Supplementary Material

Notes S1. Heat losses analysis:

The main pathway of heat loss from the evaporator includes three portions: heat transfer to bulk water ($Q_{Conduction}$), convective heat transfer into the air ($Q_{Convection}$) and heat transfer into the surrounding ($Q_{Radiation}$), as illustrated below[1-5].

(1) Radiative heat loss

The radiative heat loss ($Q_{Radiation}$) to surroundings can be calculated according to Stefan-Boltzmann equation expressed as:

$$\Phi = \varepsilon A \sigma \left(T_s^4 - T_v^4\right)$$

$$Radiation\ loss = \frac{\Phi}{AP} = \frac{\varepsilon\sigma\left(T_s^4 - T_v^4\right)}{P}$$

Where Φ (W m^{-2}) is the radiation heat flux, A (m^2) is the surface area, σ is the Stefan-Boltzmann constant (5.669 × 10^{-8} W m^{-2} K^{-4}), ε is the emissivity of material supposed as the maximum emissivity of 0.97 in this paper. T_s (316.5 K) is the surface temperature of evaporator at steady state under 1 sun illumination, T_v (311.4 K) is the adjacent environment temperature, and P is the irradiated sunlight power density. Therefore, the radiation heat flux is 34.96W m^{-2}, which is 3.47% of the radiation heat loss (1 sun = 1000 W m^{-2}).

(2) Conductive heat loss

The convective heat loss ($Q_{Convection}$) to surroundings can be calculated as:

$$Convection\ loss = k\frac{T_1 - T_2}{P\Delta l}$$

Where k denotes the thermal conductivity of bulk water (0.599 W m^{-1} K^{-1}) [5]. The two embedded thermocouples were applied to monitor the water temperature, and the distance between the thermocouples (Δl) is 5 mm. The average temperature at point 1 over one hour is about 25.30 °C. The average temperature

at point 2 over one hour is about 25.20°C. Consequently, the QConduction is estimated to be 11.98 W m^{-2}, corresponding to a conductive heat loss of 1.198%..

(3) Convective heat loss

The convective heat loss ($Q_{Convection}$) to surroundings can be calculated as:

$$Convection\ loss = h\frac{T_s - T_v}{P}$$

where h represents the convection heat transfer coefficient which is set to be 2.24 J m^{-2} s^{-1} K^{-1} here [1]., Ts is surface temperature of the evaporator. Tv is the adjacent environment temperature. Consequently, the QConvection is estimated to be 11.42 W m^{-2}, corresponding 1.14%.

Based on these analyses, the total heat loss for our evaporator is approximately 5.808%, representing a solar-to-vapor conversion efficiency of 94.092%.

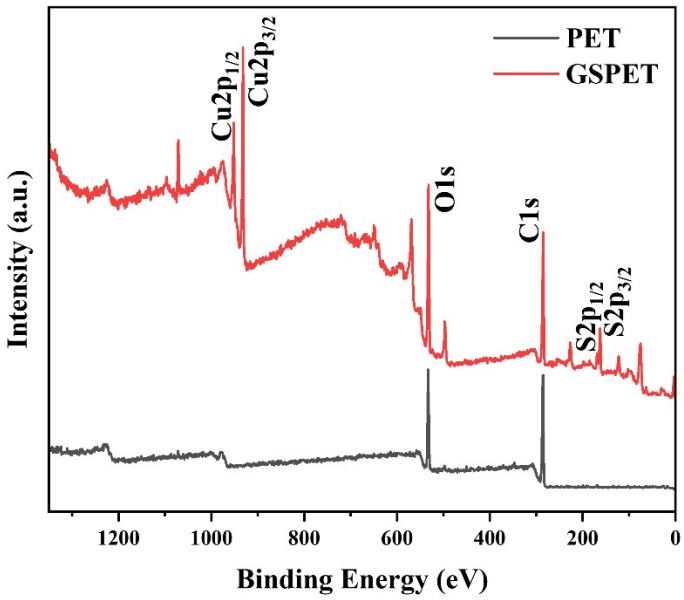

Figure S1 XPS full scan spectra of GSPET and PET.

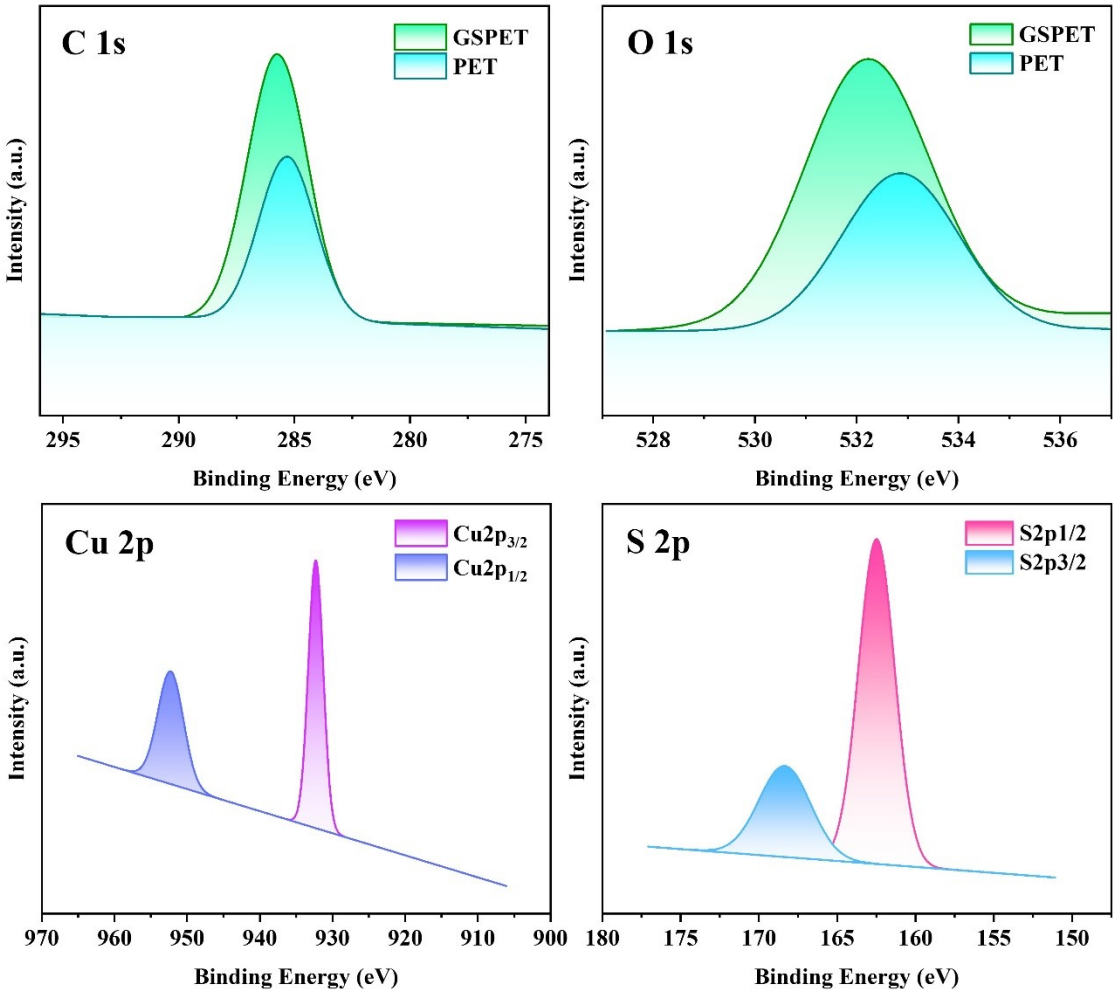

Figure S2 High-resolution XPS spectra of C 1, O 1s, Cu 2p, and S 2p from GSPET.

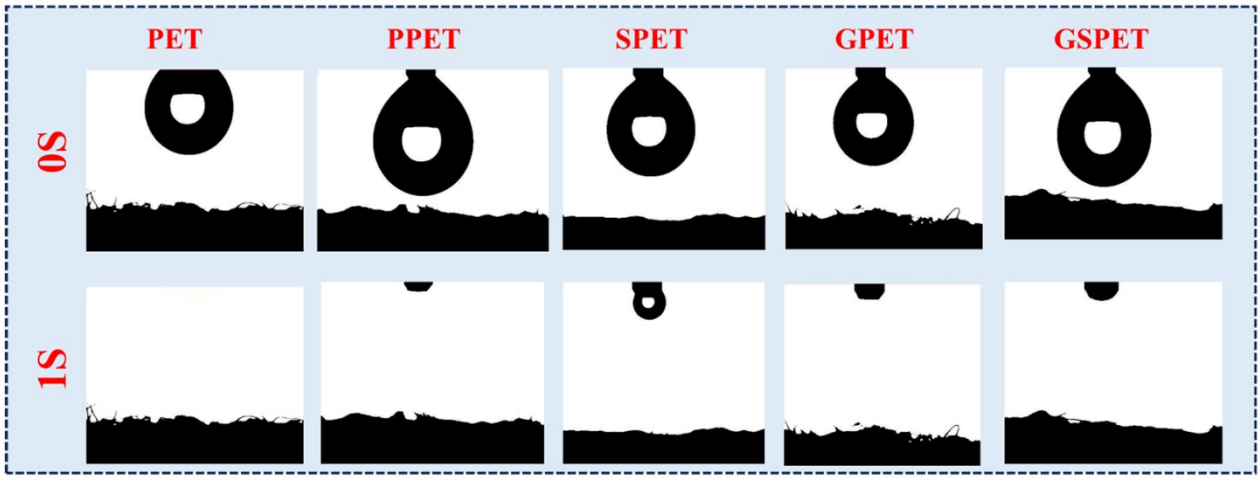

Figure.S3. Hydrophilicity of samples PET,PPET,GPET,SPET and GSPET.

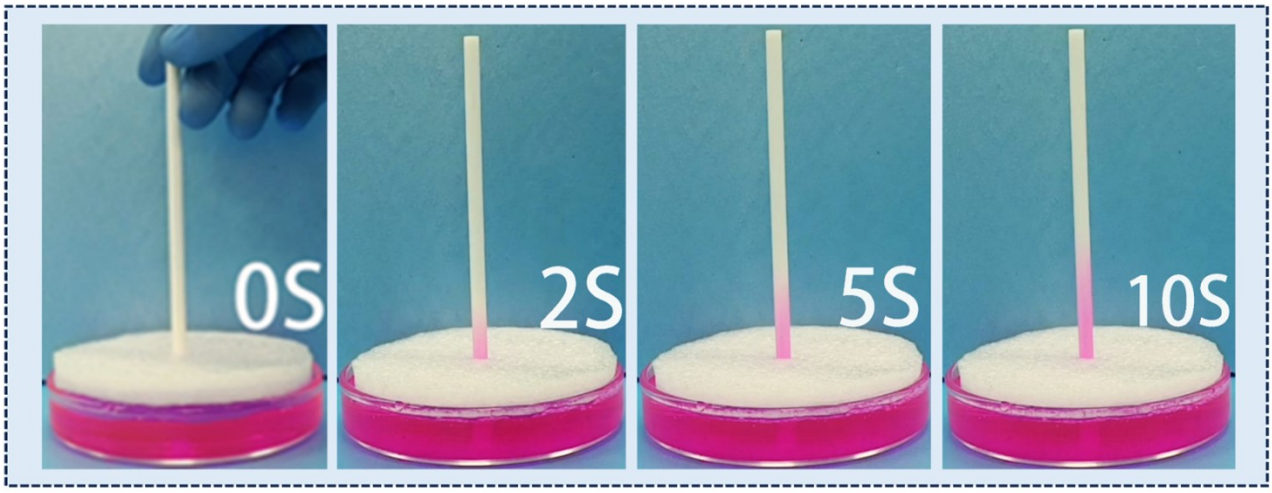

Figure.S4. Hydrophilicity of WHF water-conducting rods.

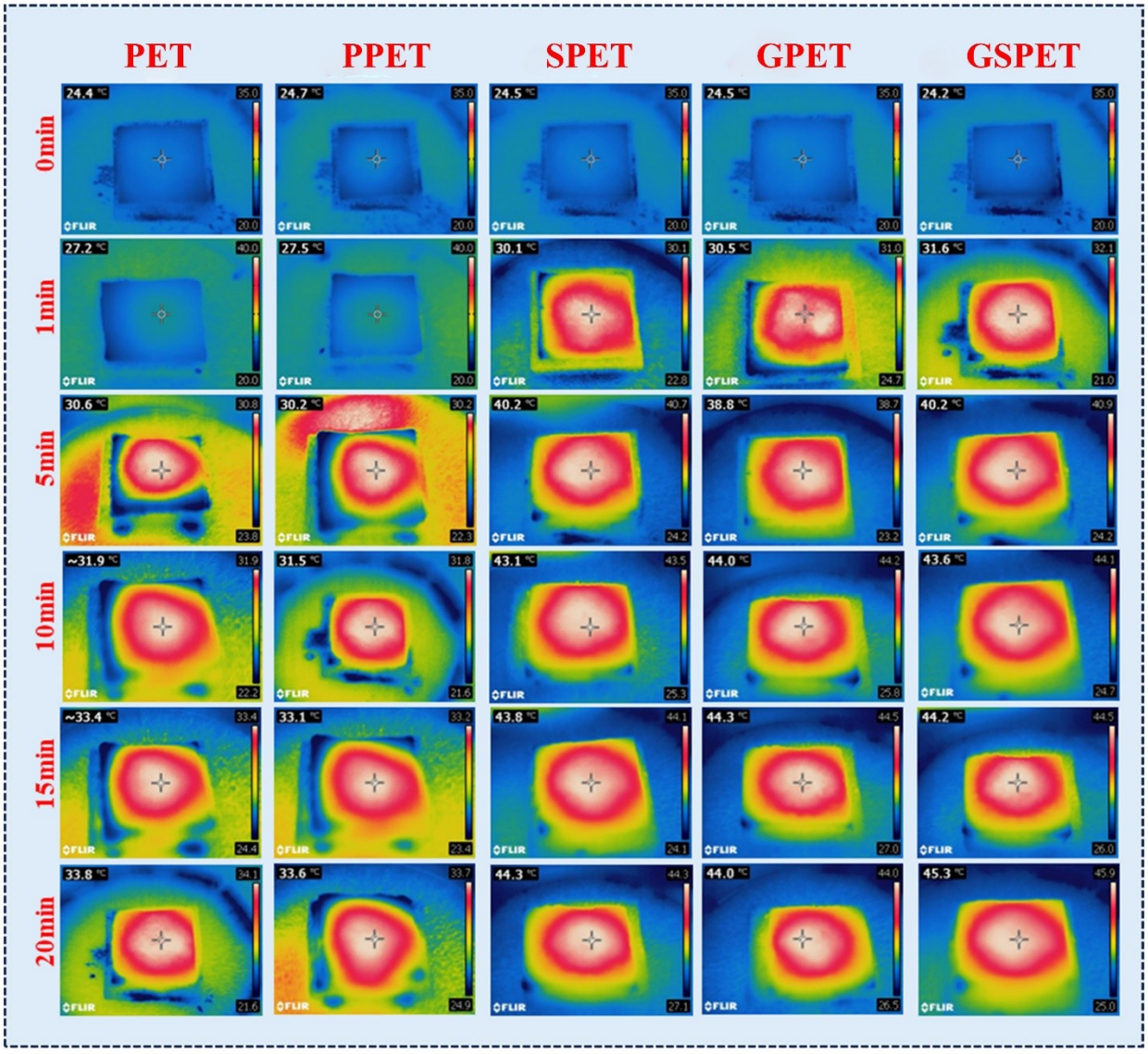

Figure.S5. Infrared photographs of the wet state warming process of samples PET, PPET, GPET, SPET and GSPET.

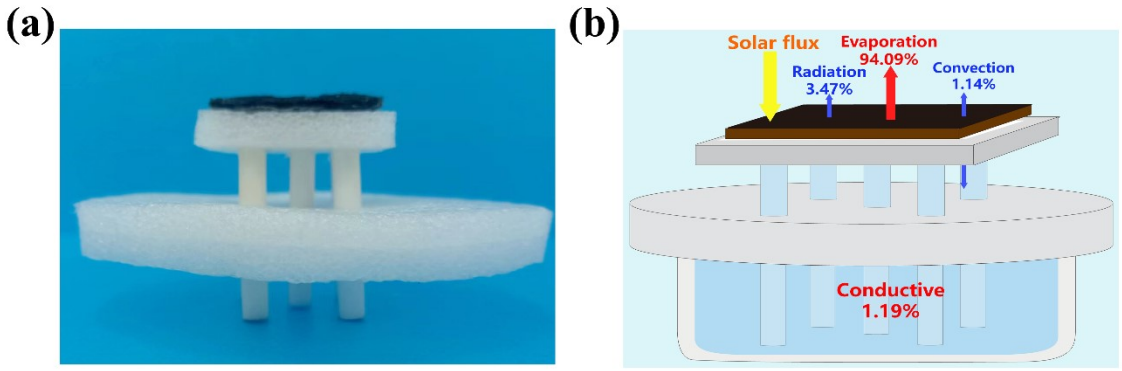

Figure.S6. (a)Physical drawing of evaporator structure. (b)Heat loss data chart.

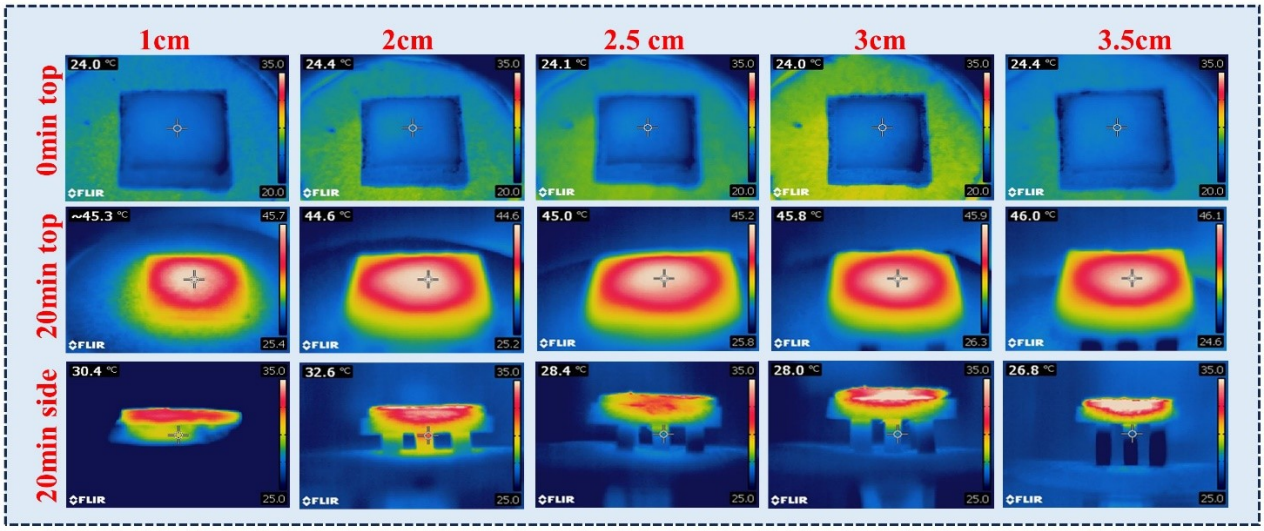

Figure.S7. Wet infrared photographs of the evaporator photothermal layer and water guide rods at different heights.

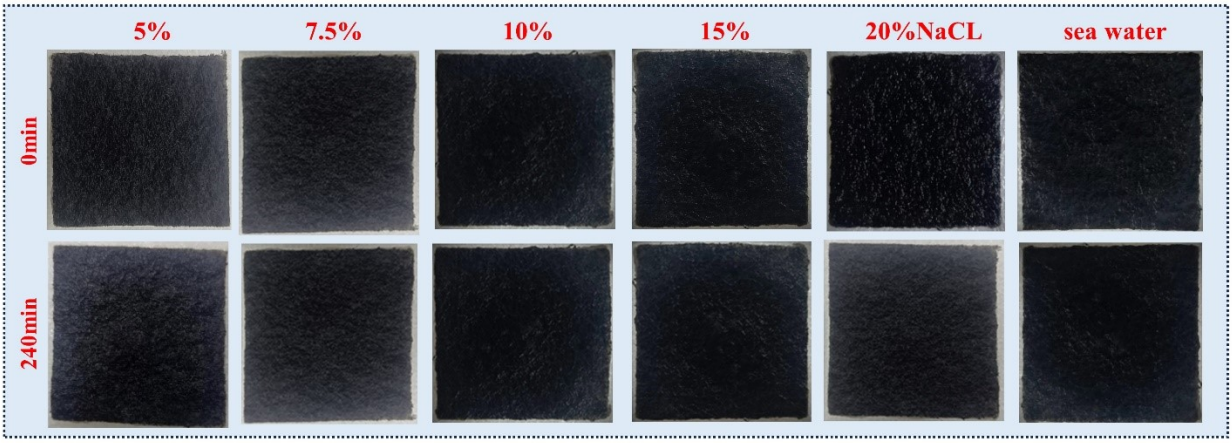

Figure.S8. Photographs of the surface of GSPET samples before and after 240 minutes of evaporation with different concentrations of NaCl and real seawater.

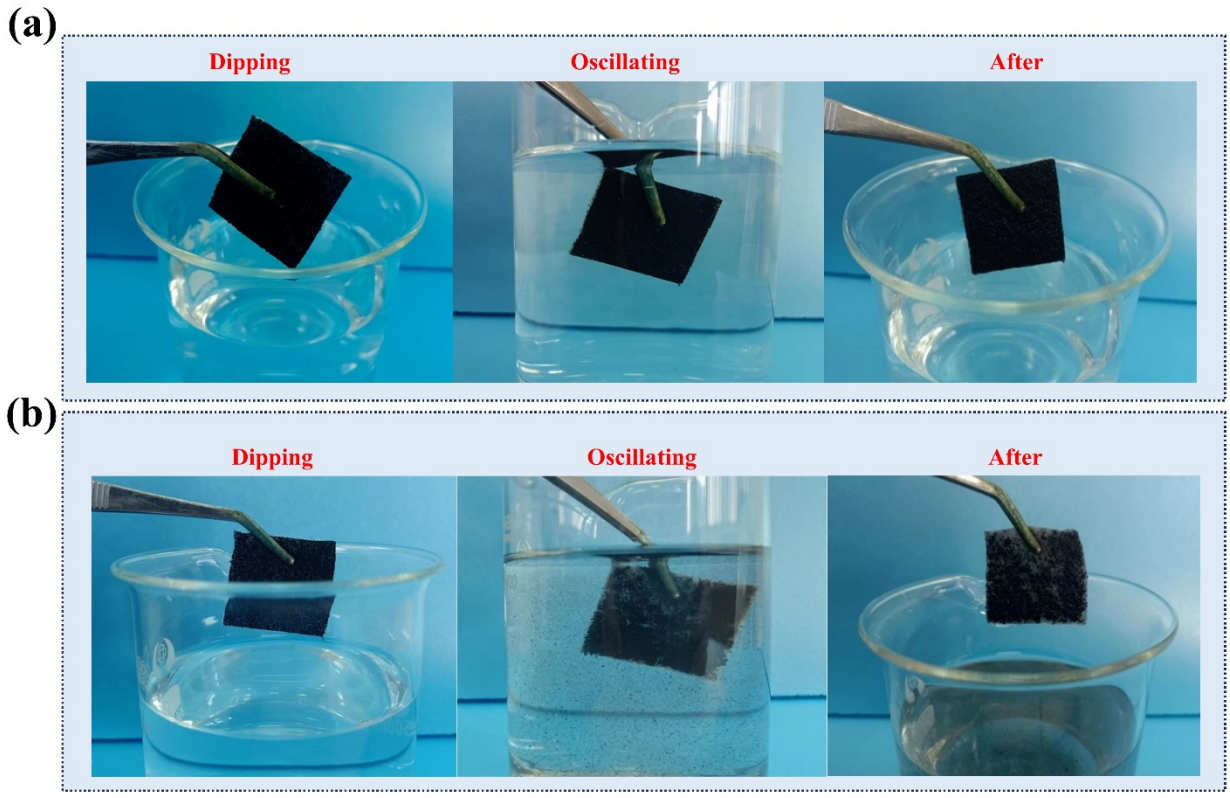

Figure.S9. Photographs of the water washing process of the photothermal layer with (b) without (c) adhesive PVA.

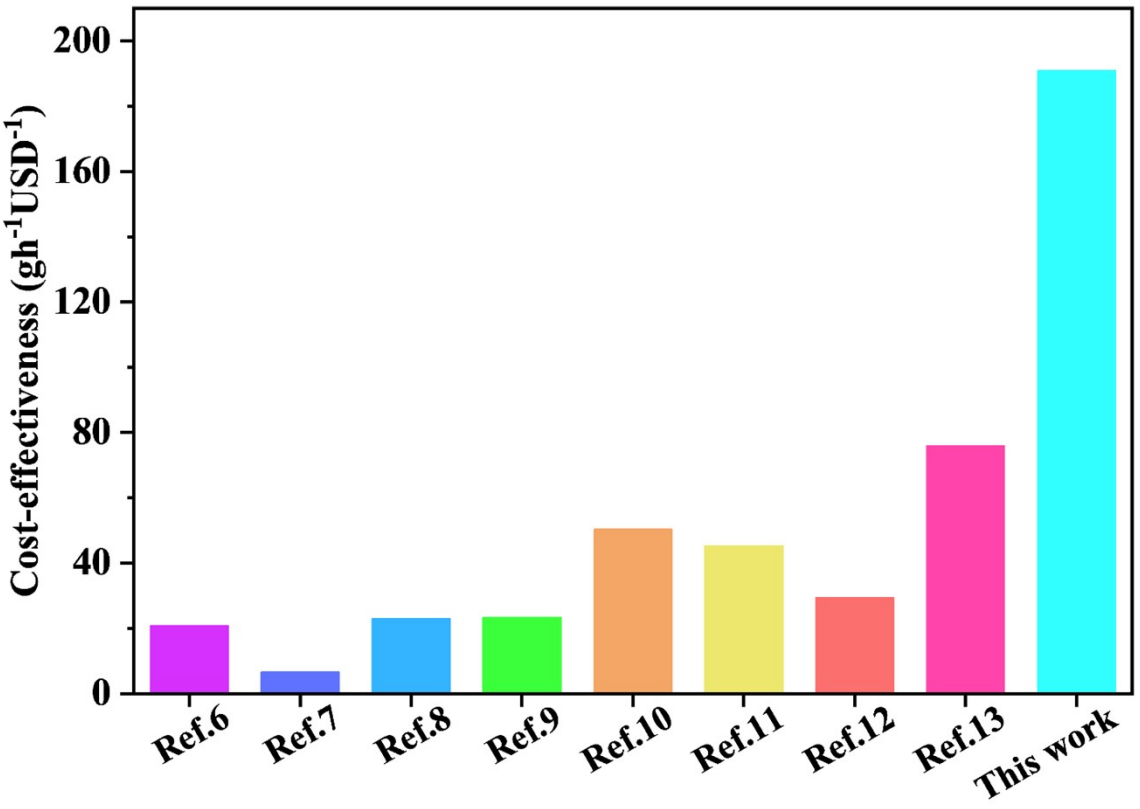

Figure.S10. Comparison of cost-effectiveness between this work and relevant literature.

Table S1. The evaporation rate and corresponding solar-to-vapor efficiency of the reported materials under 1-Sun irradiation.

Materals	Efficiency (%)	Evaporation rate ($kg\ m^{-2}\ h^{-1}$)	Reference
MXene membrane	87.1	1.54	[14]
PPy-CF fabric	90.45	1.56	[15]
DM/PVA/Fe_2O_3@cotton	82.9	1.32	[16]
MWCNT@PP/PE	89.7	1.44	[17]
Chitosan/Mxene/fabric (CMF)	88.5	1.35	[18]
MXene/carbon cotton	88.2	1.35	[19]
CuO@PDA/PB	87.10	1.39	[20]
PDA@CNT/ES nonwoven	90.77	1.29	[13]
GO/Cu_xS nonwoven	94.6	1.54	This work

Table S2. Estimation of the total cost of the prototype with 1 m^2 PDA/CNT@ES absorber. The price of all the consumables were in bulk scale.

Materals	Price ¥ ($)	Amount	Cost ($)
PET non-woven (110 g/m^2)	\$ 0.277 m^{-2}	1.0m^2	0.0152
EVA Foam (1m*1m*100mm)	\$ 0.1921 m^{-2}	1.0m^2	0.1921
Spunlaced cotton(80g/m^2)	\$ 1.25 m^{-2}	1.0m^2	0.0101
CB	\$ 2.0833 kg^{-1}	5.0 g	0.0104
Gallic acid	\$ 30.66 kg^{-1}	20.0 g	0.6133
Polyetherimide	\$ 69.28 kg^{-1}	12.0g	0.8314
NaOH	\$5.54 kg^{-1}	20.0g	0.1108
Na_2S	\$50 L^{-1}	15.0ml	0.7575
$CuCl_2{\cdot}2H_2O$	\$17.91 kg^{-1}	24.0g	0.4301
Polydimethylsiloxane	\$193.88L^{-1}	5.0ml	0.0096
Ethyl acetate	\$5.9444L^{-1}	250.0ml	1.4860

Thus, the total cost of the prototype with 1 m^2 CSPT can be estimated to be:

Total cost of CSP = 4.4666 dollars.

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