Supporting Information

Design of Unidirectional Water-Transport Skin-Derived Wearable Material Through Engineering Natural Pore-Size Gradient for Personal Wet-Thermal Management

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Supplementary Information contains:

Supplementary Figures S1-S15

Supplementary Table S1

Supplementary Movies S1-S4

1. Supplementary Figures

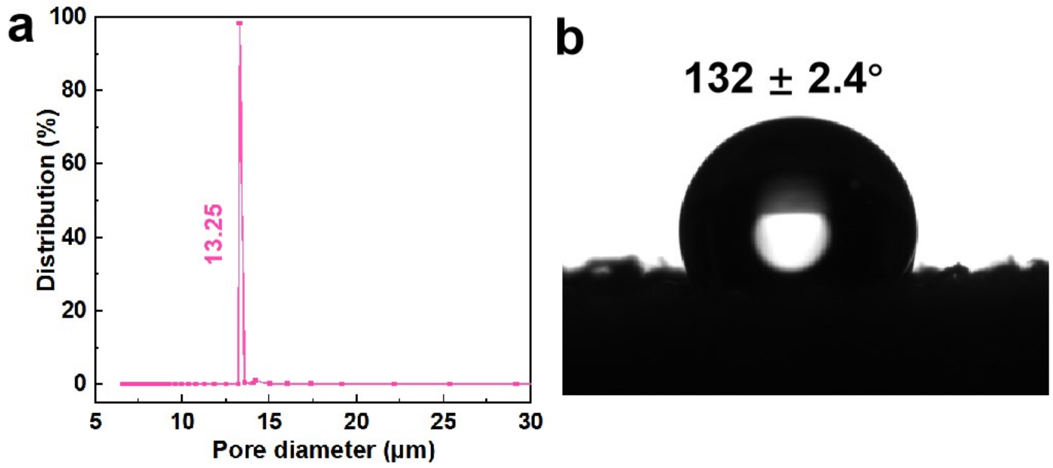

Fig. S1 Pore size distribution (a) and water contact angle (b) of N-Skin

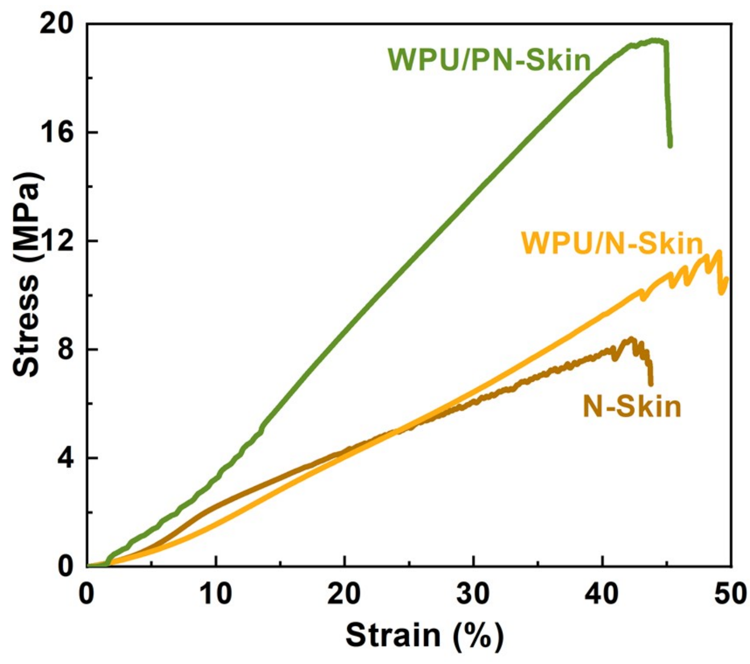

Fig. S2 Stress-strain curves of WPU/PLM and WPU/LM membranes

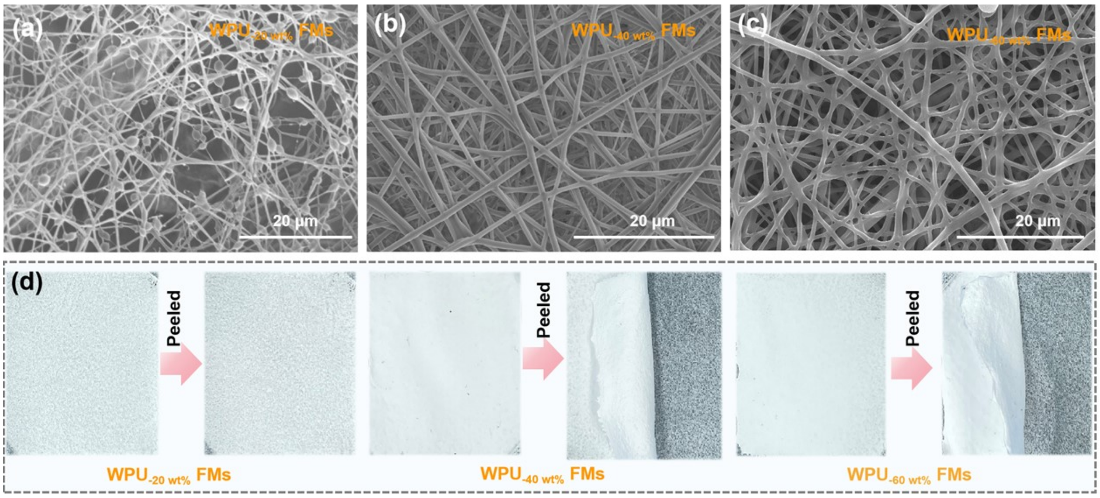

Fig. S3 (a-b) SEM images of water-processed WPU fibrous membranes derived from different WPU contents of (a) 20, (b) 40, and (c) 60 wt%. (d)The peel test using nipper of the WPU fibrous membranes.

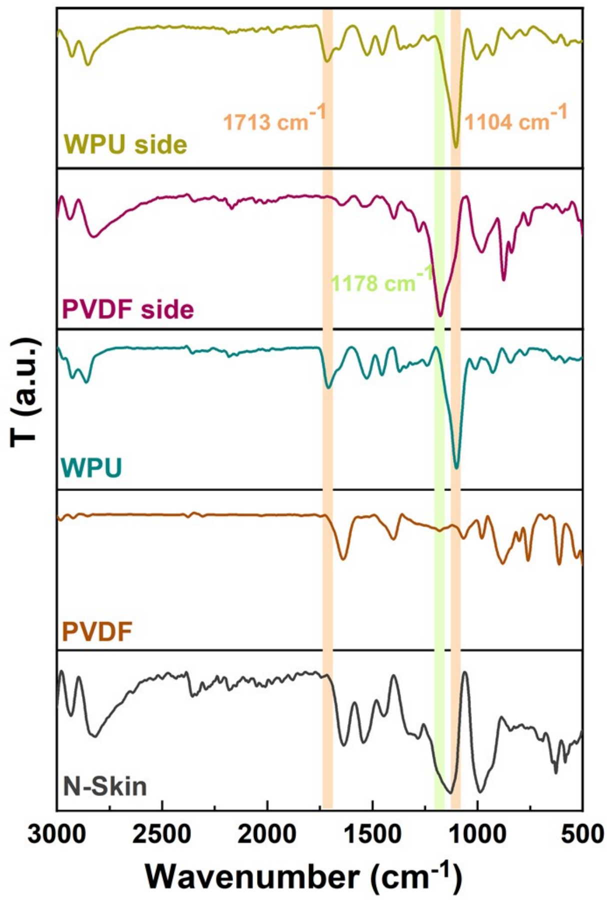

Fig. S4 FT-IR spectra of as-prepared samples

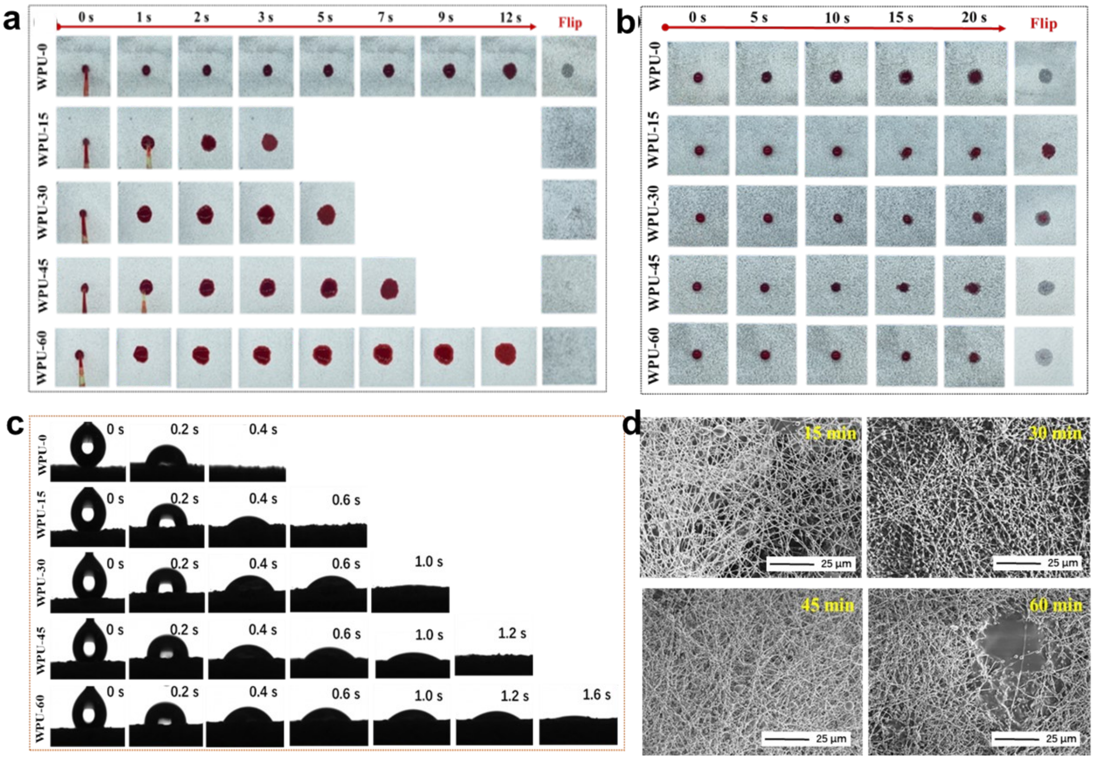

Fig. S5 Transport behavior of the water droplet of 20 μL (a) on the WPU side and (b) the corresponding PVDF side of UWT-Skin with different WPU spining time. (c) WCA photographs with time for water droplet (5 μL) on the WPU side with different spining time. (d) SEM images of WPU side with different spining time on UWT-Skin.

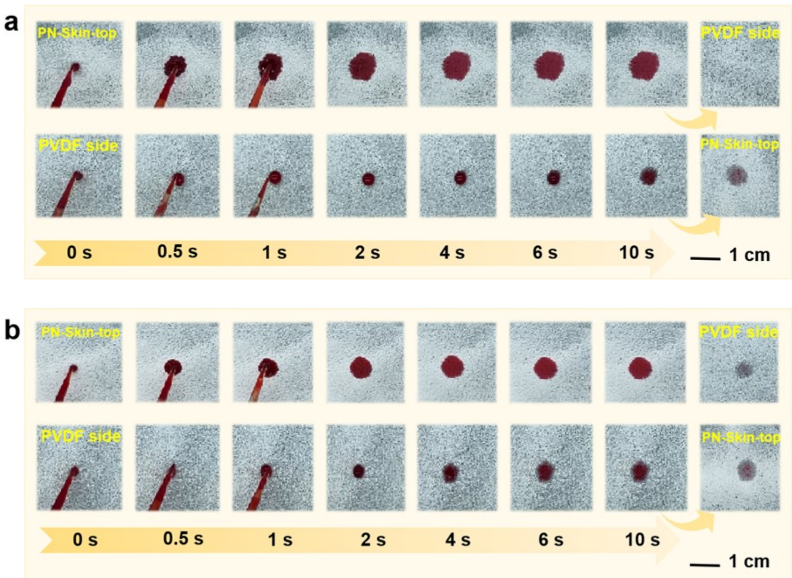

Fig. S6 Unidirectional water-transport behavior of UWT-Skin without WPU fibrous membrane after being exposed to a natural environment for 0 h (a) and 12 h (b).

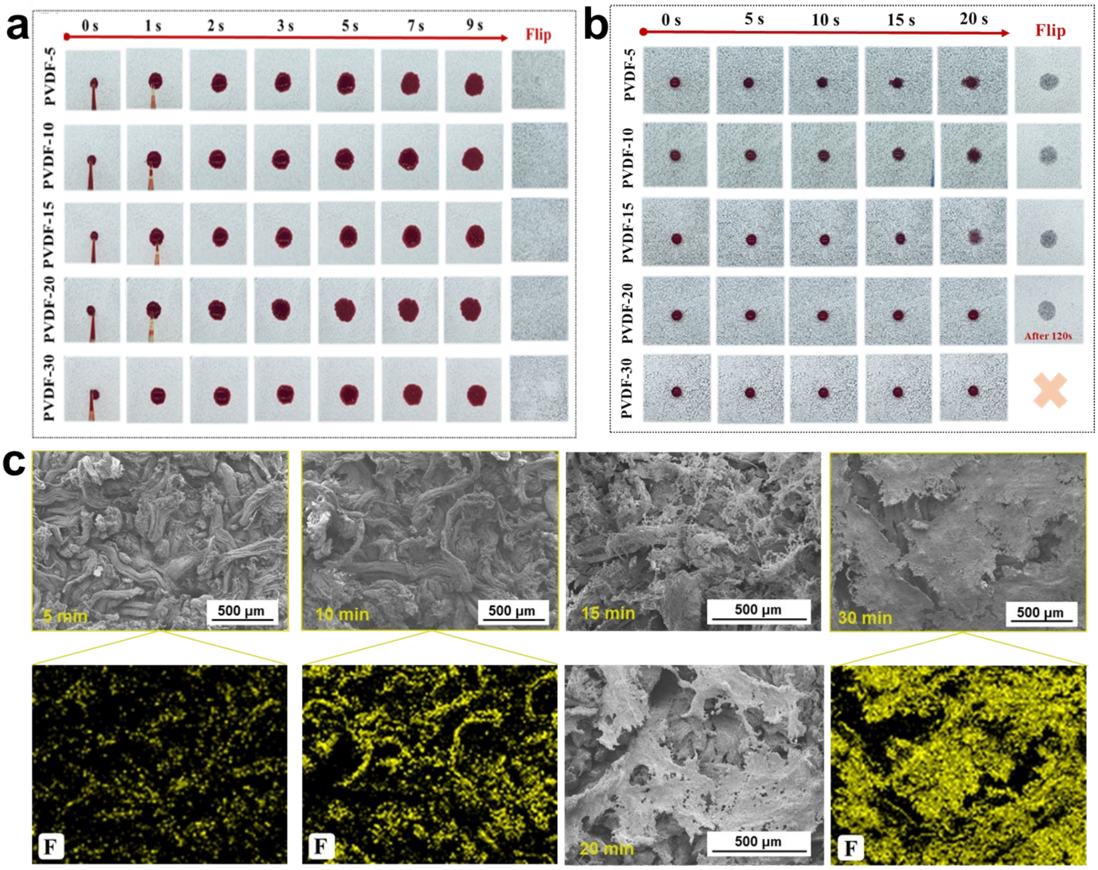

Fig. S7 Transport behavior of the water droplet of 20 μL (a) on the WPU side and (b) the corresponding PVDF side of UWT-Skin with different PVDF spraying time. (c) SEM images of PVDF side with different spraying time on UWT-Skin.

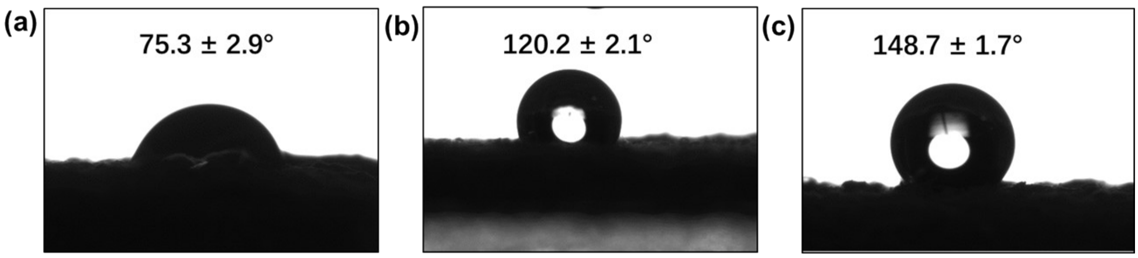

Fig. S8 WCA on WPU side surface (a), PN-Skin-middle surface (b), and PVDF side surface (c) of UWT-Skin.

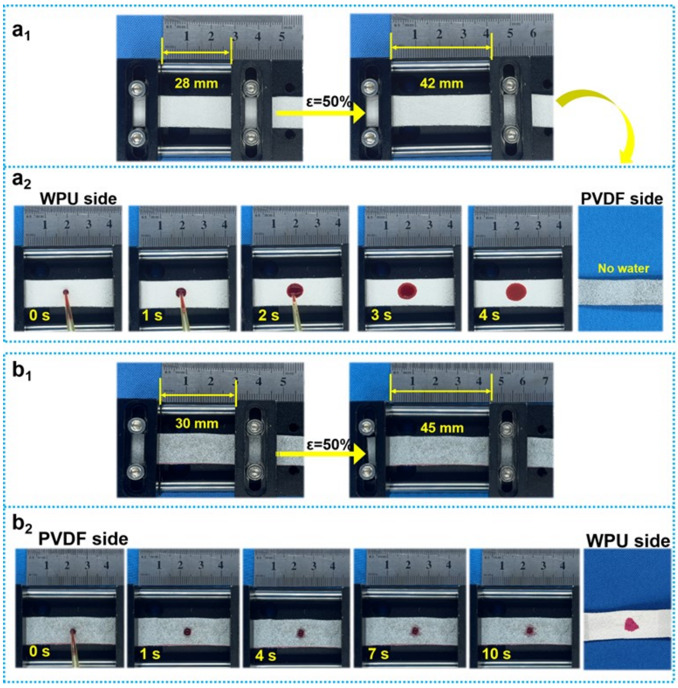

Fig. S9 Unidirectional water-transport performance of UWT-Skin at 50% strain when water was dropped on the WPU side (a) and the PVDF side (b).

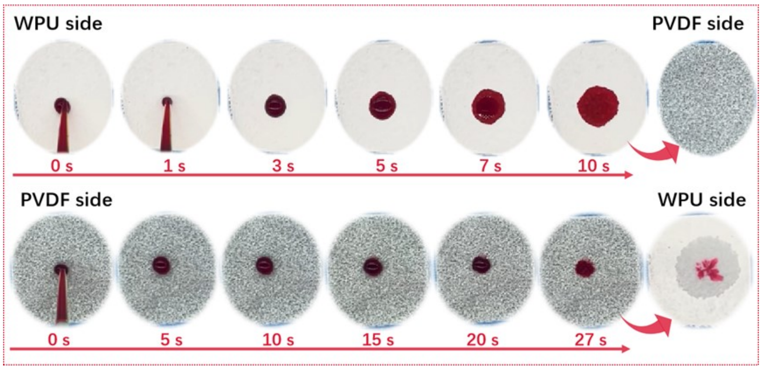

Fig. S10 Unidirectional water-transport behavior of UWT-Skin when left in everyday environment for 6 months

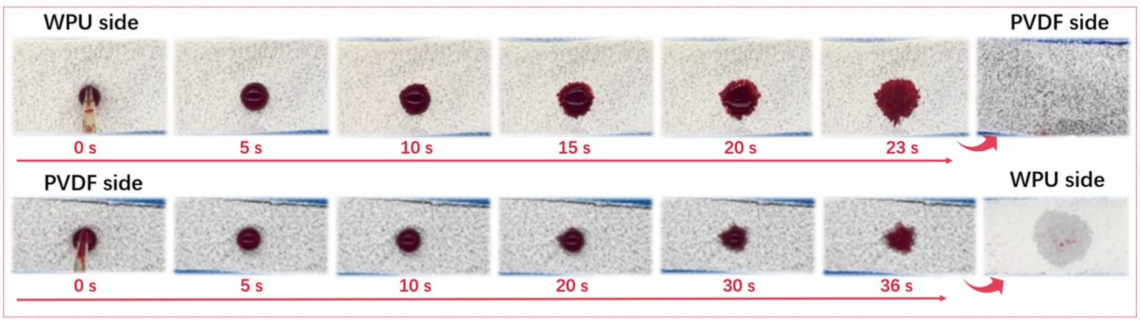

Fig. S11 Unidirectional water-transport behavior of UWT-Skin after UV radiation for 24 h

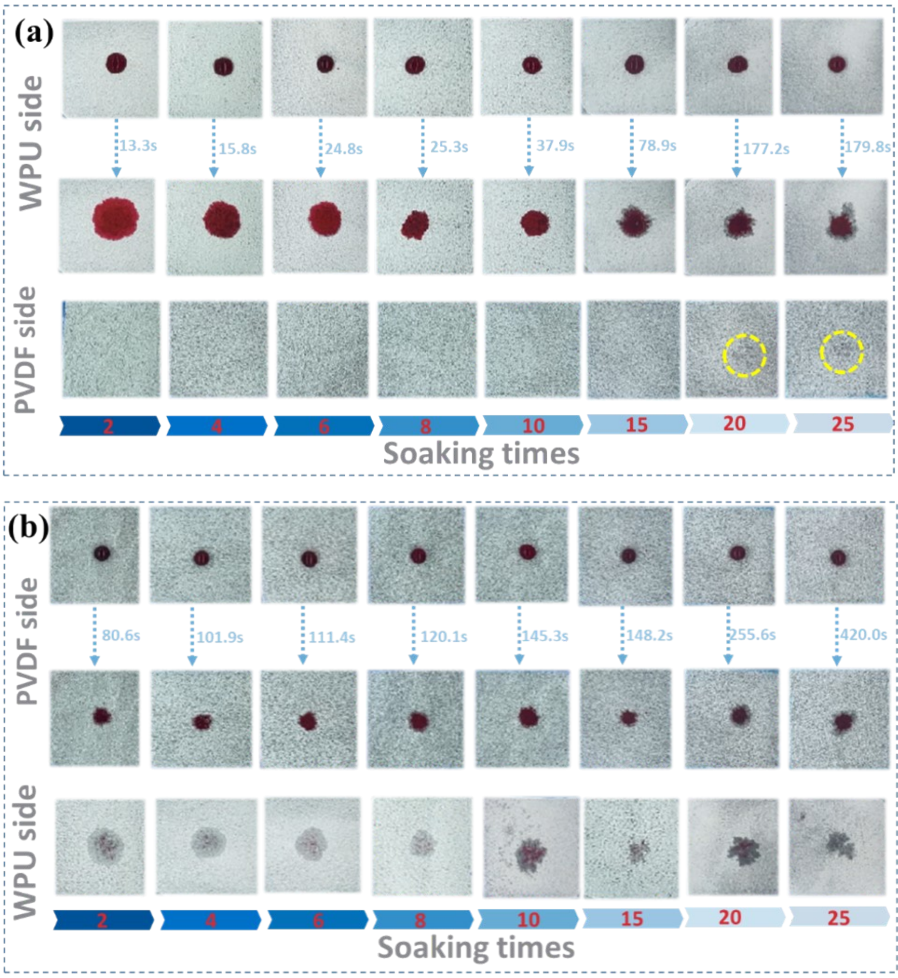

Fig. S12 Transport behavior of the water droplet of 20 μL on the UWT-Skin with different soaked times. (a) from WPU side to PVDF side, (b) from PVDF to WPU side.

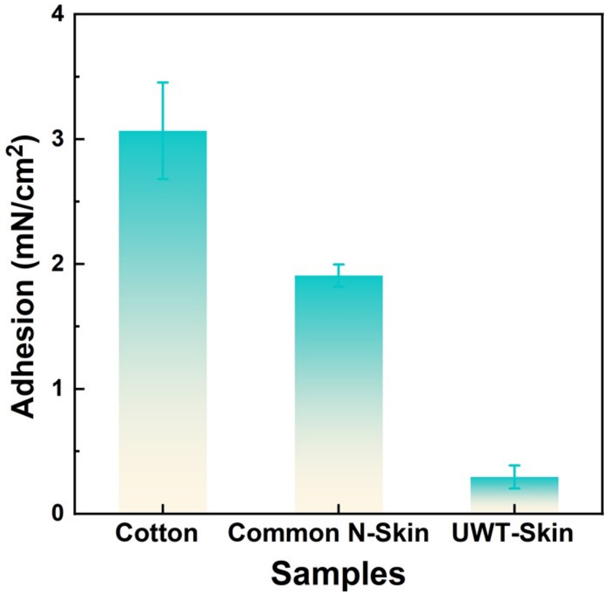

Fig. S13 Adhesion tests between the wetted skin and UWT-Skin.

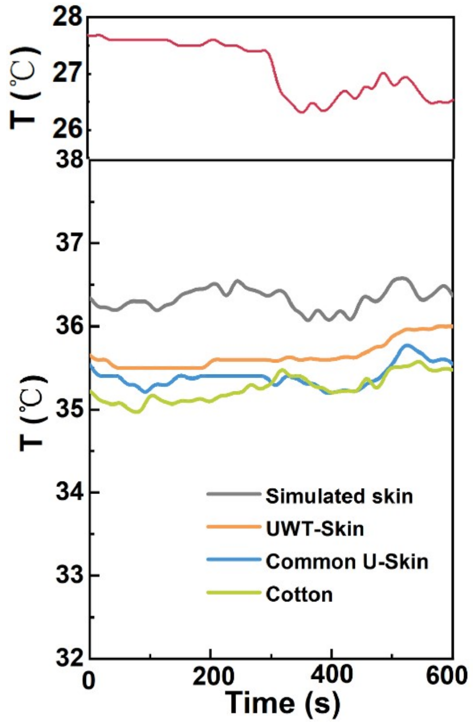

Fig. S14 Microclimate temperature between the samples and the dry simulated skin over time (a).

2. Supplementary Tables

Table S1 Previously reported fiber materials with unidirectional water-transport.

	R	Ref.
Plant fibers/polylactic acid	993	[1]
Polyacrylonitrile nanofibrous membrane/polydimethylsiloxane coating	696.6	[2]
Hydrophobic SiO_2 coating/polyester fabric	965.7	[3]
Polydimethylsiloxane coating/cotton	721	[4]
Cellulose acetate nanofibrous membrane	919	[5]
Tannic acid-polyethylenimine/octadecylamine-cotton	693.3	[6]
Polyacrylonitrile/Al_2O_3 /polypropylene fabric	870	[7]
Tannic acid@3-aminopropyltriethoxysilan@Fe(III)/ polyester-covered cotton	577.5	[8]
UWT-Skin	731	This work

[1] Gao Q, Zhu S, Huang Y, et al. Fast sweat wicking enabled by unidirectional water transport in biodegradable trilayered porous membranes produced via papermaking[J]. ACS Sustainable Chemistry & Engineering, 2024, 12(21): 8041-8050.

[2] Zheng R, Wang M, Jiang M, et al. Dynamic spectral metafabric with unidirectional moisture transport property for personal thermal management[J]. ACS Applied Materials & Interfaces, 2024.

[3] Huang G, Jin Y, Huo L, et al. An all-hydrophobic fluid diode for continuous and reduced-wastage water transport[J]. ACS Applied Materials & Interfaces, 2021, 13(43): 51708-51717.

[4] Lin Y, Liu X, Babar A A, et al. Sweat gland-inspired skin-like fabric with directional water transport and durability for efficient personal moisture management[J]. ACS Applied Materials & Interfaces, 2023, 15(45): 53105-53112.

[5] Babar A A, Miao D, Ali N, et al. Breathable and colorful cellulose acetate-based nanofibrous membranes for directional moisture transport[J]. ACS Applied Materials & Interfaces, 2018, 10(26): 22866-22875.

[6] Fan Z, Wang Y, Zhao W, et al. Unidirectional water transport fabric with nanoscale hydrophilic/hydrophobic pattern for personal moisture and thermal management[J]. Chemical Engineering Journal, 2024, 480: 148204.

[7] Xu J, Zhang F, Xin B, et al. Application of surface wettability modified polypropylene nonwoven in Janus composite fibrous mats for the function of directional water transport[J]. Polymers for Advanced Technologies, 2019, 30(12): 3038-3048.

[8] Du P, Wang J, Zhan X, et al. Asymmetric multienergy-coupled radiative warming textiles for personal thermal-moisture management[J]. ACS Applied Materials & Interfaces, 2023, 15(34): 41180-41192.

3. Supplementary Movies

Movie S1 Water transport behavior of N-Skin from top view

Movie S2 Water transport behavior of UWT-Skin from top view

Movie S3 Water transport behavior of UWT-Skin from side view

Movie S4 Water transport behavior of UWT-Skin placed vertically from side view