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Supplementary Materials for

"Skin-like" fabric for personal moisture management

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The PDF file includes:

Other Supplementary Material for this manuscript includes the following:

(available at advances.sciencemag.org/cgi/content/full/6/14/eaaz0013/DC1)

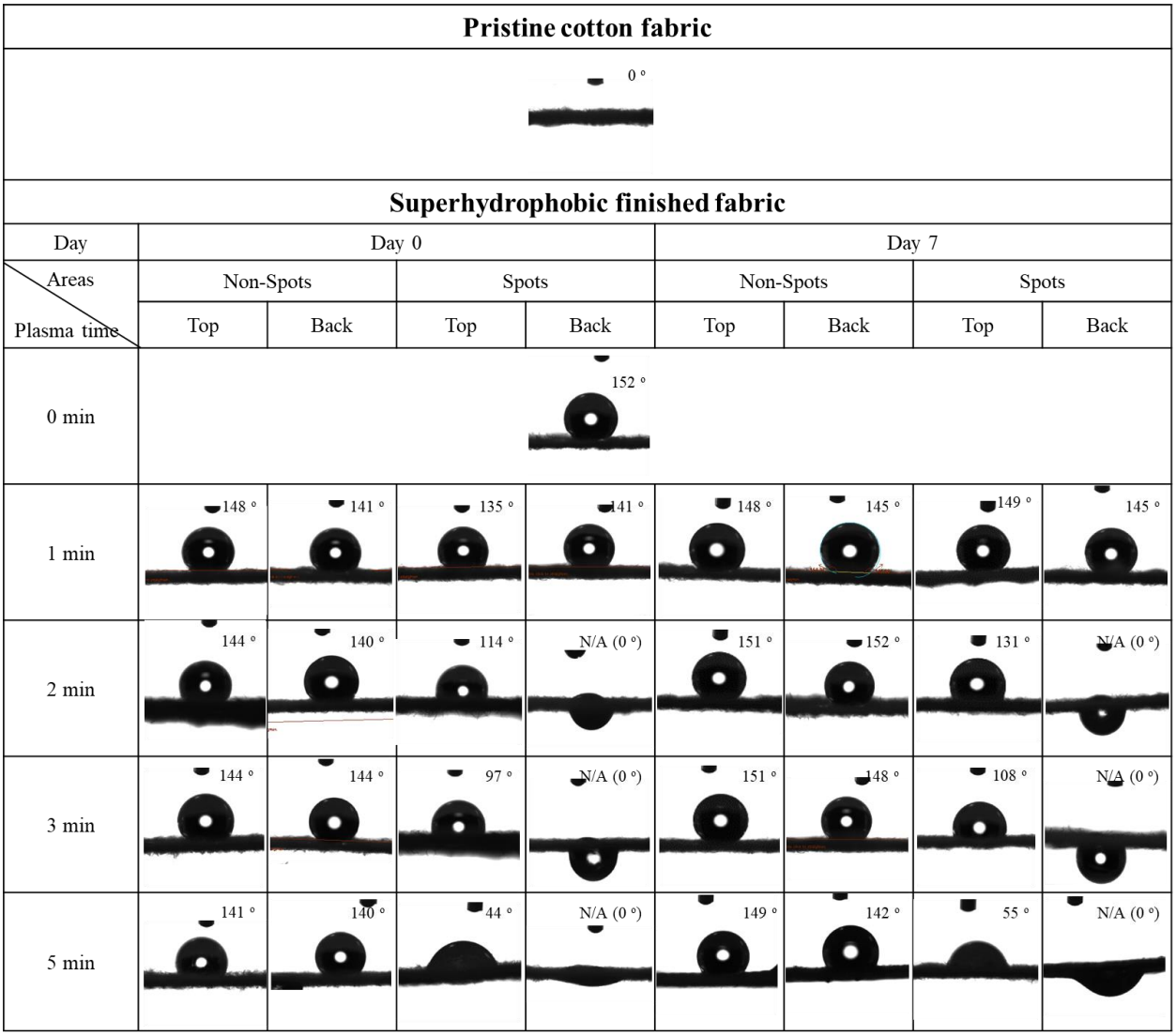

Fig. S1. A summary of water droplet images taken from contact angle measurement on pristine cotton fabric, superhydrophobic finished fabric before and after various plasma selective treatments. Both spot areas and non-spot areas from both top and back sides of the superhydrophobic finished fabric after various selective plasma treatment were measured. The treated fabrics were measured again after aging at room temperature for 7 days.

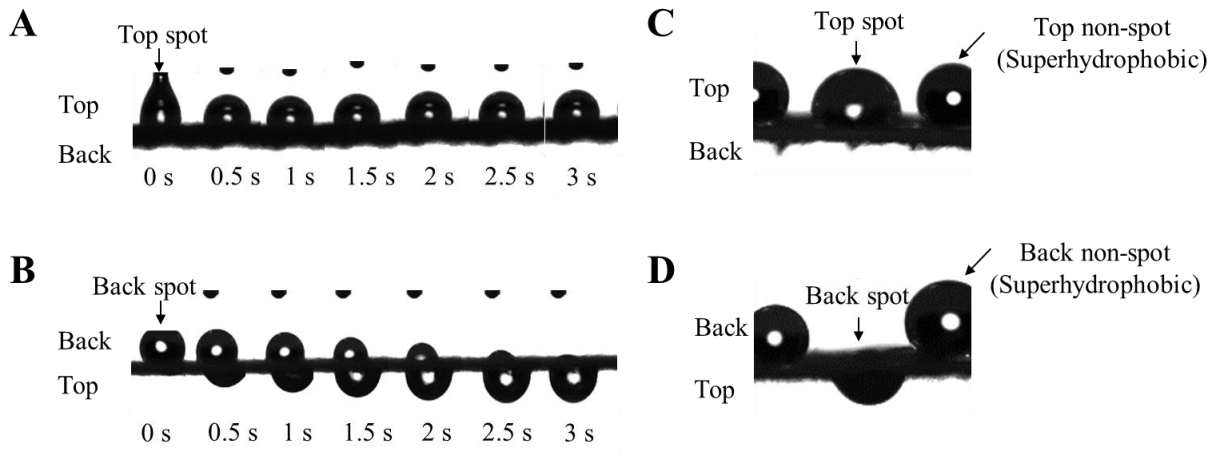

Fig. S2. Water droplet images taken from contact angle measurement on a horizontally laid superhydrophobic finished fabric after plasma selective treatment (300 W, 3 min). (A, B) Typical droplet motion on (A) exposed top spot and (B) unexposed back spot areas of the fabric for 3 s, respectively. (C, D) Typical droplet images on both spot and non-spot areas of the (C) top side and (D) back side of the fabric, respectively.

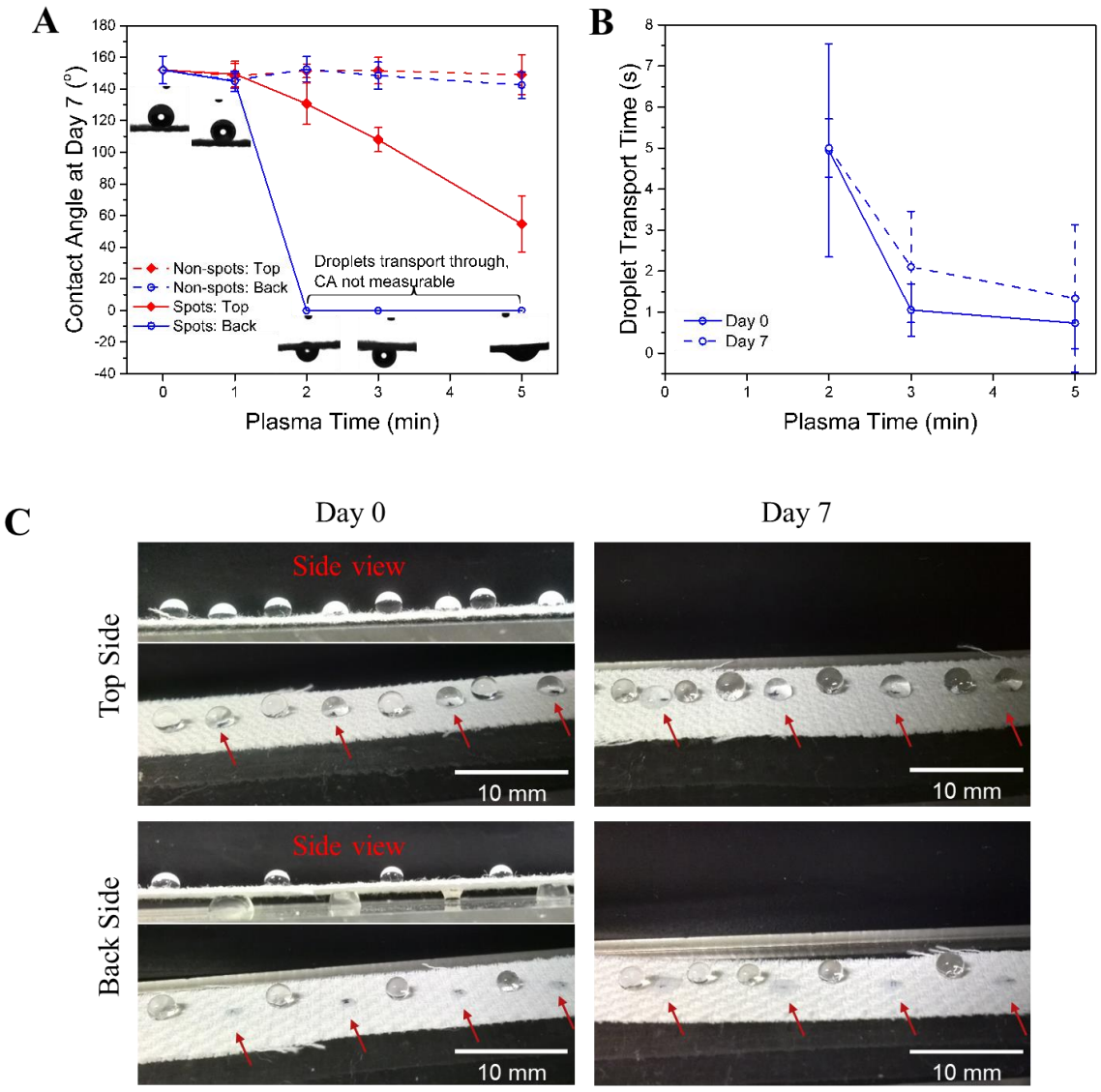

Fig. S3. Wetting durability of the superhydrophobic finished fabric after selective plasma treatment. (A) Contact angles of the spot and non-spot areas of both top and back sides of the superhydrophobic finished fabric after plasma treatment for 0 to 5 min after 7 days; insets are droplet images when dripped on the back spot areas. (B) Water transport time from the back spot area to the top spot area in both Day 0 (as-prepared) and Day 7. (C) Overview images of multiple water droplets on either side of the superhydrophobic finished fabric after selective plasma treatment (300 W, 3min), at Day 0 and Day 7. Red arrows indicate the spot channels marked in black dots on the fabrics. Insets in as-prepared samples are side views of the fabrics and droplets.

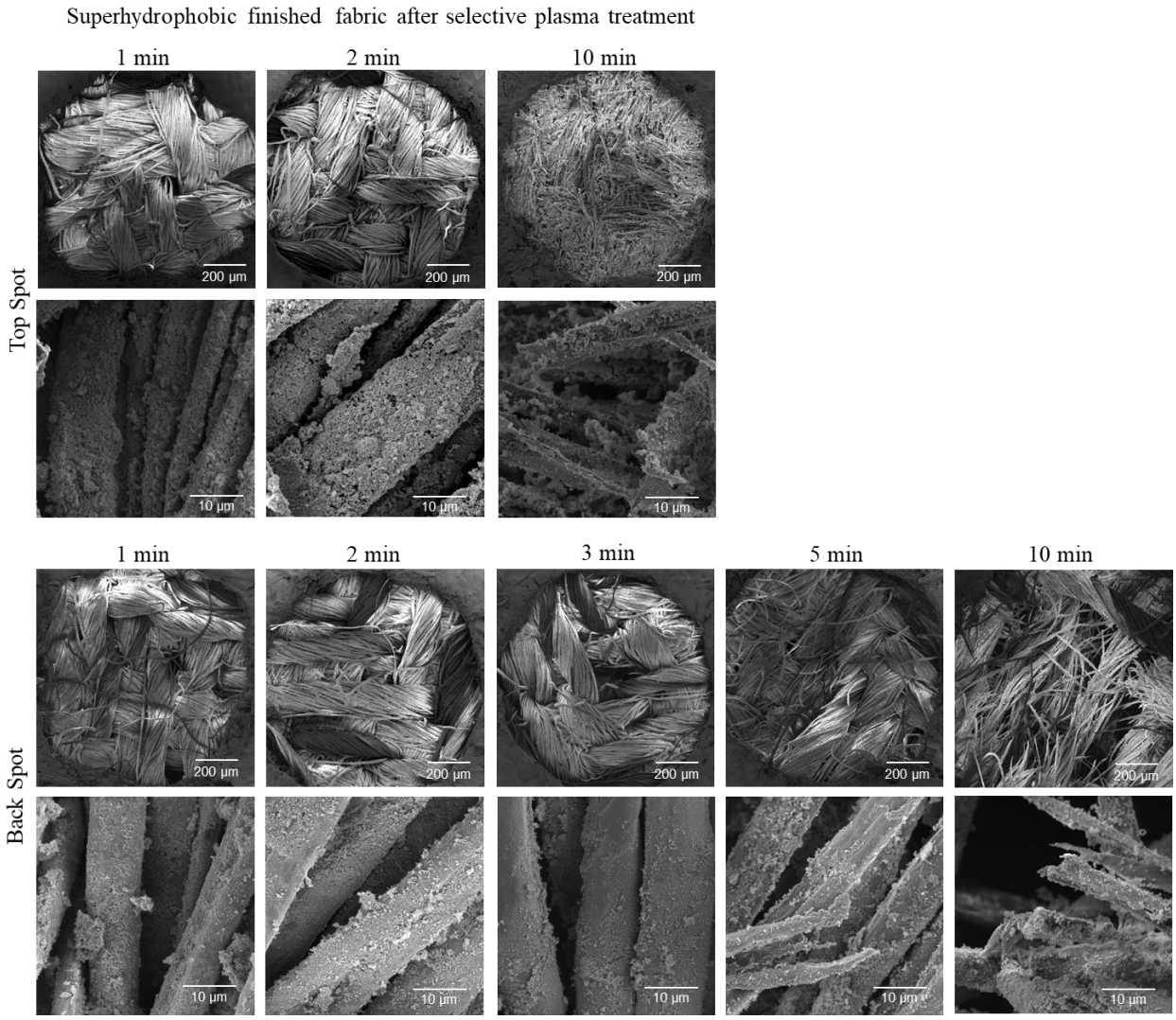

Fig. S4. SEM morphologies of exposed top spot areas and unexposed back spot areas of the of the superhydrophobic finished fabric after selective plasma treatment for 1 to 10 min. Images in Line 2 and 4 are high magnifications of Line 1 and 3, respectively.

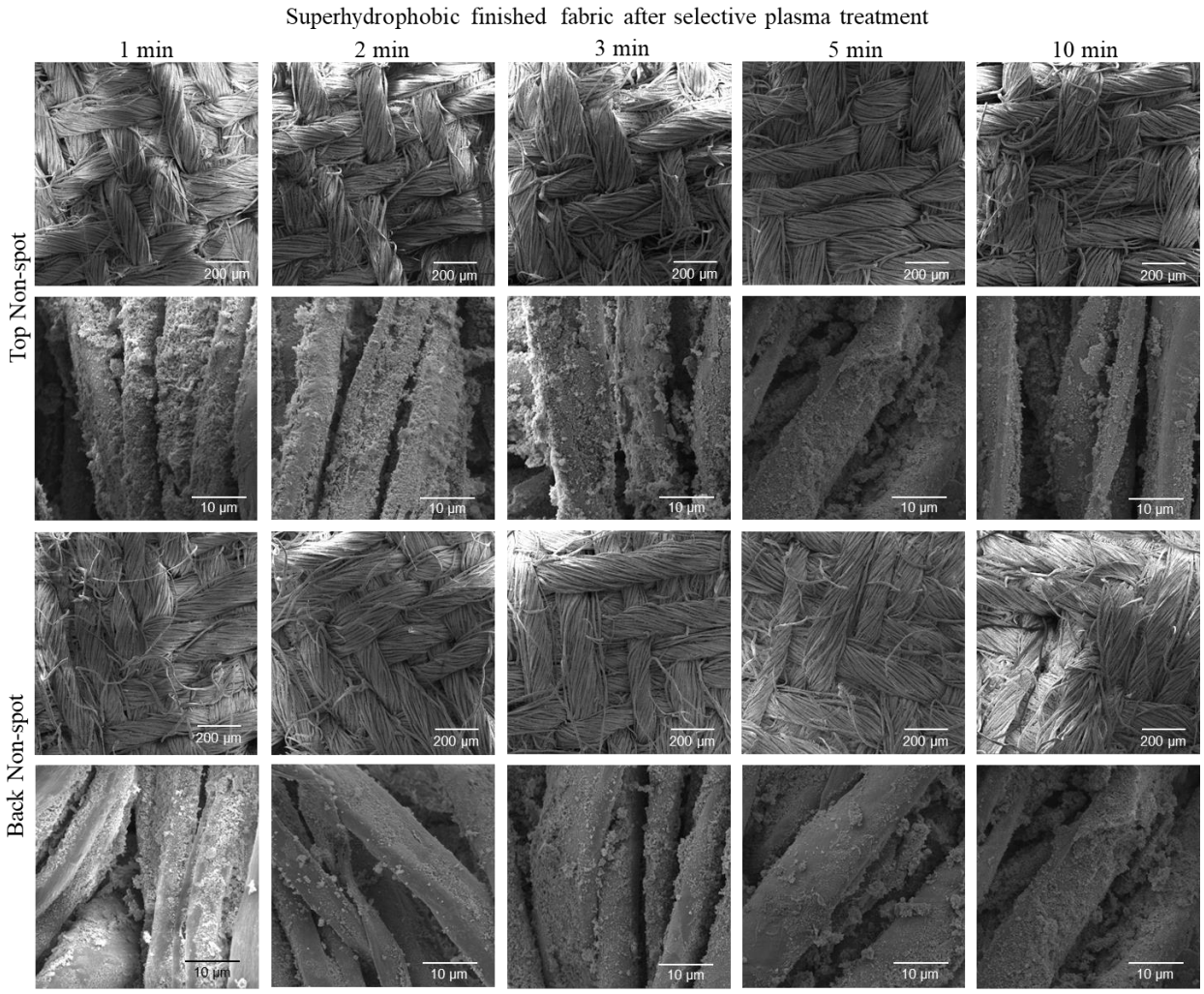

Fig. S5. **SEM morphologies of unexposed top and back non-spot areas of the superhydrophobic finished fabric after selective plasma treatment for 1 to 10 min.** Images in Line 2 and 4 are high magnifications of Line 1 and 3, respectively.

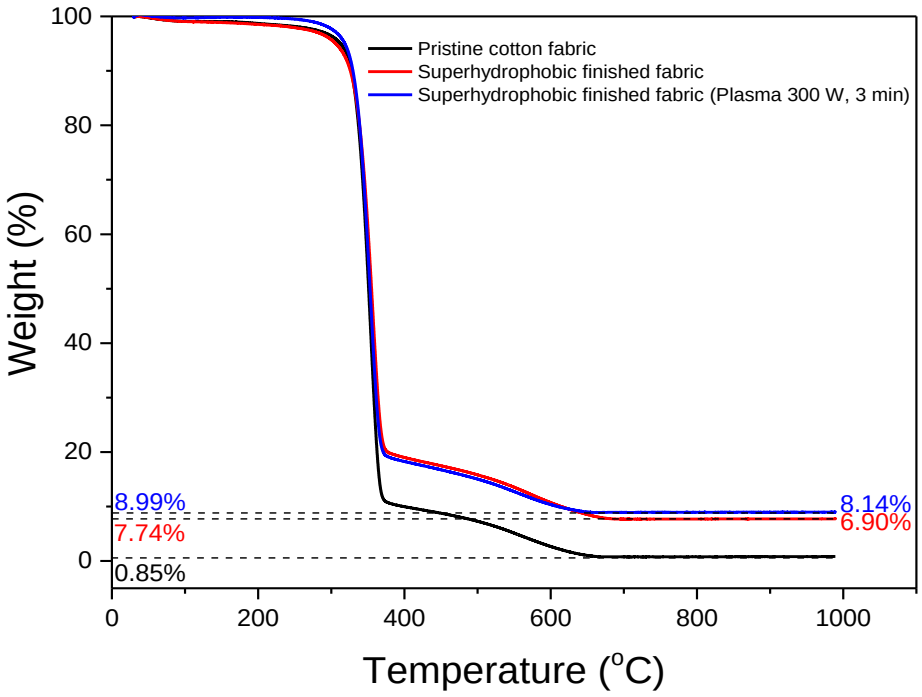

Fig. S6. Thermogravimetric analysis (TGA) spectra of pristine cotton fabric, superhydrophobic finished fabric before and after plasma treatment (300 W, 3 min).

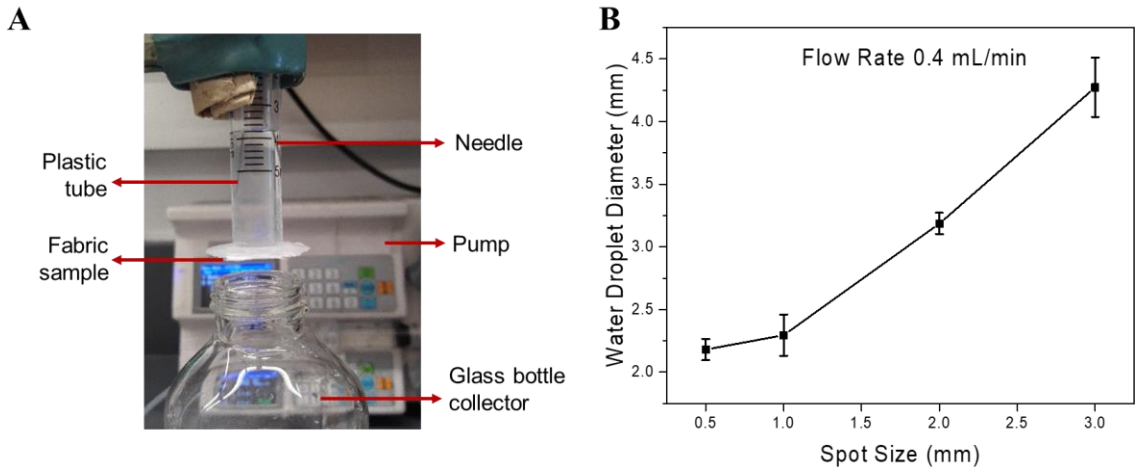

Fig. S7. Breakthrough pressure test of superhydrophobic finished fabric after selective plasma treatment. (A) Experimental set-up: a testing fabric was attached underneath a plastic hollow cylinder, water was then pumped in under different flow rates, and breakthrough pressure was recorded as the minimum pressure under which the water starts to pass through the fabric (Photo Credit: Lihong Lao, Cornell University). (B) Water droplet diameters transported through different sizes (diameters) of spot areas under a flow rate of 0.4 mL/min.

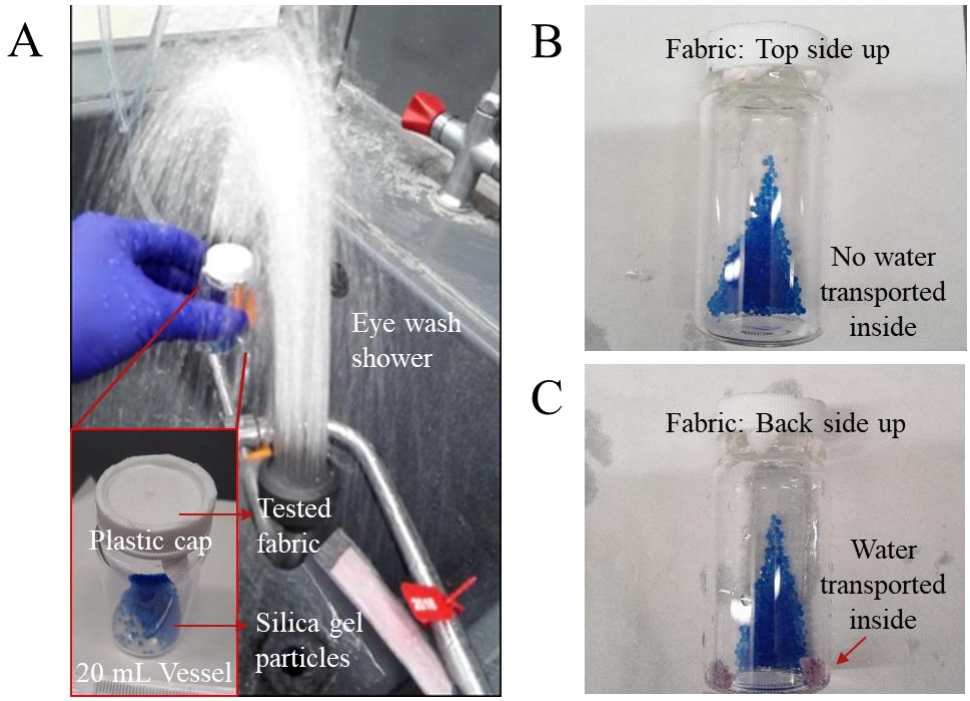

Fig. S8. Water shower test of superhydrophobic finished fabric after selective plasma treatment. (A) Experimental set-up: a testing fabric was capped on a glass vessel loaded with blue silica gel beads and was then showered by an eye shower for 10 s. Water (B) did not and (C) did transport (red arrow) through the fabric when (B) the top side and (C) back side of the fabric were up contacting the shower, respectively. (Photo Credit: Lihong Lao, Cornell University)

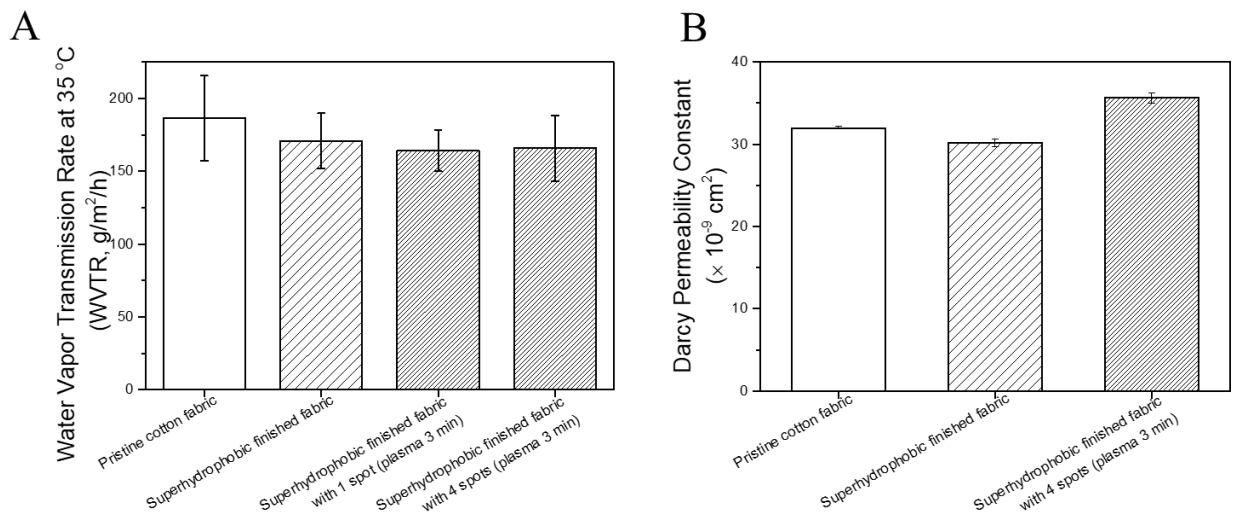

Fig. S9. Vapor and Air Permeability of superhydrophobic finished fabric after selective plasma treatment. (A) Water vapor transmission rates (WVTR) under 35 ºC and (B) Air permeabilities of pristine cotton fabric and superhydrophobic finished fabric before and after selective plasma treatment (300 W, 3 min), respectively.

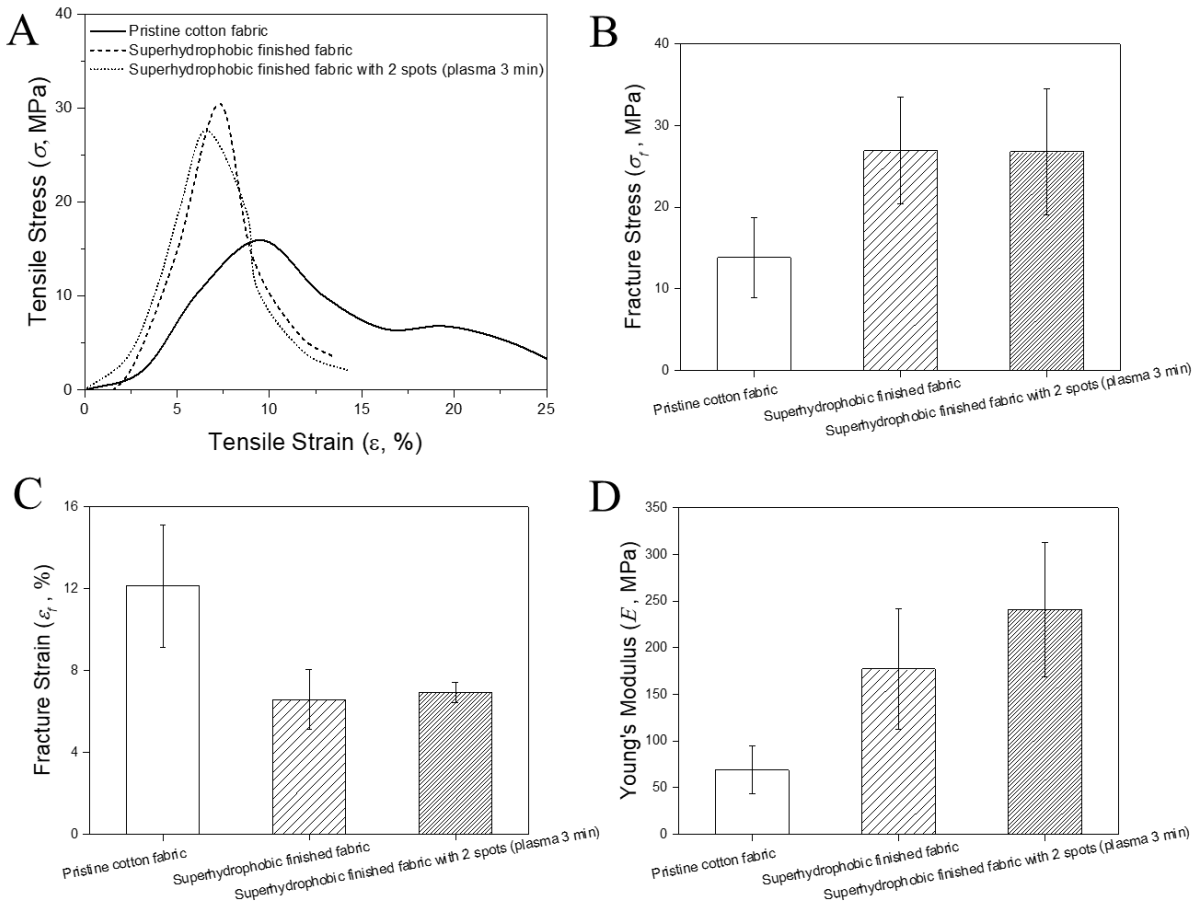

Fig. S10. Mechanical properties of superhydrophobic finished fabric after selective plasma treatment. (A) Typical stress-strain curves of pristine cotton fabric, superhydrophobic finished fabric before and after selective plasma treatment (300 W, 3 min). (B) Fracture stress (σ_f), (C) Fracture strain (ε_f) and (D) Young's Modulus (E, at 2.36% strain) of the fabrics, respectively.

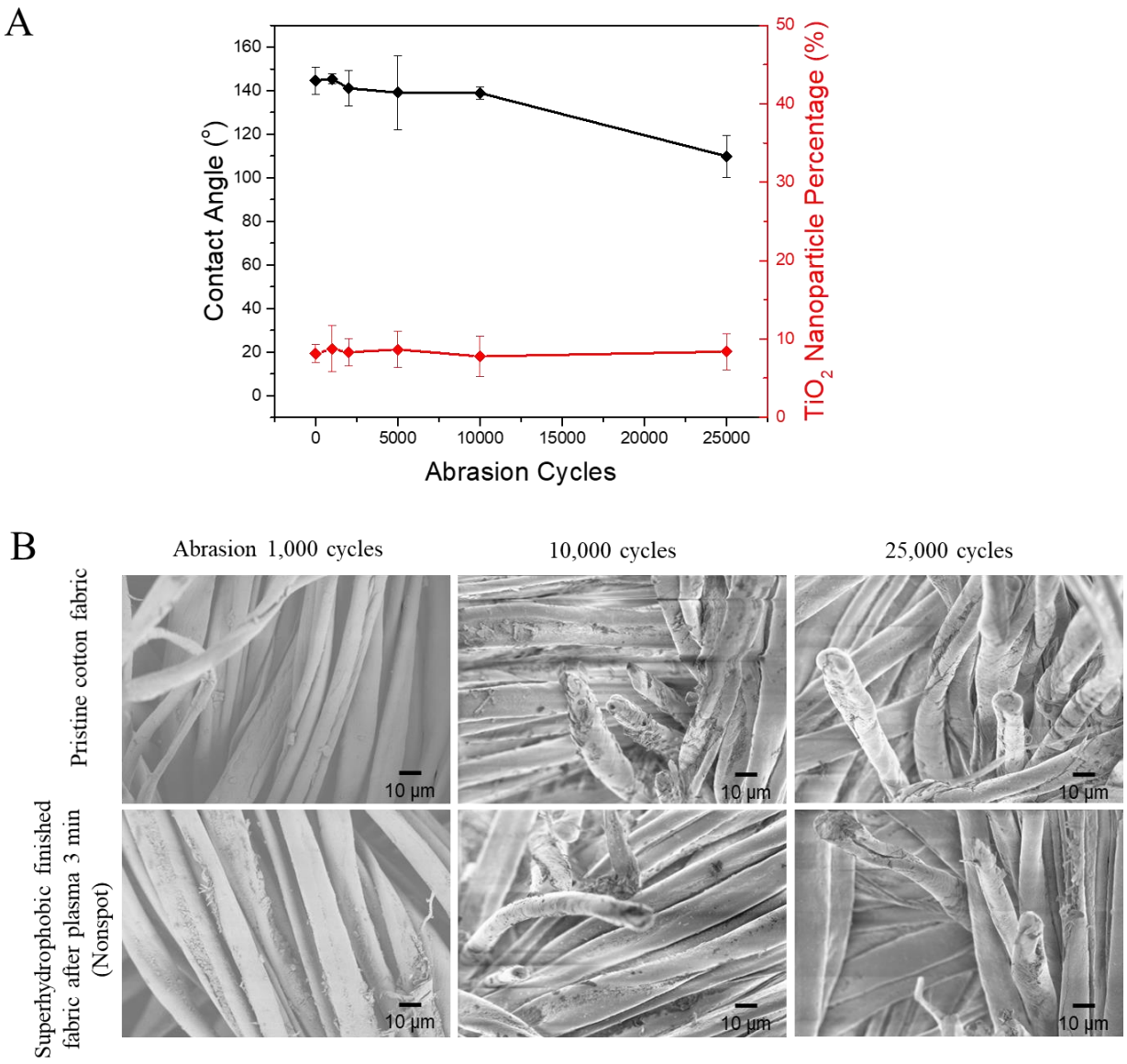

Fig. S11. Abrasion resistance of superhydrophobic finished fabric after selective plasma treatment. (A) Contact angles and TiO_2 nanoparticle contents of plasma selectively treated superhydrophobic finished fabric (300W, 3 min) after different cycles of abrasion. (B) SEM morphologies of pristine cotton fabric and plasma treated superhydrophobic fabric after abrasion for 1000, 10,000 cycles and 25,000 cycles.

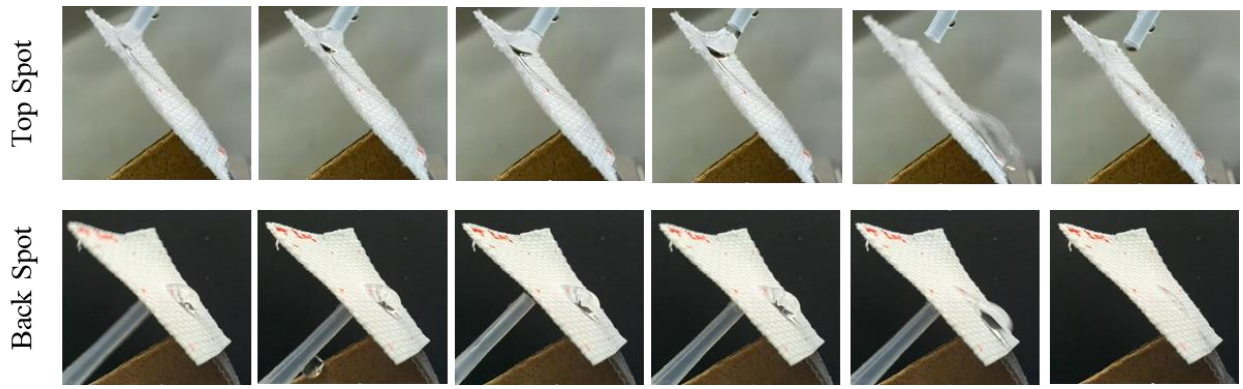

Fig. S12. Performance of "skin-like" directional flow fabric after 5 weeks' aging at room temperature. Still frames taken from videos when water from pipette was dripped onto an inclinedly laid (45 ^{o}) plasma (300 W, 3 min) selectively treated superhydrophobic finished fabric with 5 weeks' aging on exposed top spot (time interval, 0.25 s) and unexposed back spot (time interval, 1.00 s). Red spots on the fabrics indicate the exposed top spots.

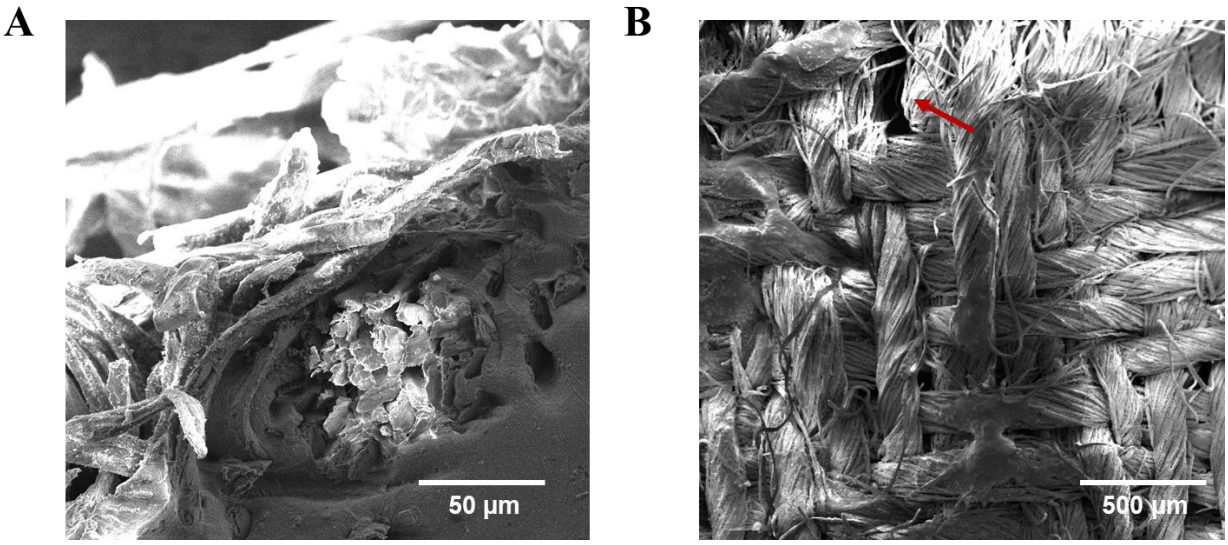

Fig. S13. Additional SEM morphologies of superhydrophobic finished fabric to support the understanding of the mechanism of the directional water transport property. (A) Cross-section of the fabric, showing the semi-axes *a* and *b* of the yarn are approximately 80 µm and 50 µm, respectively, and (B) low magnification of images in Fig. 2C, showing a half distance *c* approximately 50 µm and a big pore with greater *c* (red arrow) between yarns of the superhydrophobic finished fabric.

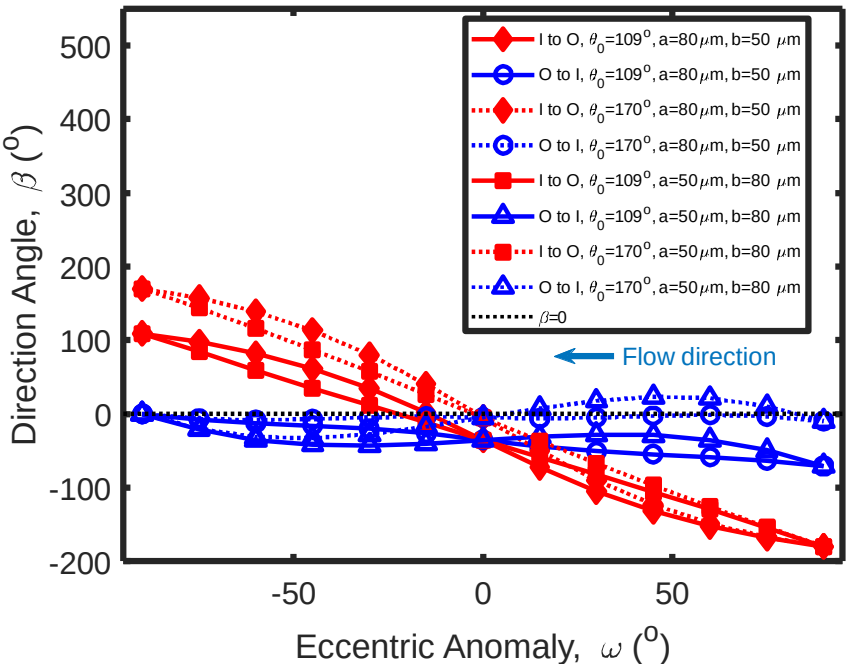

Fig. S14. Dependence of direction angle on eccentric anomaly of the elliptical yarns in different flow directions. The semi-major axis and semi-minor axis vary at different values of the maximum contact angles on one side of the porous spot.

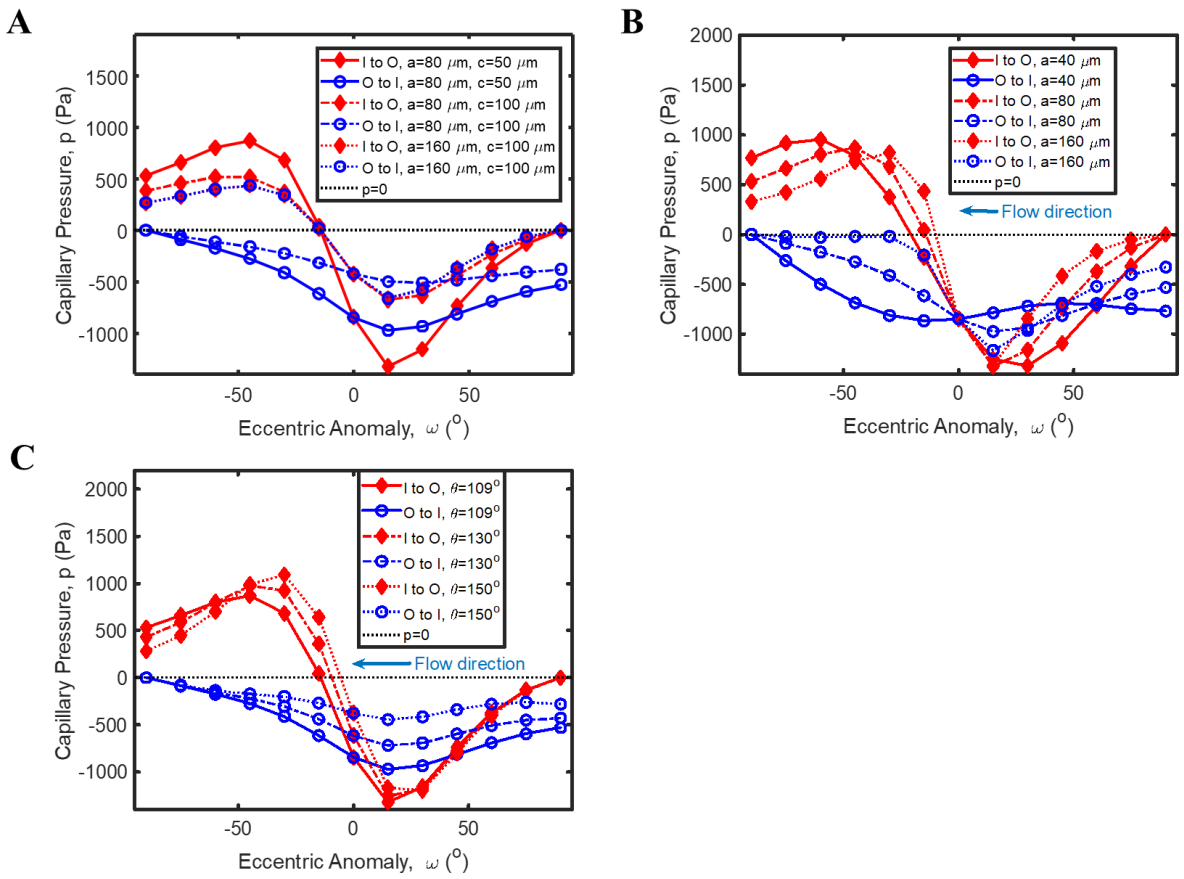

Fig. S15. Dependence of capillary pressure on eccentric anomaly of the elliptical yarns under different circumstances. (A) at different semi-principal axes in different flow directions. The semi-principal axes and the half-distance between yarns vary in three groups as follows: $a = 80$ μm, $b = 50$ μm, $c = 50$ μm; $a = 80$ μm, $b = 50$ μm, $c = 100$ μm; and $a = 160$ μm, $b = 100$ μm, $c = 100$ μm. (B) at different shapes of elliptical yarns in different flow directions. The semi-principal axes and vary in three groups as follows: $a = 40$ μm, $b = 50$ μm; $a = 80$ μm, $b = 50$ μm; and $a = 160$ μm, $b = 50$ μm. (C) at different maximum contact angles in different flow directions. The contact angles vary in three groups as follows: $\theta_0 = 109^o$; $\theta_0 = 130^o$; and $\theta_0 = 150^o$.

Movie S1A

Water droplets (20 μL per droplet) on the **top** spot area of a horizontally laid superhydrophobic finished cotton fabric after selective plasma treatment (300 W, 3 min).

Movie S1B

Water droplets (20 μL per droplet) on the **back** spot area of a horizontally laid superhydrophobic finished fabric after selective plasma treatment (300 W, 3 min).

Movie S2A

Continuous water droplet supply (10 μL/min) by a needle on the **top** spot area of a 45^{o} inclinedly laid superhydrophobic finished fabric after selective plasma treatment (300 W, 3 min).

Movie S2B

Continuous water droplet supply (10 μL/min) by a needle on the **back** spot area of a 45^{o} inclinedly laid superhydrophobic finished fabric after selective plasma treatment (300 W, 3 min).

Movie S3A

Continuous water flux (0.4 mL/min) by a needle to test the breakthrough pressure on the **top** side of the superhydrophobic finished fabric after selective plasma treatment (300 W, 3 min) having one spot diameter of 1 mm by placing a plastic hollow cylinder on the fabric.

Movie S3B

Continuous water flux (0.4 mL/min) by a needle to test the breakthrough pressure on the **back** side of the superhydrophobic finished fabric after selective plasma treatment (300 W, 3 min) having one spot diameter of 1 mm by placing a plastic hollow cylinder on the fabric.

Movie S4A

Continuous artificial sweat droplet supply (10 μL/min) by a needle on the **top** spot area of a superhydrophobic finished fabric after selective plasma treatment (300 W, 3 min). The fabric was originally laid horizontally, and then was rotated clockwise to certain inclined angles.

Movie S4B

Continuous artificial sweat droplet supply (10 μL/min) by a needle on the **back** spot area of a superhydrophobic finished fabric after selective plasma treatment (300 W, 3 min). The fabric was originally laid horizontally, and then was rotated clockwise to certain inclined angles. The feeding was initially upwards to test the transport behavior against the gravity.

Movie S4C

A first droplet of artificial sweat supply (10 μL/min) by a needle upwards to the **back** spot area of a horizontally-laid superhydrophobic finished fabric after selective plasma treatment (300 W, 3 min).