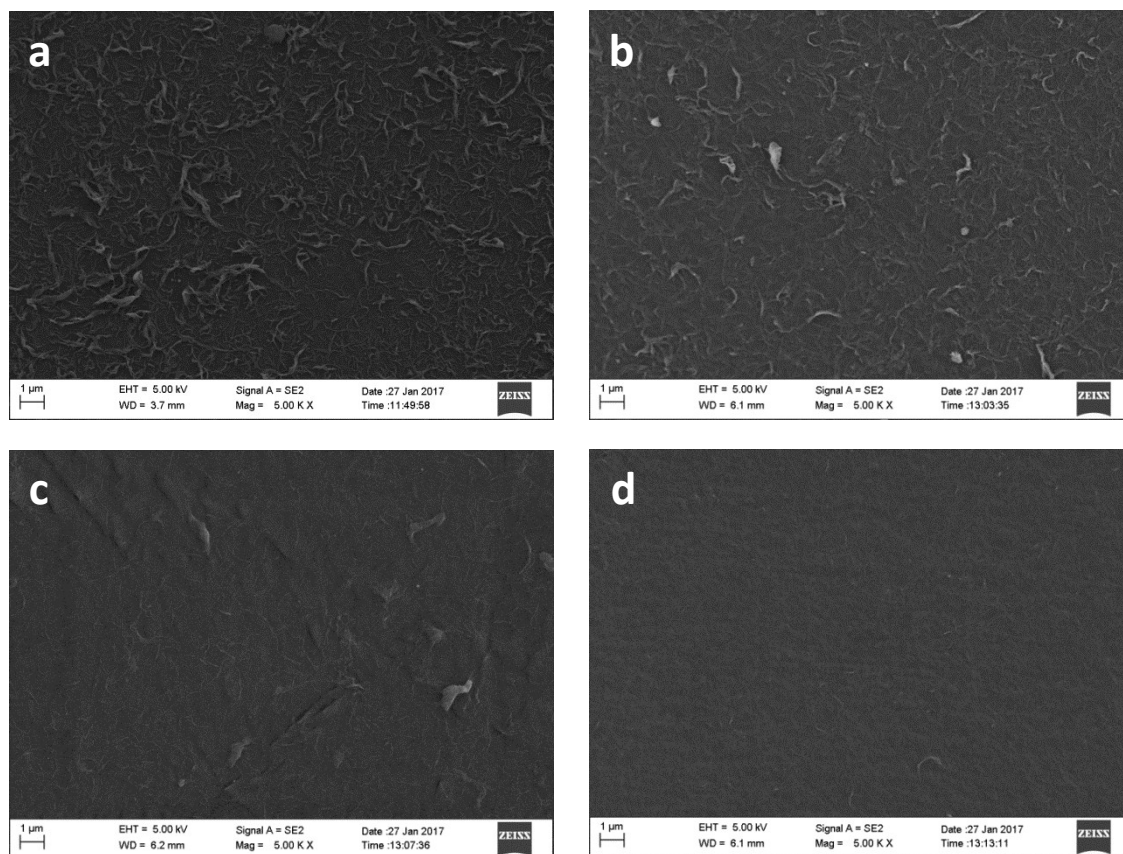


**Figure S4.** Surface SEM images of LDPE films subjected to ultrasonication in a 0.1 mg/mL MWCNTs dispersion in (a) water, (b) ethanol, (c) IPA and (d) NMP for 15 min, respectively. The temperature was maintained at 0 °C during ultrasonication.

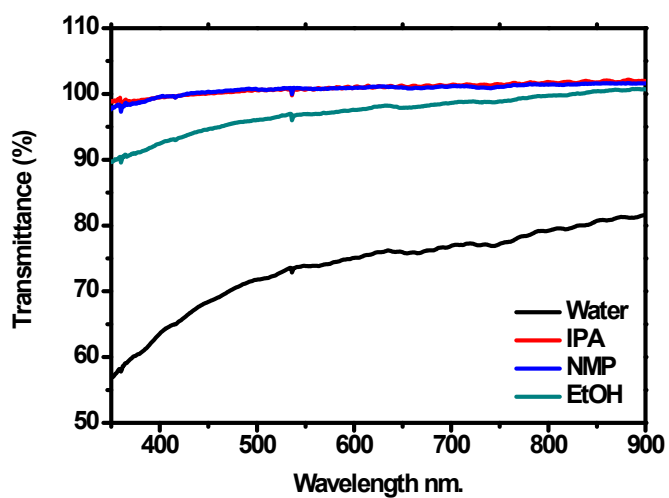


**Figure S5.** Transmittance spectra of CNTs-LDPE films fabricated in MWCNTs dispersions with various solvents.

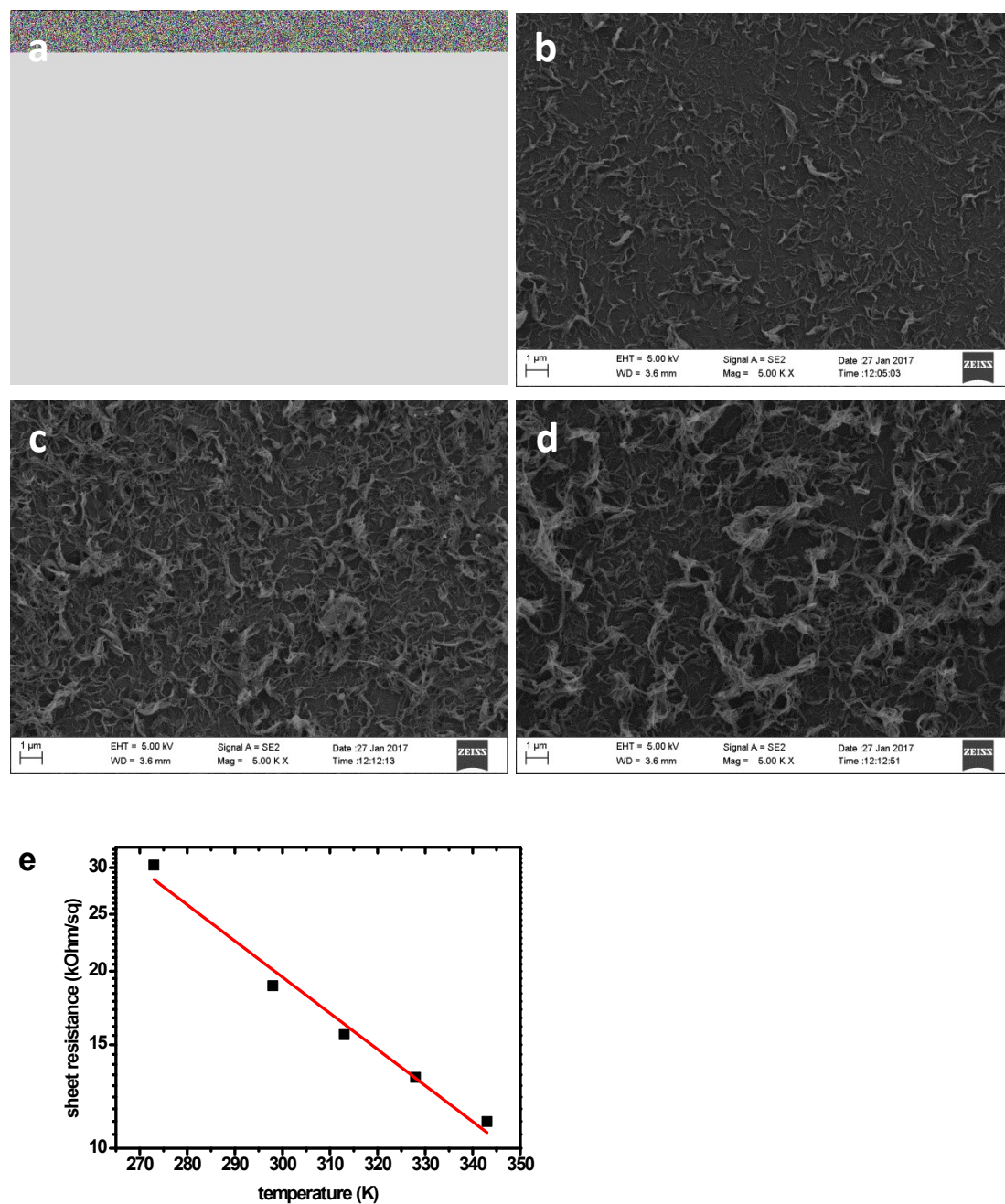
Single-walled CNTs (SWCNTs) can be processed by the same method as well, and similar results were obtained as shown in Figure S6, S7 and S8. However, SWCNTs were bundled together if there was no surfactant added in the system during processing. Although the addition of surfactant such as sodium dodecylbenzenesulfonate (SDBS) could help debundle SWCNTs, it would further complicate the system and hinder us from understanding the mechanism of the ultrasonic soldering process. Thus, the analysis of this paper was mainly based on MWCNTs results.



**Figure S6.** Surface SEM images of LDPE films subjected to ultrasonication in a 0.1 mg/mL SWCNTs dispersion in (a) water, (b) ethanol, (c) IPA and (d) NMP for 15 min, respectively. The temperature was maintained at 0 °C during ultrasonication.



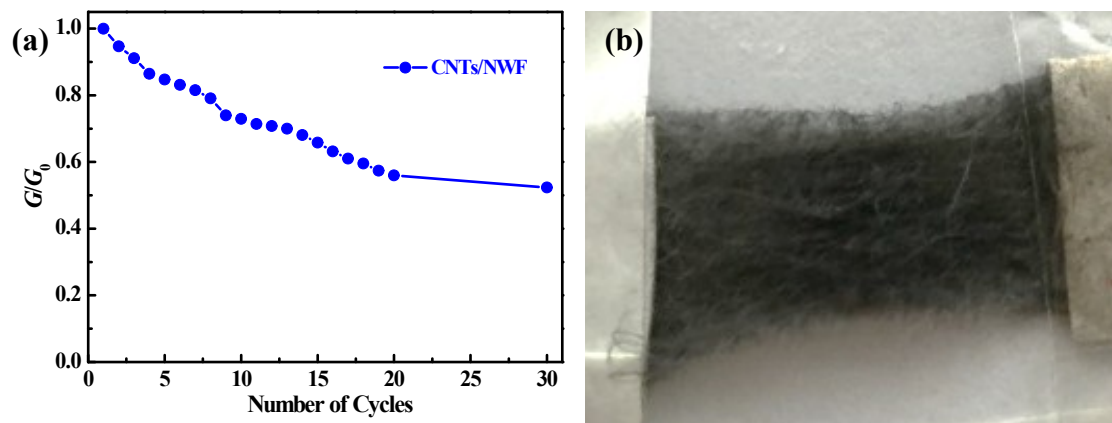
**Figure S7.** Transmittance spectra of CNTs-LDPE films fabricated in SWCNTs dispersions with various solvents.



**Figure S8.** Surface SEM images of LDPE films subjected to ultrasonication in a 0.1 mg/mL SWCNTs water dispersion for 15 min. The temperatures were maintained at (a) 0 °C, (b) 40 °C,



(c) 55 °C and (d) 70 °C during ultrasonication, respectively. (e) Sheet resistance of SWCNTs-LDPE films vs temperature.



**Figure S9.** (a) Relative conductance of CNTs-NWF upon peeling by scotch tape. (b) Optical image of CNTs-NWF after 30 times of peeling.

After 30 times peeling, the conductance is over 50% of its original value. However, the reduction of conductance was main attributed to the physical destruction of the conductive network of CNTs-NWF. As shown by the optical image of CNTs-NWF after 30 times peeling (Figure S9b), the adhesives of the tape pulled out and broke the fine NWF fibers from the fabric.