Supplementary Information

Ecofriendly Screen Printing of Silver Nanowires Ink for Flexible and Stretchable Electronics

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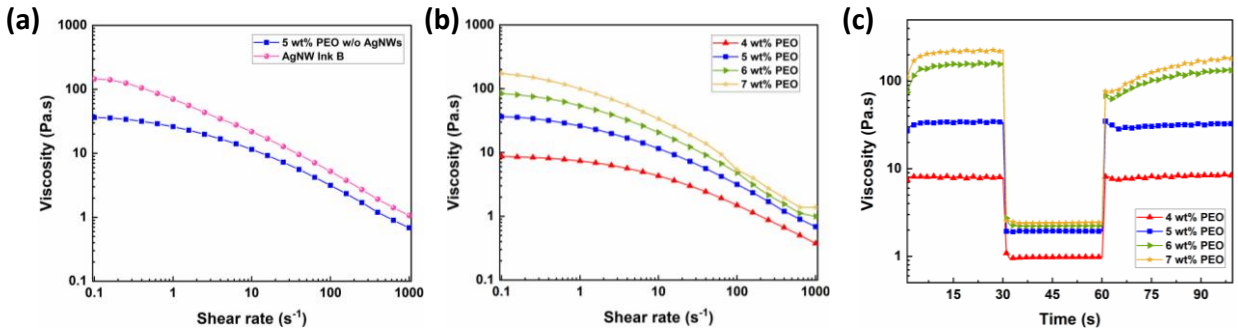

Figure S1 (a) Viscosity as a function of shear rate for 5 wt% PEO solution (without AgNWs) and AgNW Ink B (7 wt% AgNW-5 wt% PEO). (b) Viscosity as a function of shear rate 4, 5, 6, and 7 wt% PEO solutions. (c) Rheological behavior of 4, 5, 6, and 7 wt% PEO solutions during the screen-printing process.

Table S1 Viscosity of different PEO solutions (4%, 5%, 6% and 7% weight ratio) at different shear rates. Each shear rate corresponded to a printing step in the screen-printing process.

PEO Solutions (wt%)	0.1 s^{-1} @ 20s	200 s^{-1} @ 50s	0.1 s^{-1} @ 80s	Recovery @ 80s (%)	0.1 s^{-1} @ 90s	Recovery @ 90s (%)
4	8.085	0.981	8.015	99.1	8.515	100.0
5	34.002	1.940	31.400	92.4	32.817	96.5
6	156.358	2.237	109.602	70.1	129.330	82.7
7	217.350	2.406	140.834	64.8	172.417	79.3

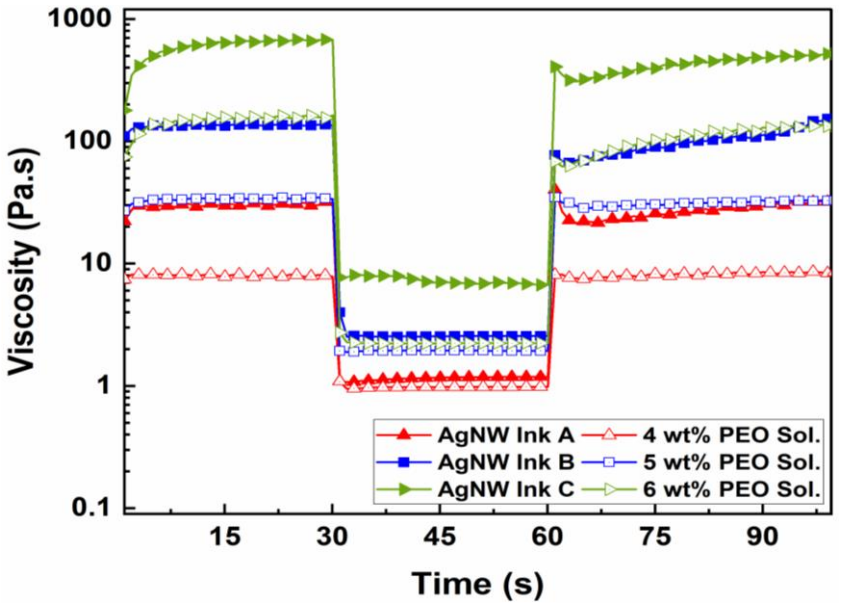

Figure S2 Rheological behavior of different PEO solutions (4, 5, and 6 wt%) and AgNW-based inks during the screen-printing process. The composition of AgNW-based inks is Ink A (7 wt% AgNW-4 wt% PEO), AgNW Ink B (7 wt% AgNW-5 wt% PEO), and AgNW Ink C (7 wt% AgNW-6 wt% PEO).

Table S2 Viscosity of different PEO solutions (4, 5, and 6 wt%) and AgNW-based inks at different shear rates. Each shear rate corresponded to a printing step in the screen-printing process. The composition of AgNW-based inks is – AgNW Ink A (7 wt% AgNW- 4wt% PEO), AgNW Ink B (7 wt% AgNW-5 wt% PEO), and AgNW Ink C (7 wt% AgNW- 6 wt% PEO).

PEO Solutions (wt%)	**0.1 s^{-1} @ 20s**	**200 s^{-1} @ 50s**	**0.1 s^{-1} @ 80s**	**Recovery @ 80s (%)**	**0.1 s^{-1} @ 90s**	**Recovery @ 90s (%)**
4	8.085	0.981	8.015	99.1	8.515	100.0
5	34.002	1.940	31.400	92.4	32.817	96.5
6	156.358	2.237	109.602	70.1	129.330	82.7
AgNW-based Ink – 7 wt% AgNWs with different PEO content						
AgNW Ink A (4 wt% PEO)	31.024	1.180	26.189	84.4	29.327	94.5
AgNW Ink B (5 wt% PEO)	134.306	2.56	99.193	73.9	112.54	83.8
AgNW Ink C (6 wt% PEO)	651.416	6.848	443.917	68.1	476.782	73.1

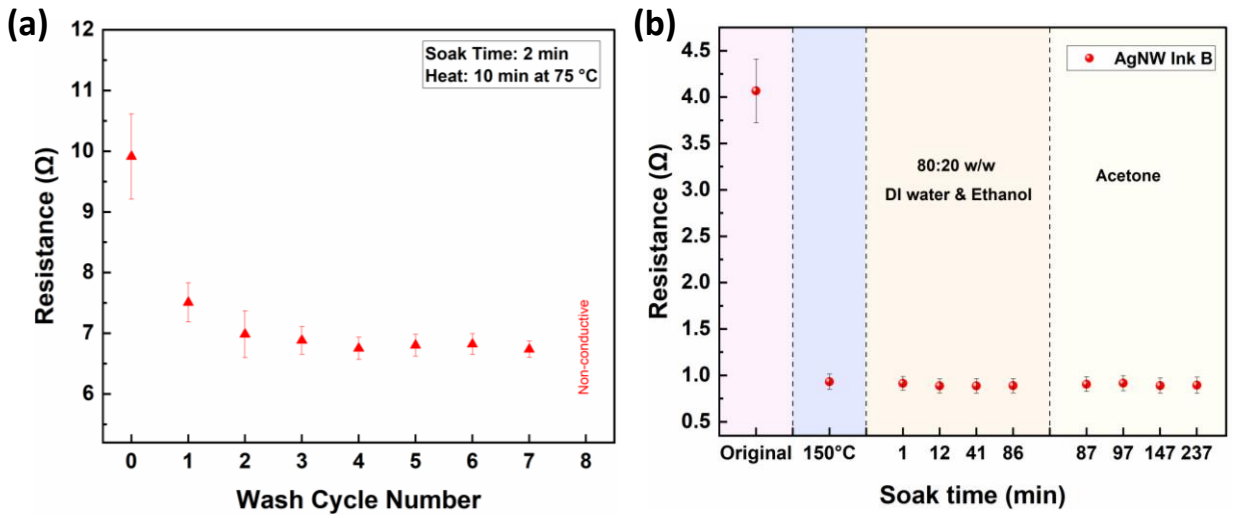

Figure S3. (a) Resistance of screen-printed patterns as a function of wash cycle number. The printed pattern was soaked in DI water for 2 min followed by heating at 75 ºC for 10 min. (b) Solvent resistance of screen-printed AgNW lines after thermal annealing at 150 ºC for 30 min as the post-printing step.

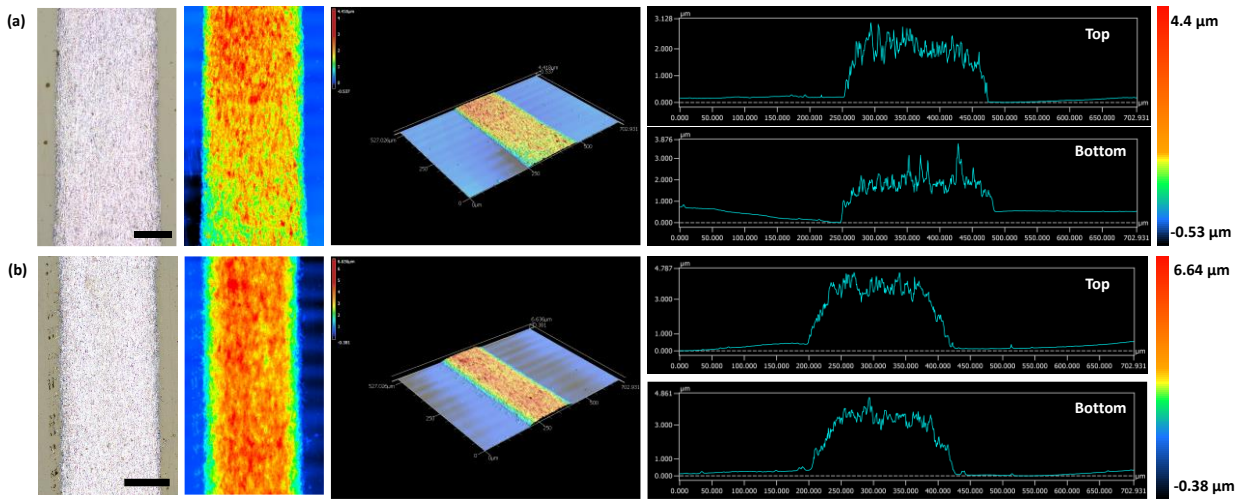

Figure S4. Influence of printing passes. The optical images, thickness profile, 3D thickness profile, and representative cross-sectional profile of printed lines for (a) one printing pass, and (b) two printing passes. With one and two printing passes, the difference between the top and bottom end of the printed pattern is 0.748 µm and 0.074 µm respectively. Scale bar 100 µm.

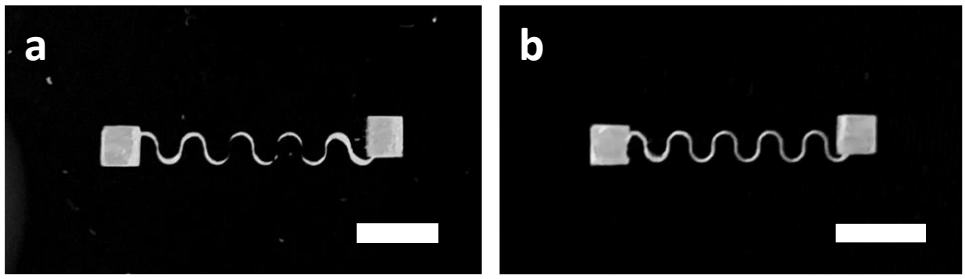

Figure S5. Screen printed AgNW patterns at a printing speed of (a) ~12 $cm \cdot s^{-1}$ and (b) ~6 $cm \cdot s^{-1}$. Higher printing speed can lead to incomplete transfer of AgNW ink on to the substrate. Scale bar: 5 mm.

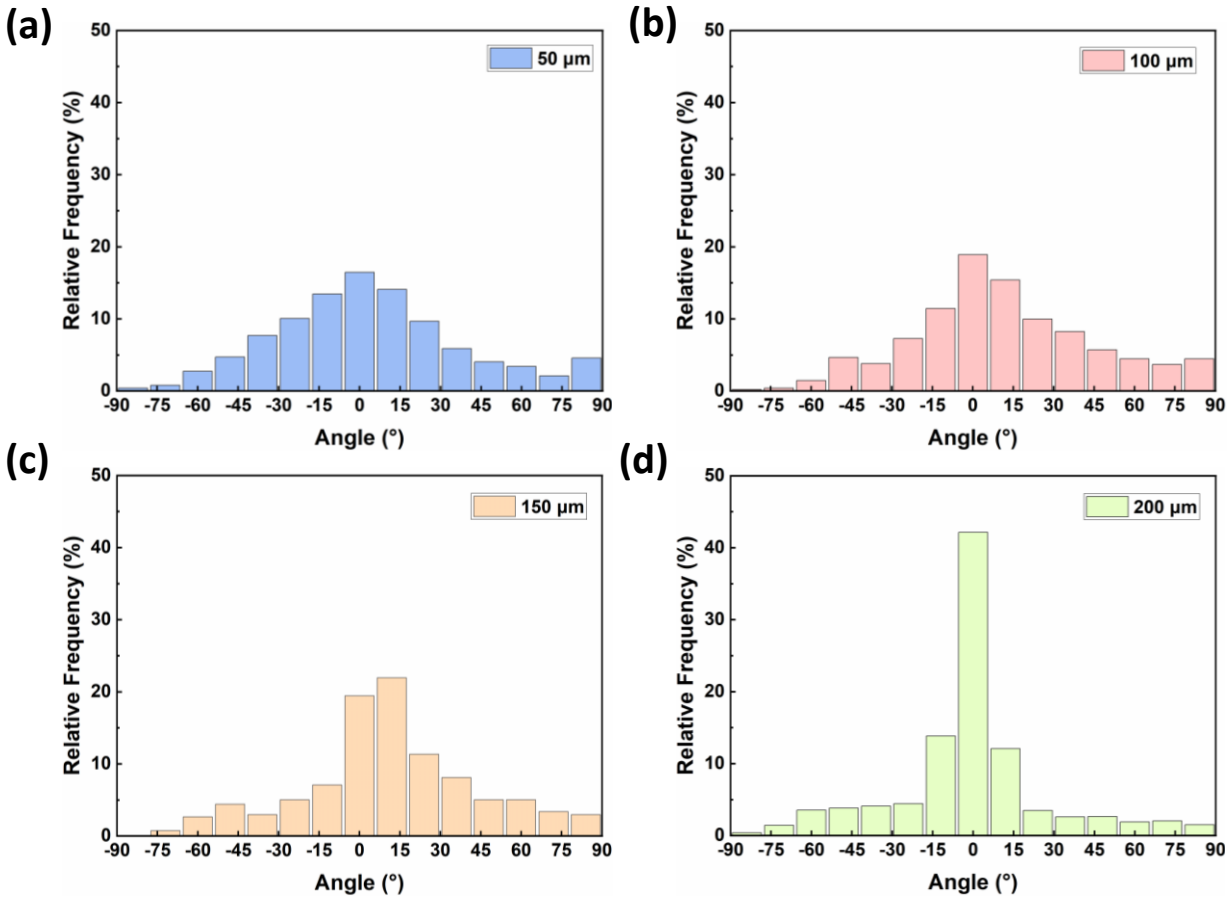

Figure S6. AgNW alignment for screen-printed lines for (a) 50, (b) 100, (c) 150, and (d) 200 µm line widths.

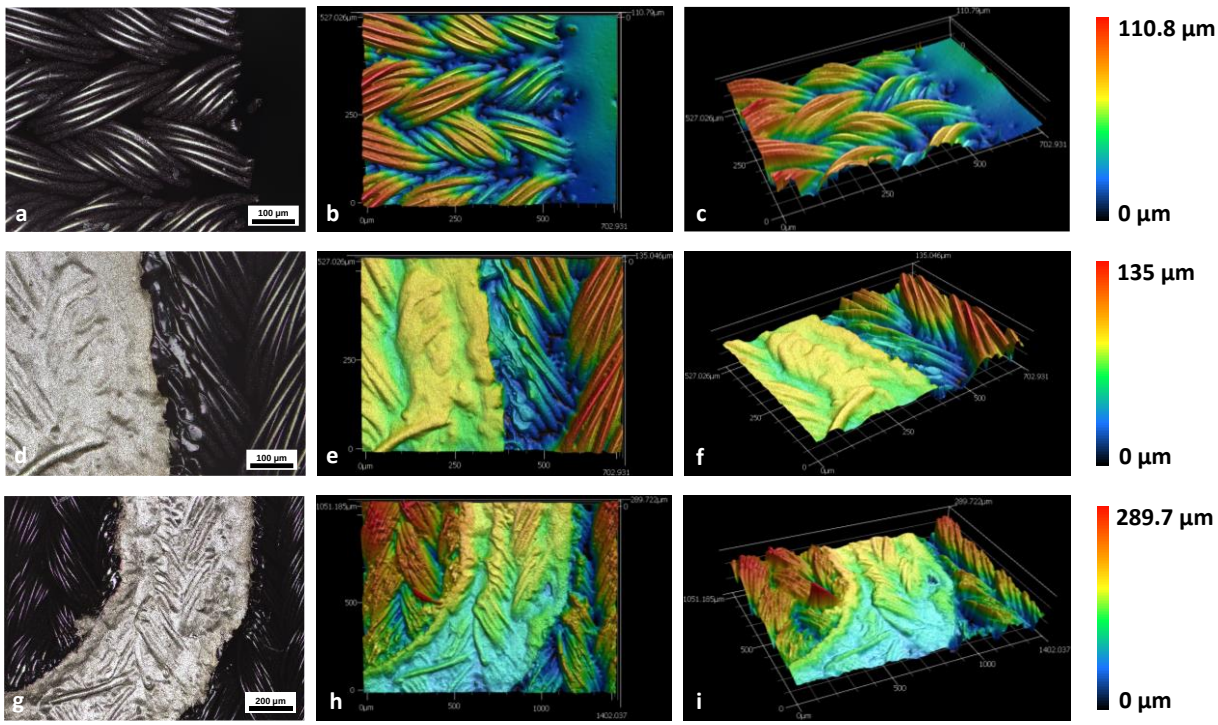

Figure S7. Confocal microscopy images (a) and 3D height map (b-c) of textile used for screen printing. Confocal microscopy images (d and g) and 3D height map (e, f, h and i) of screen-printed pattern on textile at two different magnifications.

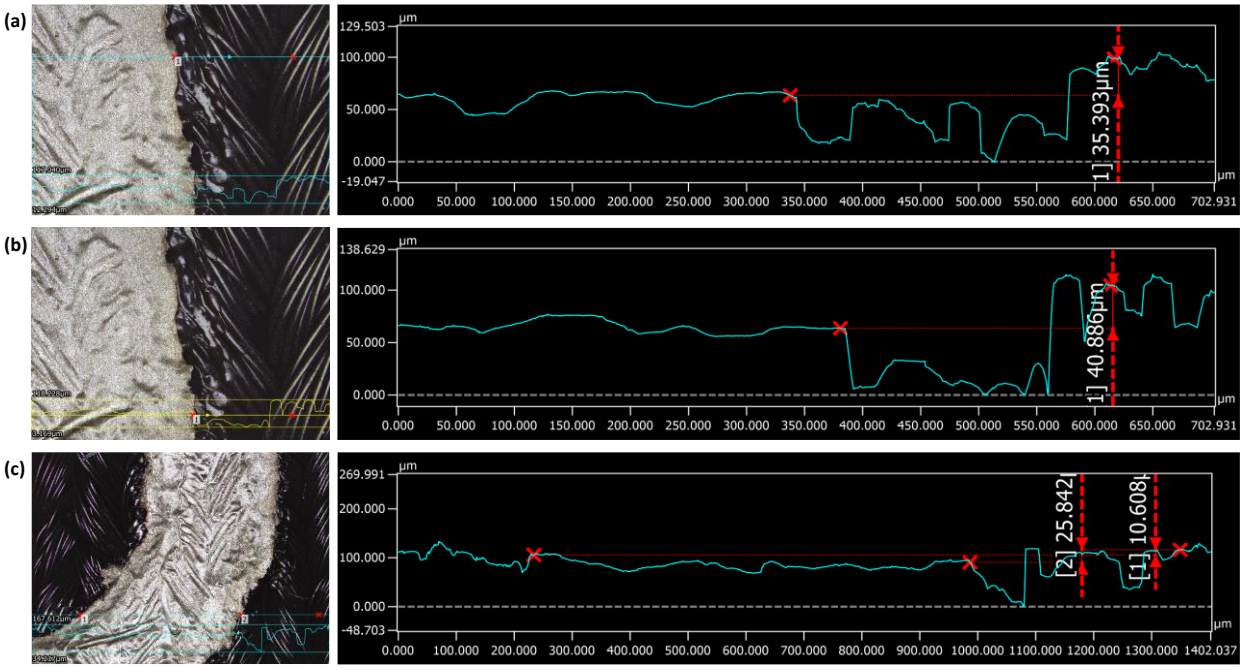

Figure S8 Confocal microscopy images and corresponding thickness profiles for screen printed patterns on textile at two different magnifications, (a-b) 20x and (c) 10x. The thickness values shown by red cross markers are measured from the top weave of the textile. The height profile lines are measured at locations shown by pink (a), yellow (b), and blue (c) lines. The red cross markers show the height of the printed AgNW pattern in reference to the top weave of the textile.

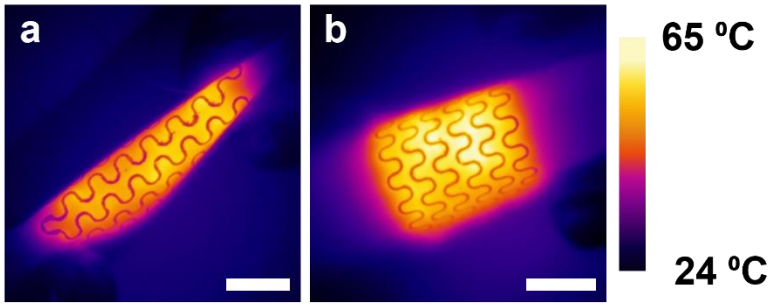

Figure S9 IR images showing performance of the textile-based heater during different folding deformations. Scale bar: 10 mm.