Supporting Information for

A Novel Photothermal Water Evaporation Membrane with Self-healing and Anti-reflection

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4 pages, 4 figures and 1 table total

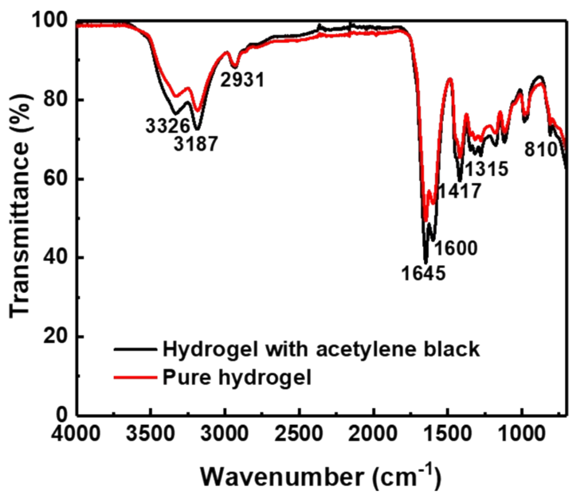

Fig. S1. The FTIR spectrum of the pure hydrogel and hydrogel with acetylene black.

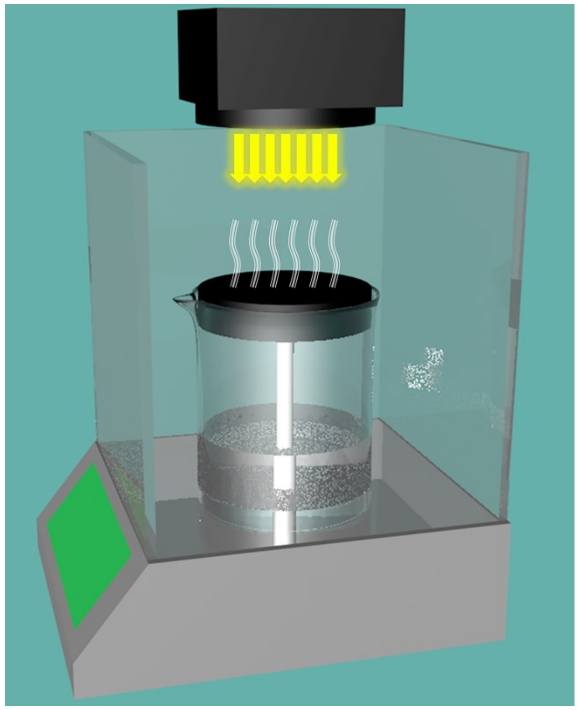

Fig. S2. The schematic diagram of evaporation performance test, optical power density is controlled to 1 sun, and the mass loss over time is tested through the subtraction method.

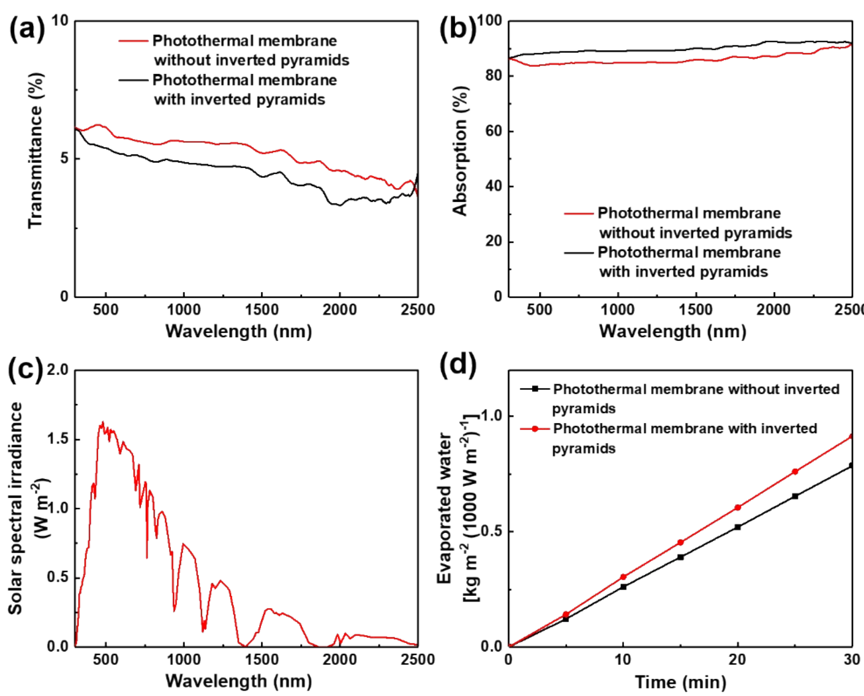

Fig. S3. The transmittance spectra (a) and absorption spectra (b) of the membrane, the solar spectrum irradiance (c) and the curve of the evaporation performance normalized to the light absorption power density (d).

The evaporation rate is normalized by the following steps. Firstly, the reflection and transmittance are measured directly and shown in Fig. 4(a) and Fig. S3(a). Secondly, according to the reflection and transmittance, the absorption of the membrane is calculated through the formula

$$A(\lambda)=1-R(\lambda)-T(\lambda)$$

where $A(\lambda)$ is the absorption at different wavelengths, $R(\lambda)$ is the reflection at different wavelengths, and $T(\lambda)$ is the transmittance at different wavelengths. The result is shown in Fig. S3(b). Thirdly, according to the absorption calculated above and the solar spectral irradiance shown in Fig. S3(c), the light absorption power density of the membrane is calculated through the formula

$$A=\int_{\lambda_{min}}^{\lambda_{max}} A(\lambda)E(\lambda)d\lambda$$

where A is the light absorption power density of membrane, $E(\lambda)$ is solar spectral irradiance at different wavelengths, λ_{min} is 300 nm, and λ_{max} is 2500 nm. The result of the light absorption power density of the membrane without anti-reflection structure is 825 W m^{-2}, while that of the membrane with anti-reflection structure is 865 W m^{-2}. The evaporation rate is normalized to the light absorption power density, and then shown in Fig. S3(d).

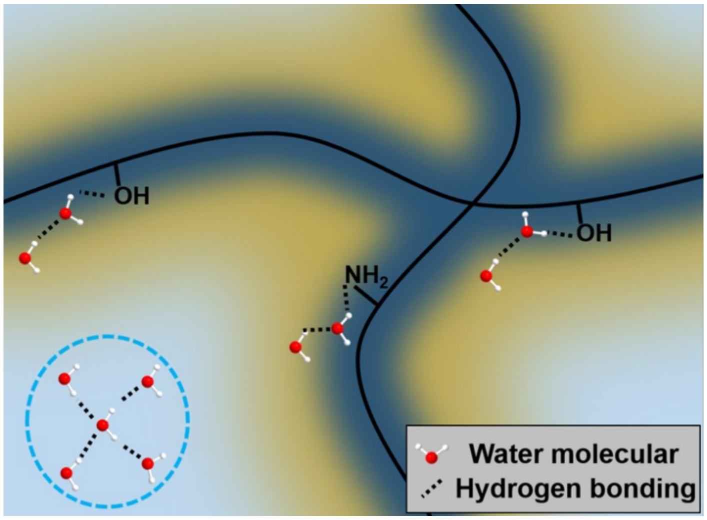

Fig. S4. Three states of water in hydrogel.

The water and hydrogel with the same superficial area are synchronously set in a closed container together with the supersaturated potassium carbonate solution under a temperature of 25 ºC and ambient air pressure, where the supersaturated potassium carbonate solution is used to control the constant vapor pressure in the closed container. When the temperature and pressure are both stable, after evaporating for the same time, measure the mass loss of the hydrogel and bulk water, and calculate the equivalent enthalpy of evaporation using the following formula.

$$U_{in}=E_0 m_0=E_{equ} m_g$$

where E_0 and m_0 are the evaporation enthalpy and mass change of bulk water, m_g is the mass change of hydrogel. Because the temperature, pressure, and input energy are all the same, the only effect on evaporation is the enthalpy of evaporation, and the two are in a direct proportional relationship, so the equivalent enthalpy of evaporation is estimated from the difference in evaporation. The values in Table S1 are estimates for the enthalpy of evaporation at 25°C.

Sample	Pure water	Pure hydrogel	Hydrogel 1	Hydrogel 3	Hydrogel 5	Hydrogel 7	Hydrogel 9
Evaporation enthalpy ($kJ\cdot kg^{-1}$)	2450	2141	2116	2061	2031	1940	1928

Table S1. The evaporation enthalpy of different samples, *hydrogel 1* means the hydrogel with 0.01 g acetylene black doped, and the following samples is the same.