nature COMMUNICATIONS

All-fiber tribo-ferroelectric synergistic electronics with high thermal-moisture stability and comfortability

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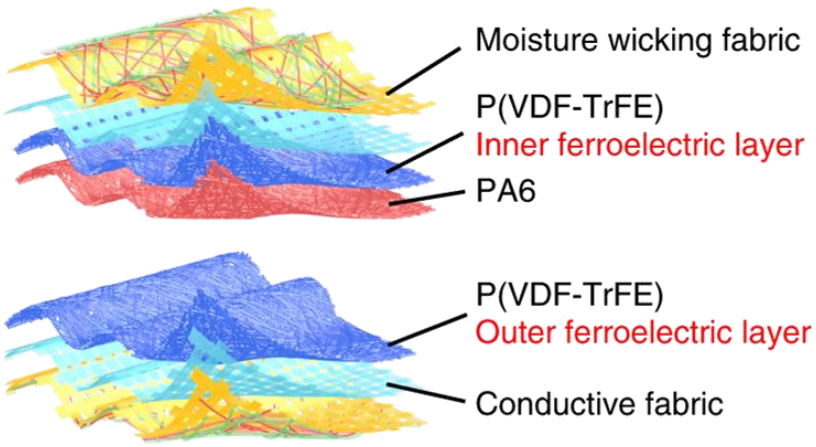
❑All fabric based electronic with good wearability was developed.

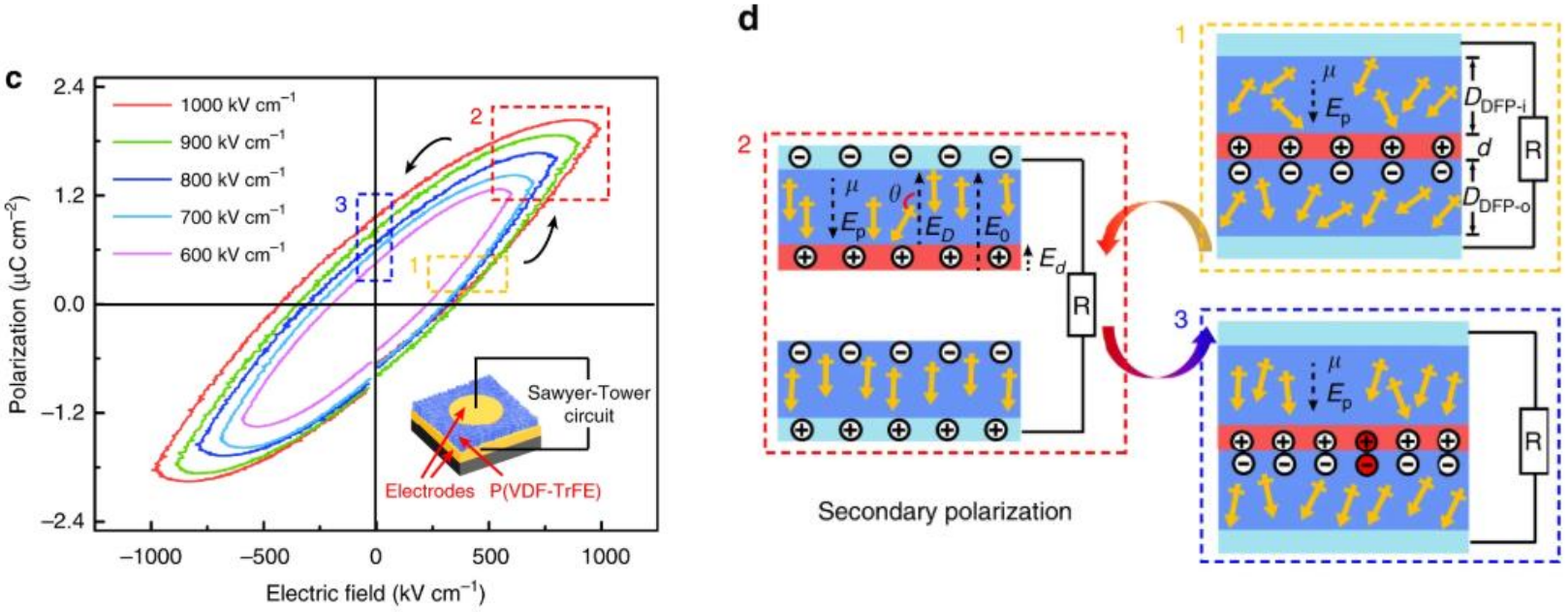
➢**All-fiber triboferroelectric synergistic e-textile** with outstanding thermal moisture comfortability.

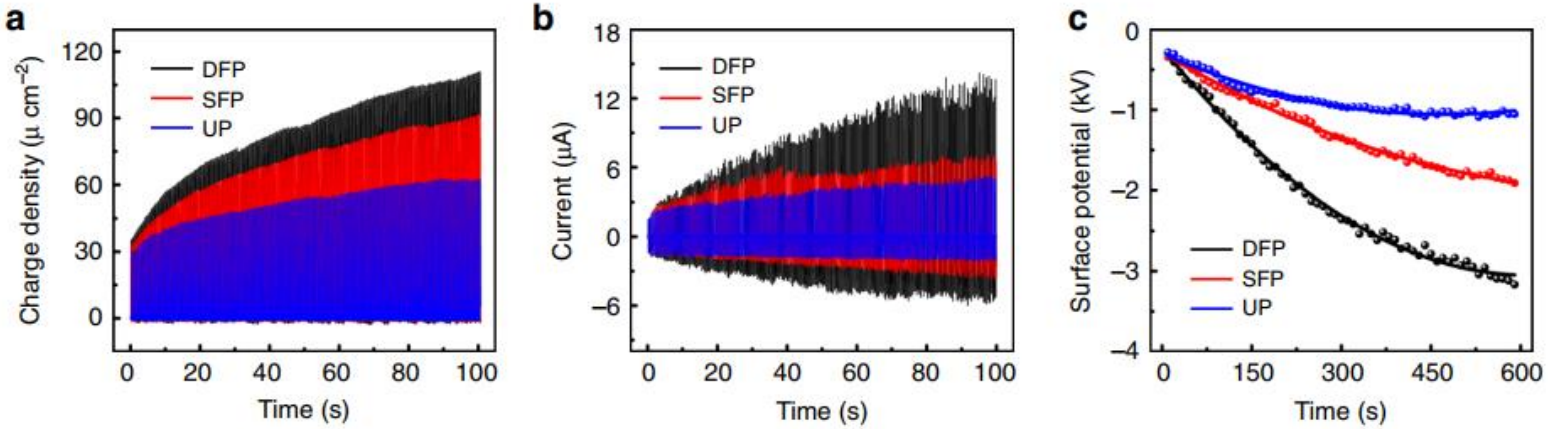
❑The all-fiber tribo-ferroelectric synergistic e-textile, consists of four function fabric layers,

1. Two nanofiber nonwovens poly(vinylidene fluoride-trifluoroethylene) (P(VDF-TrFE)) and polyamide 6 (PA6) with opposite tribo-polarity for contact electrification,
2. Nickel–Copper (Ni–Cu) fabric electrode for charge induction, and
3. The moisture-wicking fabric for directional water transport and rapid evaporation.

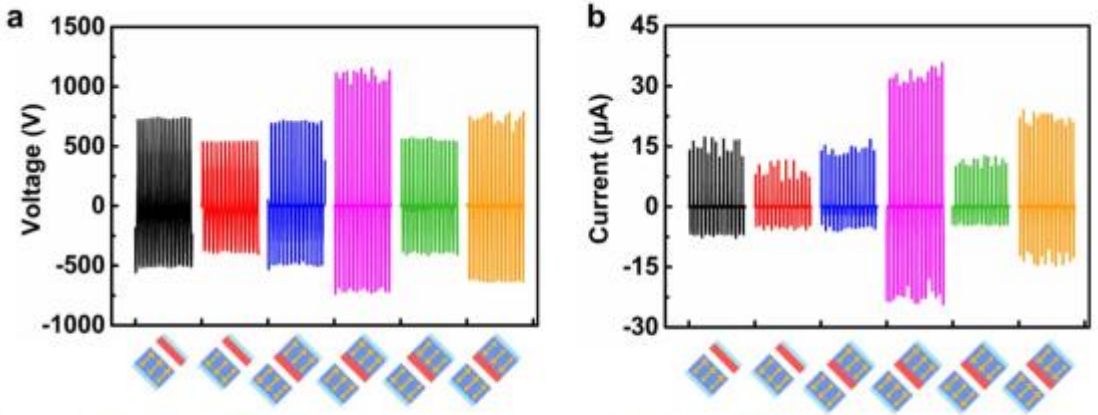


The P(VDF-TrFE) nanofibers also act as a polymer ferroelectricity (defined as inner/outer ferroelectric layers) for constructing tribo-ferroelectric synergistic enhancement effect. Electrospinning was adopted to induce rich ferroelectric β-phase as well as the steering polarization of CF_2 dipoles (defined as primary polarization) in P(VDF-TrFE) nanofibers





DFP, SFP, and unpolarized (UP) etextiles.



Supplementary Figure 6. Effect of primary polarization direction of P(VDF-TrFE) on output performance.

(a) Voltage (under 100 MΩ load). (b) Short-circuit current.

Construction of all-fiber e-textile with high thermal-moisture stability and comfortability

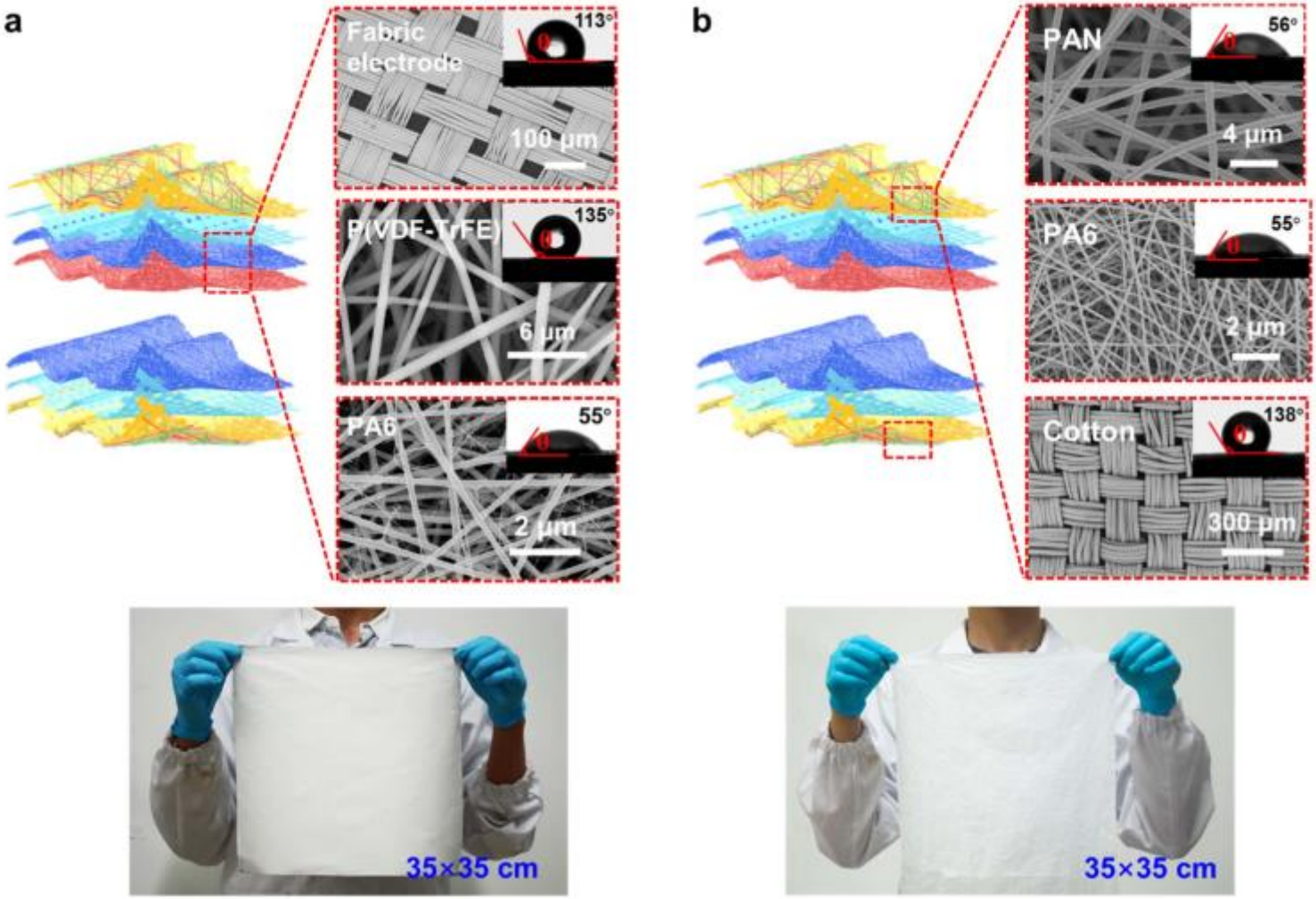
Wet environments are detrimental to electronics.

A moisture-wicking fabric based on bilayer hydrophilic nanofiber membranes with different pore sizes and a hydrophobic cotton membrane The functions of each layer are as follows:

(1) A hydrophilic polyacrylonitrile (PAN) nanofiber outer layer close to skin which was used to carry away the sweat from human body,

(2) A hydrophilic PA6 nanofiber intermediate layer which absorbing sweat from the PAN layer and rapidly diffusing,

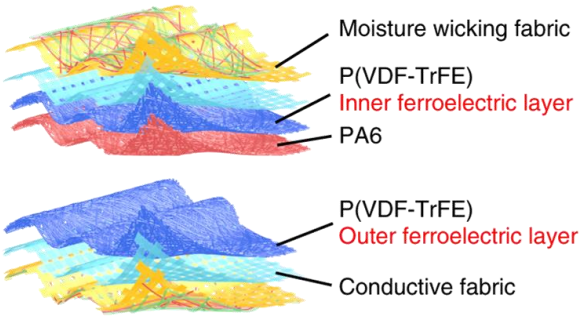
(3) A hydrophobic and breathable cotton fabric as the inner layer which effectively prevent liquid water in PA6 layer from diffusing to fabric electrode.



Fabric electrode + P(VDF-TrFE) + PA6

Moisture wicking fabric

Air permeability refers to the performance of gas molecules through the fabric and is the most basic property in fabric permeability.



15.90 mm s-1

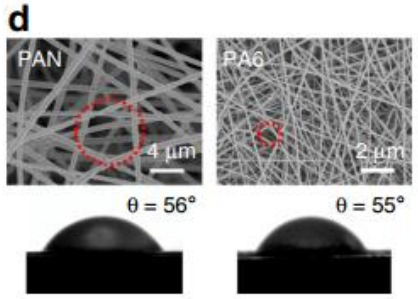
0.020 g cm-2

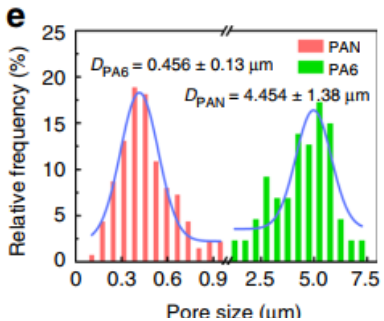
34.10 mm s-1

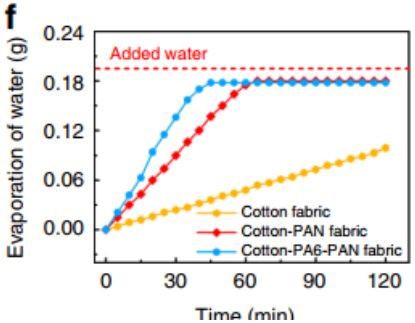
0.018 g cm-2

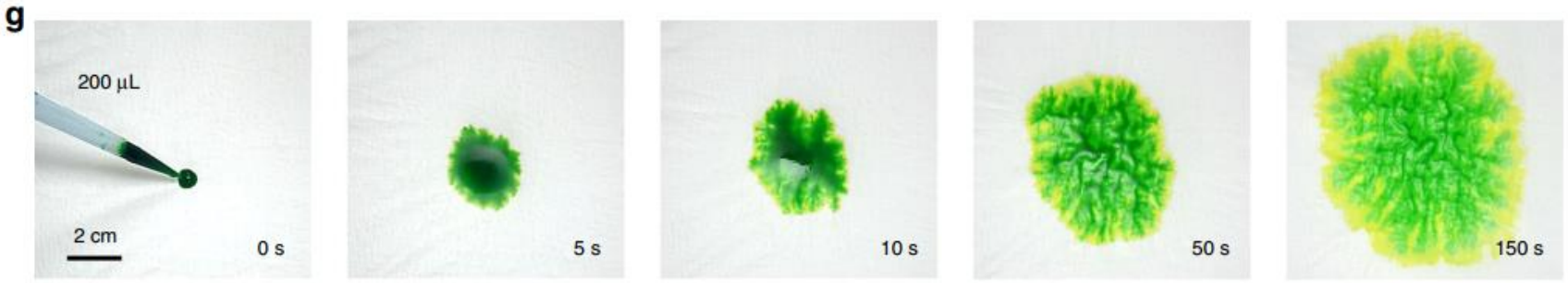
Air permeability

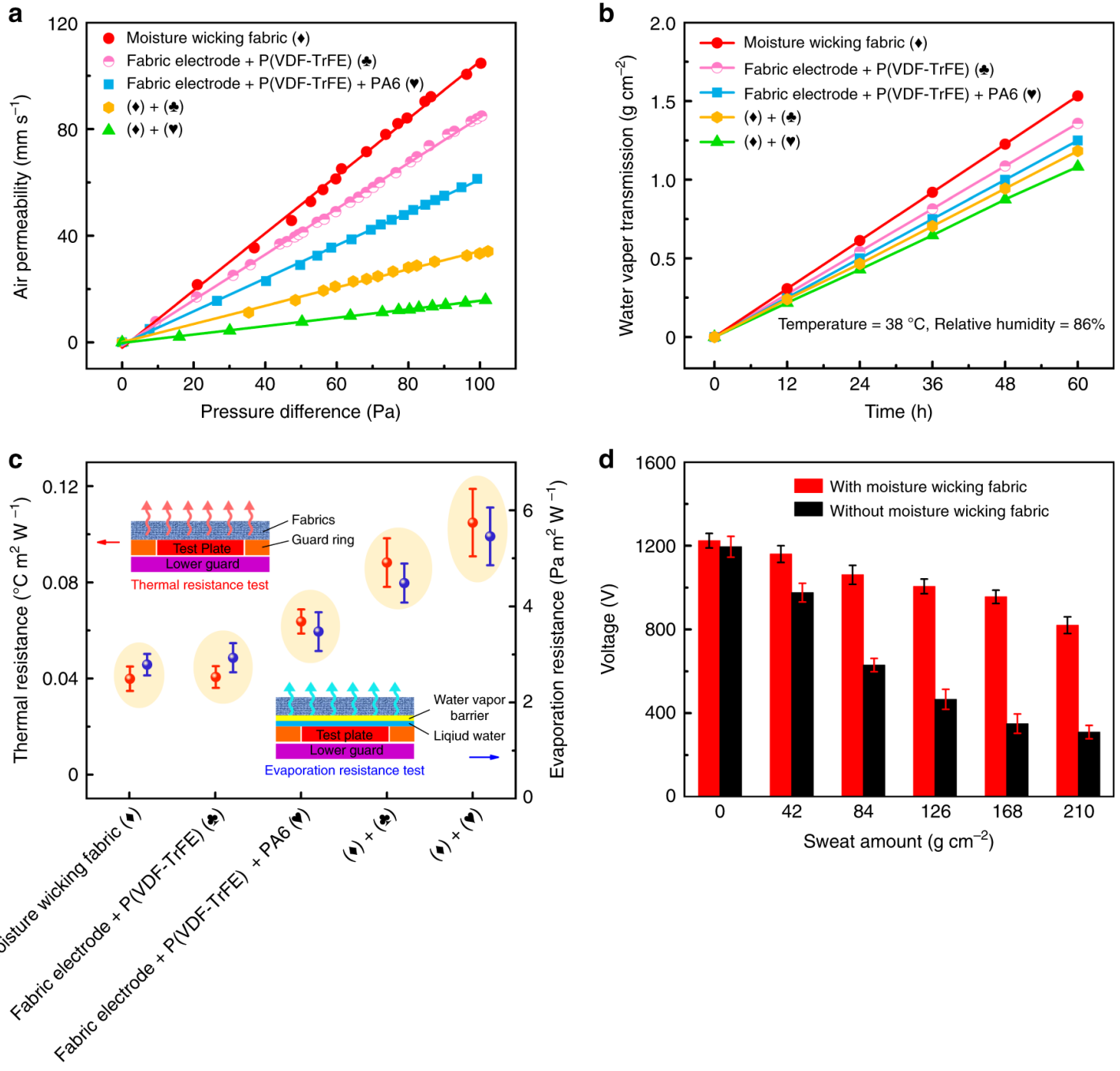
Moisture permeability

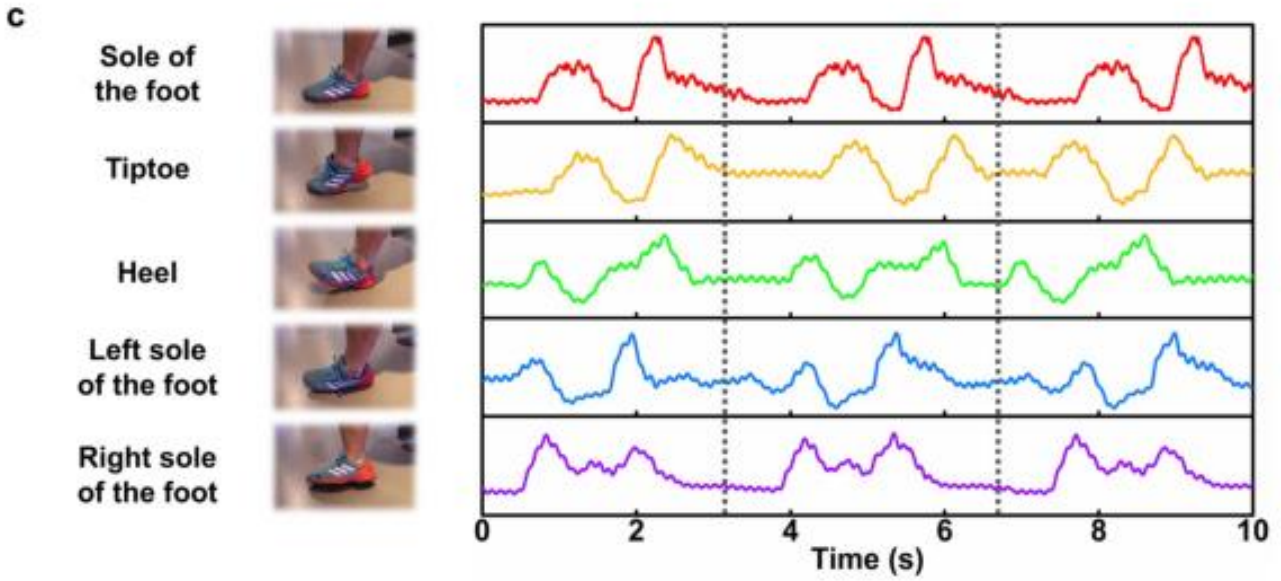









a
Moisture wicking fabric (♦)
Fabric electrode + P(VDF-TrFE) (♣)
Fabric electrode + P(VDF-TrFE) + PA6 (♥)
(♦) + (♣)
(♦) + (♥)
Air permeability (mm s−1)
Pressure difference (Pa)
b
Water vaper transmission (g cm−2)
Time (h)
Temperature = 38 °C, Relative humidity = 86%
c
Thermal resistance (°C m2 W−1)
Evaporation resistance (Pa m2 W−1)
Fabrics
Guard ring
Test Plate
Lower guard
Thermal resistance test
Water vapor barrier
Liqiud water
Test plate
Lower guard
Evaporation resistance test
Moisture wicking fabric (♦)
Fabric electrode + P(VDF-TrFE) (♣)
Fabric electrode + P(VDF-TrFE) + PA6 (♥)
(♦) + (♣)
(♦) + (♥)
d
With moisture wicking fabric
Without moisture wicking fabric
Voltage (V)
Sweat amount (g cm−2)



Questions

Thank you