Supporting Information

Janus polyoxymethylene fabric with unidirectional moisture transport and all-weather passive radiative cooling

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S1. Calculations of average solar reflectance and average *IR* emittance

The average solar reflectance $\bar{R}_{solar}$ and average infrared emittance $\bar{\varepsilon}_{IR}$ of materials are defined by Eq.(1) and Eq.(2), respectively: [1]

$$\bar{R}_{solar} = \frac{\int_0^{\infty} I_{solar}(\lambda) R_{solar}(\lambda,\theta) d\lambda}{\int_0^{\infty} I_{solar}(\lambda) d\lambda} \#(1)$$

$$\bar{\varepsilon}_{IR} = \frac{\int_{8\mu m}^{13\mu m} I_{BB}(\lambda,T) \varepsilon(\lambda,\theta) d\lambda}{\int_{8\mu m}^{13\mu m} I_{BB}(\lambda,T) d\lambda} \#(2)$$

Where, $I_{solar}(\lambda)$ is the solar illumination spectra with air mass 1.5, $R_{solar}(\lambda,\theta)$ and $\varepsilon(\lambda,\theta)$ are the reflectivity and emissivity of sample at wavelength (λ) and angle (θ), respectively, $I_{BB}(\lambda, T)$ is a blackbody's spectral radiance at temperature (T).

S2. Calculations of theoretical net radiative cooling power

In an open environment, the material will emit heat through the surface, and the absorbed heat includes the heat from solar radiation (P_{solar}), ambient radiation (P_{amb}) and heat transfer by conduction and convection due to temperature differences ($P_{conv+cond}$). The net cooling power refers to the difference between the radiated power and the absorbed power, expressed as, [2, 3]

$$P_{cool} = P_{rad} - P_{amb} - P_{solar} - P_{conv+cond} \#(3)$$

At night, due to the disappearance of solar radiation, the expression of net cooling power can be simplified as,

$$P_{cool} = P_{rad} - P_{amb} - P_{conv+cond} \#(4)$$

Specifically, the radiated energy through the cooling radiator:

$$P_{rad} = A\int d\Omega\cos\theta\int_0^{\infty} d\lambda I_{BB}(T_s,\lambda)\varepsilon(\lambda,\theta)\#(5)$$

the absorbed power due to incident atmospheric thermal radiation:

$$P_{amb} = A\int d\Omega\cos\theta\int_0^{\infty} d\lambda I_{BB}(T_{amb},\lambda)\varepsilon(\lambda,\theta)\varepsilon_{atm}(\lambda,\theta)\#(6)$$

the absorbed energy from solar radiation:

$$P_{solar} = \int_0^{\infty} d\lambda \in (\lambda,\theta_{sol})I_{AM1.5}(\lambda)\#(7)$$

The lost energy due to convection and conduction:

$$P_{conv+cond}(T_s,T_{amb}) = Ah_c(T_{amb} - T_s)\#(8)$$

Where, A is the radiation area, θ is the local zenith angle, T_s is the temperature covered by the sample, T_{amb} is the ambient temperature and assumed to be 303 K, $\varepsilon(\lambda, \theta)$ is the emissivity of the material at the wavelength λ. Atmospheric emissivity $\varepsilon_{atm}(\lambda, \theta)$ is related to atmospheric transmittance, wavelength, and zenith angle, which can be obtained according to $\varepsilon_{atm}(\lambda, \theta) = 1 - t(\lambda)^{1/\cos\theta}$, where $t(\lambda)$ is the atmospheric transmittance at zenith angle θ. In Eq.(5) and Eq.(6), I_{BB} is the intensity of the radiation wave when the real-time temperature is T and the wavelength λ generated by the black body, which is calculated by,

$$I_{BB}(T,\lambda) = \frac{2hc^2}{\lambda^5}\frac{1}{e^{hc/\lambda K_B T} - 1}\#(9)$$

In Eq.(7), the solar radiation intensity is provided by $I_{AM1.5}(\lambda)$, and θ is taken as 0° because our test device is completely facing the sun. Typical non-radiative heat transfer coefficient h_c is in the range of 0-12 $W\cdot m^{-2}\cdot K^{-1}$.

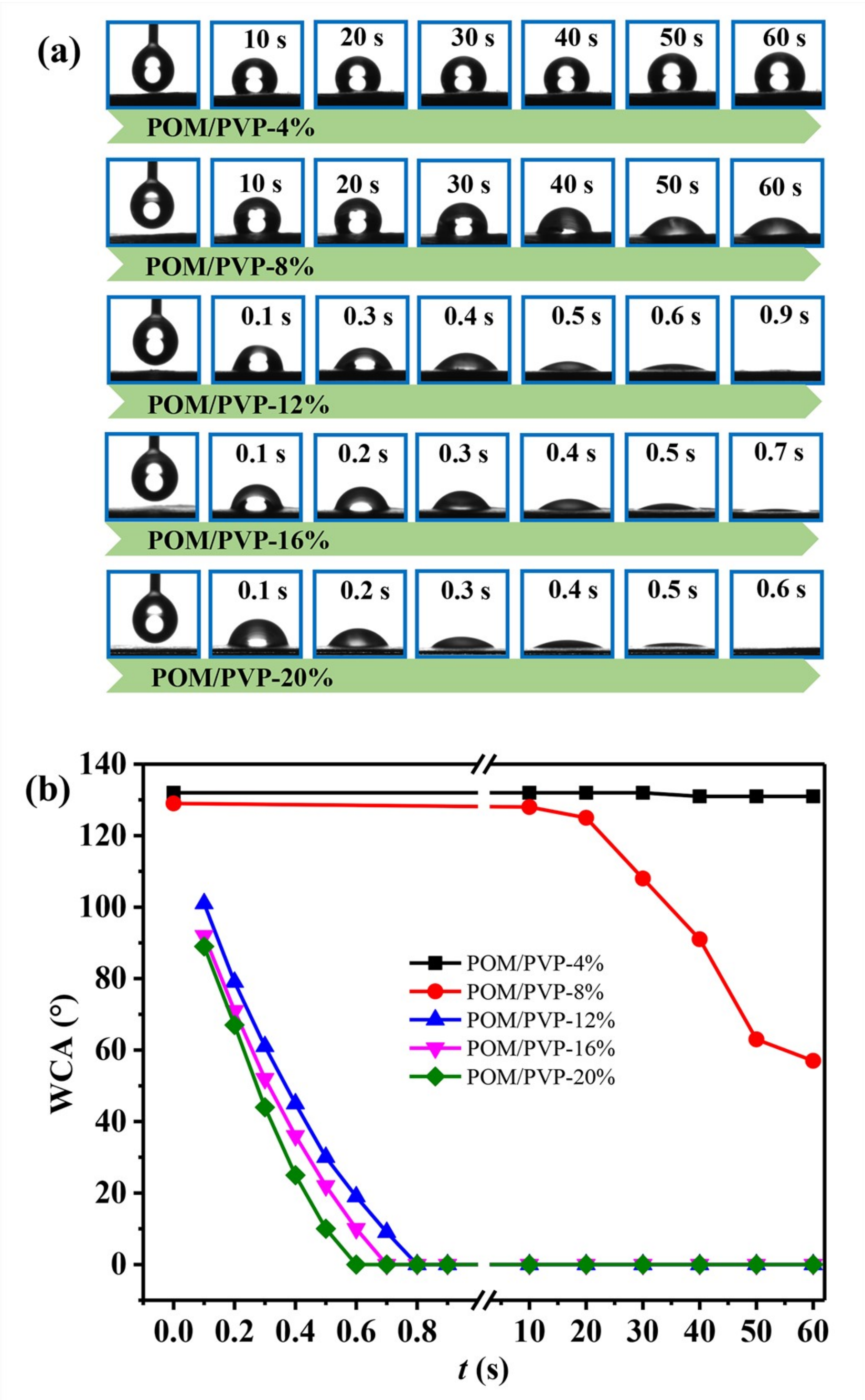

Fig. S1. (a) The wettability and (b) dynamic water contact angle of POM/PVP nanofibrous fabrics with different PVP dosages.

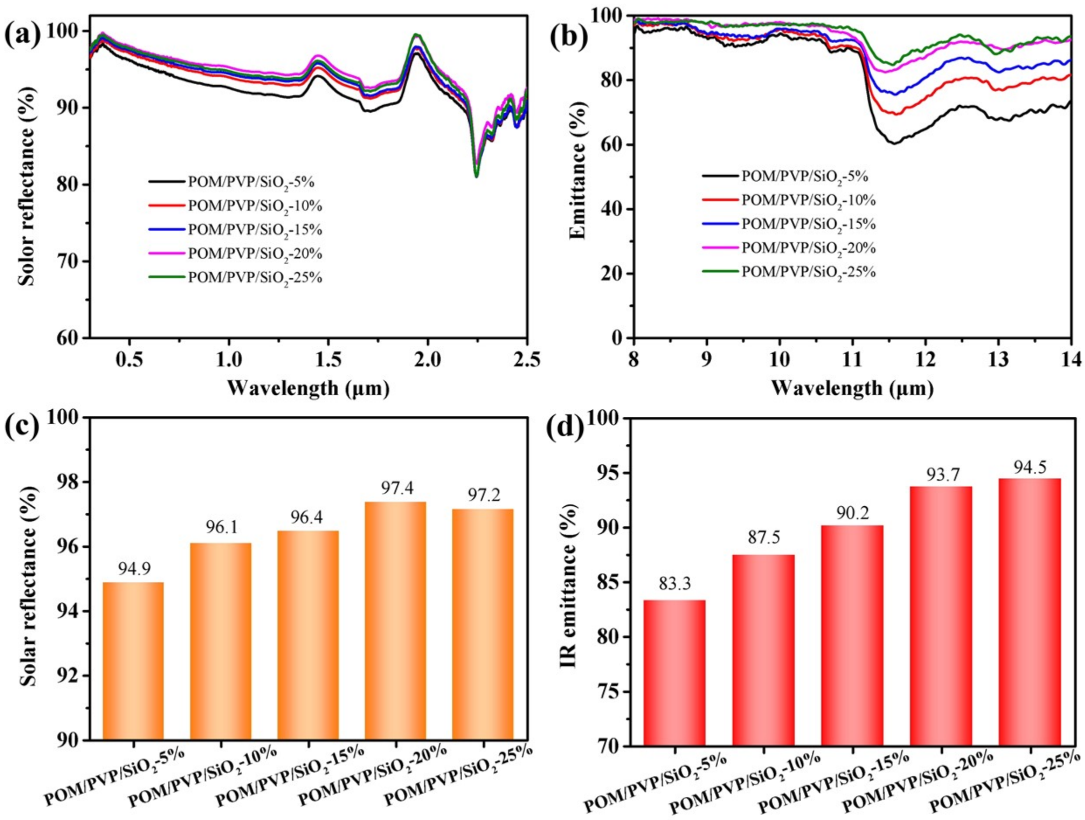

Fig. S2. (a, c) Solar reflectance and (b, d) *IR* emittance of Janus POM fabrics with different SiO_2 dosages.

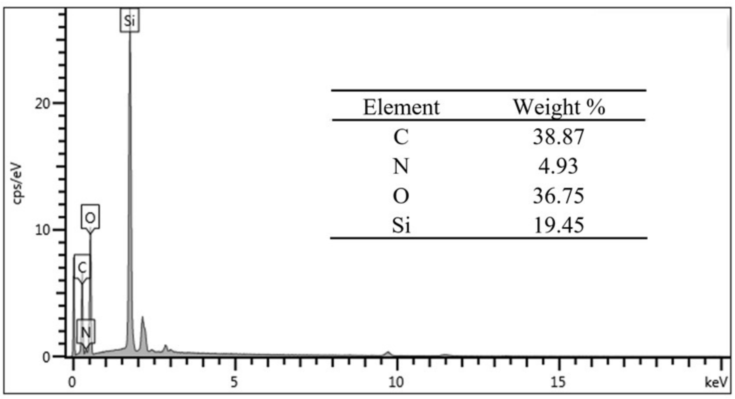

Fig. S3. EDS analysis of the outer layer of Janus POM fabric.

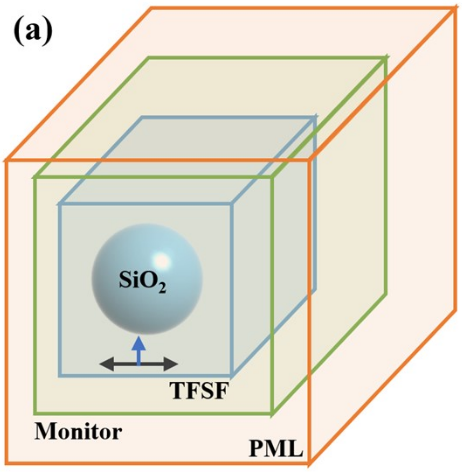

Fig. S4. Schematic diagram of the numerical simulation model of finite-difference time-domain solution (FDTD, Lumerical), (a) SiO_2 nanoparticles, (b) POM fibers. FDTD was used to calculate the scattering efficiency of SiO_2 nanoparticles and POM fibers. Perfect Matching Layer (PML) boundary conditions were adopted in the x, y, and z-axis. Total-field scattered-field source (TFSF) was used to provide 0.25-2.5 um of light. The Analysis group of cross-sections was used to measure the scattering efficiency.

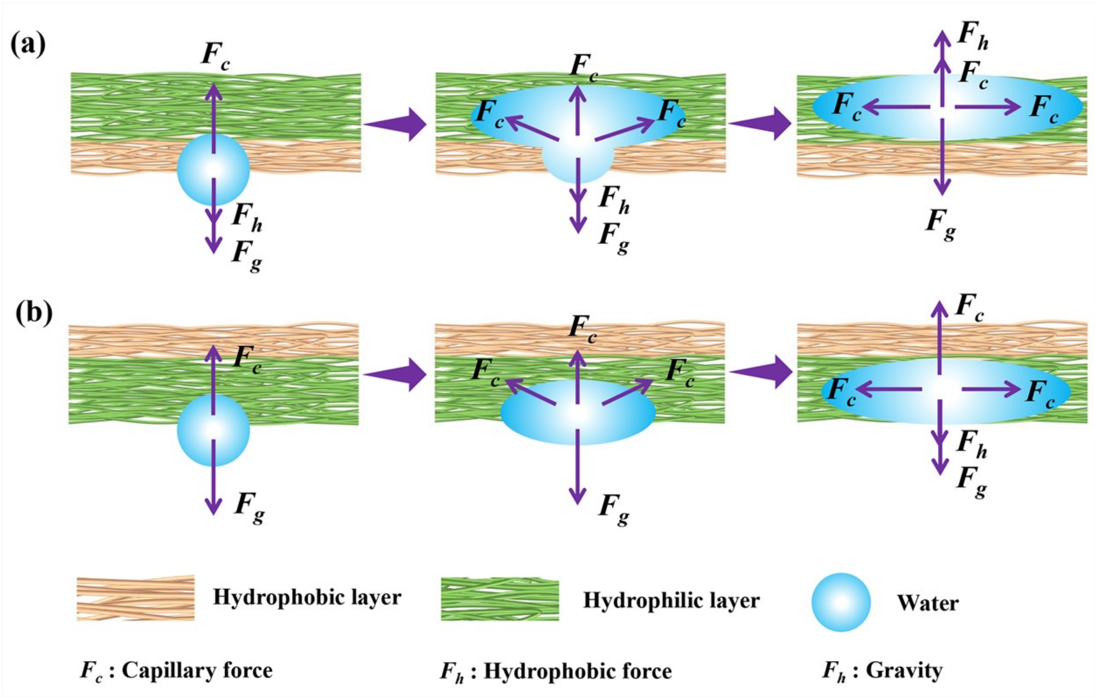

Fig. S5. Schematic of unidirectional moisture transport mechanism of Janus POM fabric.

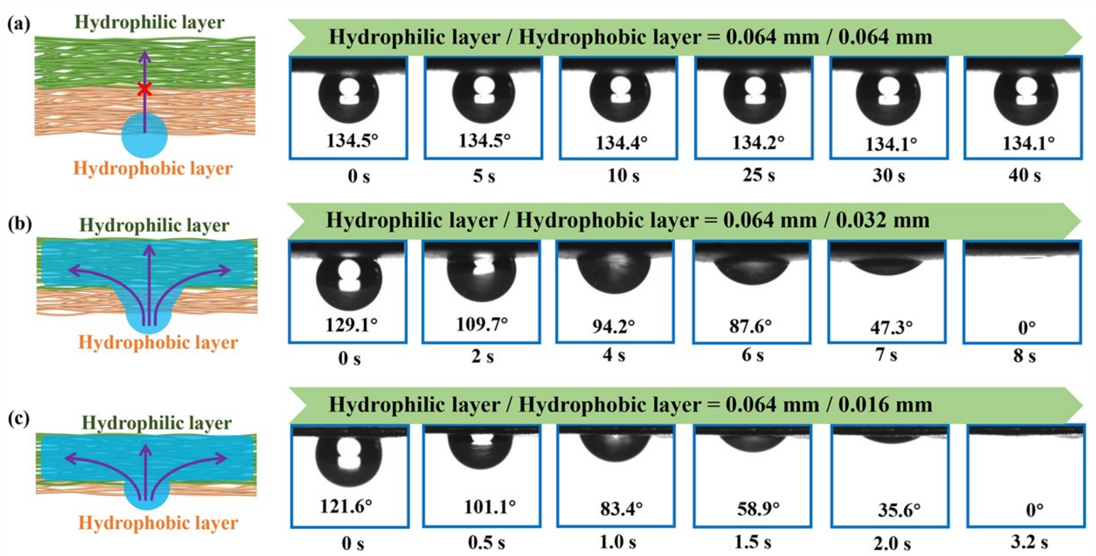

Fig. S6. The moisture transport schematic and dynamic water contact angle of Janus POM fabrics with different hydrophobic layer thicknesses.

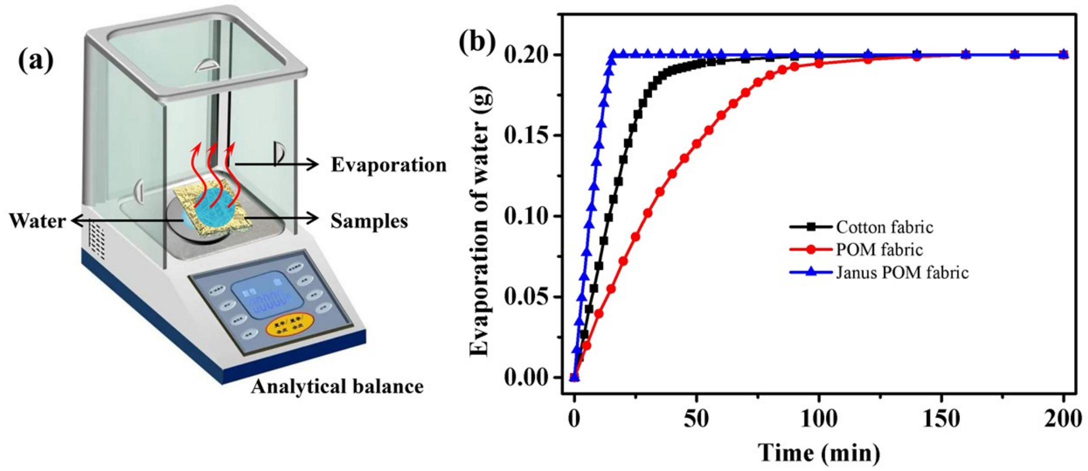

Fig. S7. (a) Schematic of the moisture evaporation experiment at room temperature. (b) Comparison of water evaporation rates of cotton, POM, and Janus POM fabrics.

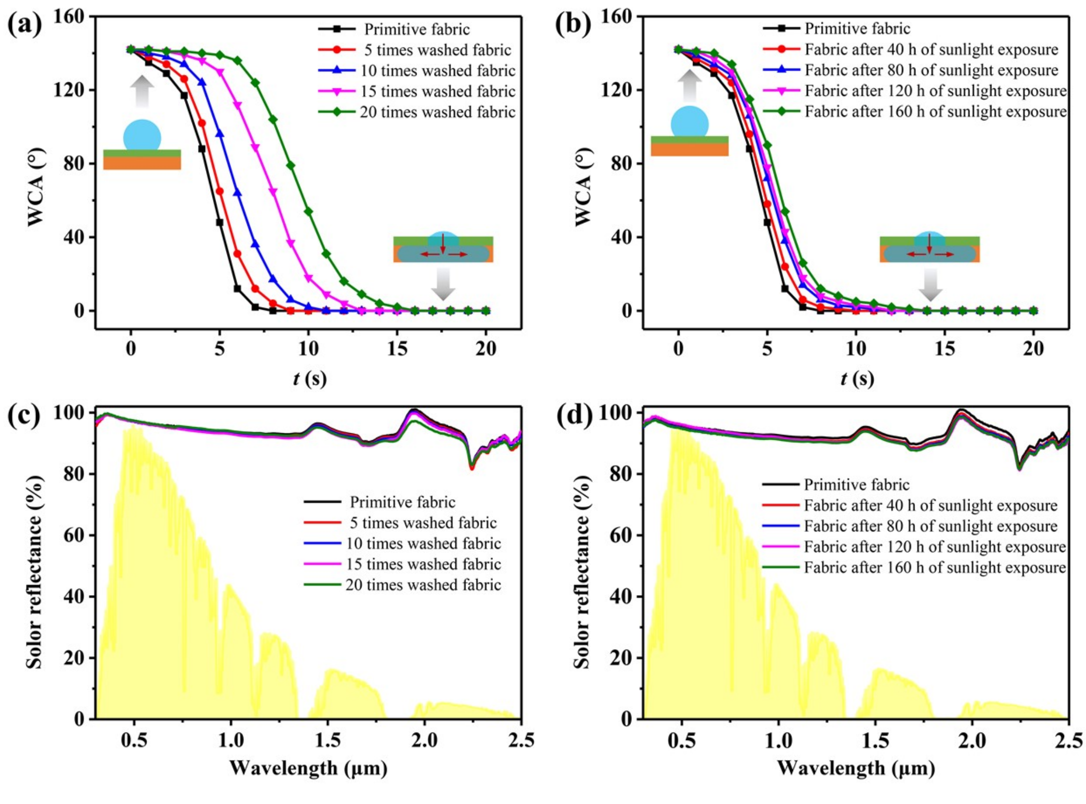

Fig. S8. Durability evaluation of Janus POM fabric. Unidirectional moisture transport performance of Janus POM fabric (a) after washing and (b) after sunlight exposure, solar reflectance of Janus POM fabric (c) after washing and (d) after sunlight exposure.

Table S1. The comparison of radiative cooling and unidirectional moisture transport properties of Janus POM fabric with other reported materials.

Sample	Solar reflectance (%)	*IR* emittance (%)	Cooling power ($W\cdot m^{-2}$)	Unidirectional moisture transport	Ref.
Glass-polymer metamaterial	96.0	93.0	93.0	No	4
Porous PVDF-HFP	~97.0	~96.0	96.0	No	5
PVDF/PUA coating	93.4	93.3	94.2	No	6
$MgHPO_4\cdot 1.2H_2O$ coating	92.2	94.0	78.2	No	7
$CaCO_3$ paint	~96.0	89.6	93.1	No	8
SiO_2/nanoporous PE	96.2	90.0	85.0	No	9
Cellulose/SiO_2	~94.0	>90.0	52.0	No	10
Hierarchically porous PLA	91.0	92.0	117.0	No	11
Porous cellulose acetate	97.4	92.0	110.0	No	12
Inorganic metapaper	99.0	90.0	104.0	No	13
Hierarchical TPU/ZIF-8 nanofiber	~97	~93	105.0	No	14
RCSM-Cotton	95.9	75.5	/	Yes	15
Hierarchical metafabric	91.8	95.2	/	Yes	16
RCUM-Textile	89.7	94.9	/	Yes	17
Janus POM fabric	97.4	93.7	130.2	Yes	This work

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