**†Electronic Supporting Information**

# Highly Porous Hydrogel for Efficient Solar Water Evaporation

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## Supplementary Figures

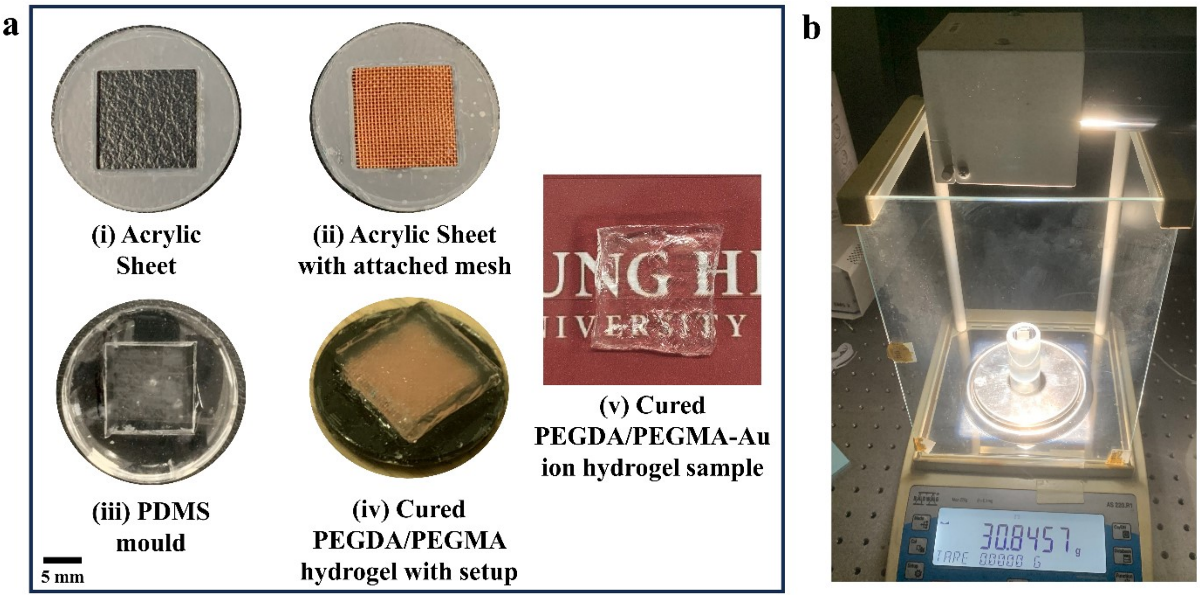


*Figure S1. Digital image of (a) (i)* Laser cut a*crylic sheet (ii) Acrylic sheet with attached mesh (iii) PDMS mould for varying thickness of hydrogel (iv) Bottom view of the final cured hydrogel in the setup, (v) optical image of the cured PEGDA/PEGMA-Au ion (10ppm) hydrogel, scale bar is for all the images from i to v (b) Experimental setup on a mass balance under1 sun illumination*

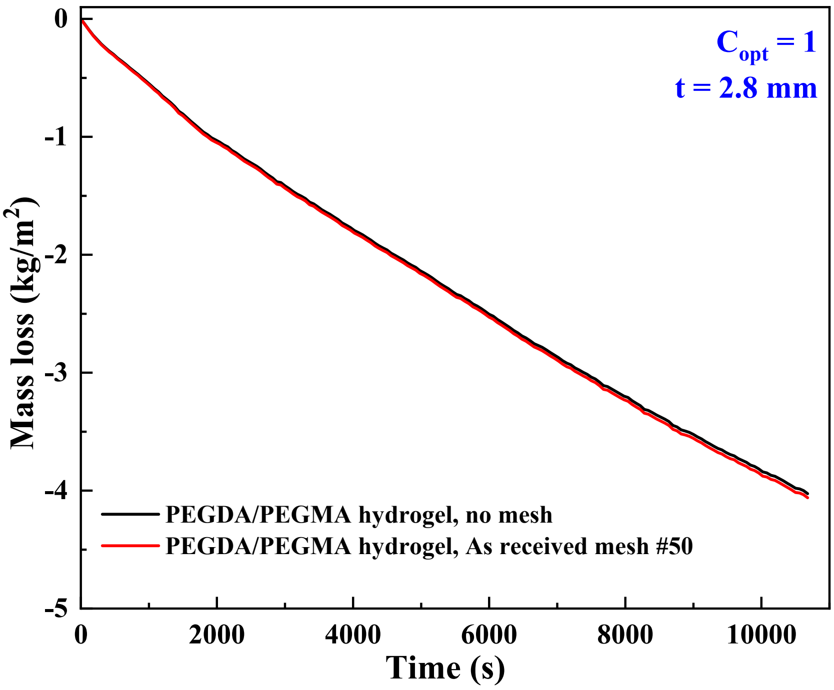


*Figure S2. Rate of mass loss for PEGDA/PEGMA hydrogel with and without mesh*

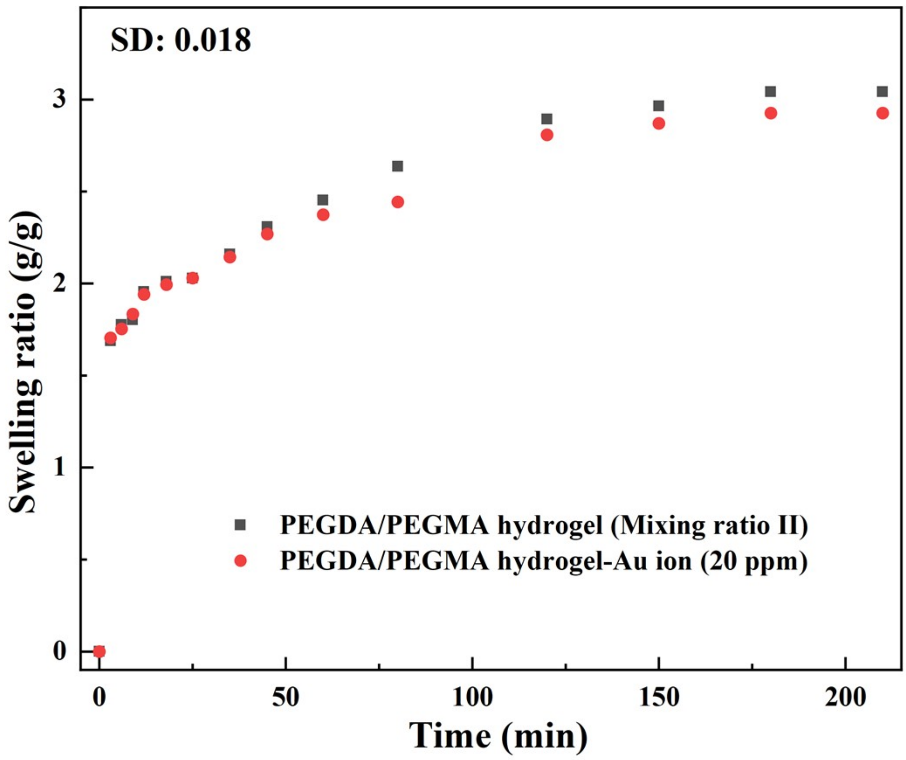


*Figure S3. Comparison of swelling ratios*

## Supplementary Notes

- ### Effect of mesh on evaporation

The effect of mesh on the evaporation rate is also investigated and the rate of mass loss is shown in **Figure S2**. Analysis suggests that the inclusion of a hydrophobic mesh does not impede the evaporation process, as the evaporation rate for PEGDA hydrogel with and without mesh are nearly identical. This observation can be attributed to the substantial disparity in pore sizes between the mesh and the hydrogel. Thus, mesh #50 (with pore size of approximately 0.28 mm) primarily acts as a mechanical support to position the hydrogel at the liquid-air interface, without significantly affecting the evaporation dynamics.

- ### UV-vis-NIR spectra

To assess the light absorptivity, absorption spectra of all hydrogel samples were analysed using a UV-Vis-NIR Spectrophotometer equipped with an integrated sphere and shown in Figure 4c. The PEGDA/PEGMA-Au-ion (10 ppm) hydrogel exhibits a notably higher average total light absorption of 52%, spanning a broad wavelength range from 350 to 1200 nm, compared to the PEGDA/PEGMA hydrogel without nanoparticles. This enhanced absorbance is likely due to the strategic incorporation of a minimal concentration of Au ions, specifically 10 ppm, during the hydrogel preparation. The presence of these nanoparticles improves the material's optical properties, enabling better light absorption across the measured spectrum. This finding underscores the effectiveness of incorporating metallic ions at low concentrations to boost the functional attributes of hydrogels. The high absorption is due to the 3D networking porous structure, which enhances multi-scattering of light.

- **Calculation of heat loss in evaporation process**

The energy consumption of the setup mainly arises from three sources: conduction loss from the PEGDA/PEGMA-Au ion hydrogel (10 ppm) to water, convection from PEGDA/PEGMA-Au ion (10 ppm) hydrogel to water, and radiation heat loss the from PEGDA/PEGMA-Au ion (10 ppm) hydrogel to the environment (**Figure 5c**).

*Conduction heat loss:*

$$Q_{Conduction} = \frac{m\, C_p\, \Delta T}{t\, .\, A} = \frac{0.0253\ \times 4180\ \times 1.8}{0.0001\ \times 10800} = 176\ \text{W/m}^2$$

The conduction heat loss if 1000 W/m$^2$ heat is given to the system ($Q'_{Conduction}$):

$$\frac{Q_{Conduction}}{Q_{in}} \times 100 = \frac{176}{1000} \times 100 = 17.6\ \%$$

Where, m denotes the weight of water (g), $C_p$ denotes the specific heat capacity of pure water (4180 J/kg $^0$C), $\Delta T$ is the change in the temperature after 3 hr of operation, $t$ is the irradiation time and $A$ is the exposed surface area of the hydrogel (0.0001 m$^2$).

*Convection heat loss:*

$$Q_{Convection} = h\ \times\ (T_{Hydrogel} - T_{env}) = 5\ \times\ (297 - 293) = 20\ \text{W/m}^2$$

Where, *h* is the heat transfer coefficient, approximately 5 W/m$^2$ $^0$C, $T_{Hydrogel}$ is the temperature of the hydrogel and $T_{env}$ is the temperature of the adjacent environment.

The convection heat loss if 1000 W/m$^2$ heat is given to the system ($Q'_{Convection}$):

$\frac{Q_{Convection}}{Q_{in}} \times 100 = \frac{20}{1000} \times 100 = 2$ %

*Radiation heat loss:*

$Q_{Radiation} = \varepsilon \sigma \left(T_{Hydrogel}^{4} - T_{env}^{4}\right) = 5.67 \times 10^{-8} \times 0.874 \times \left(297^4 - 293^4\right)$

= 20.3 W/m$^2$

Where, $\varepsilon$ is the emissivity, $\sigma$ denotes the Stefan-Boltzmann constant (m$^2$/$^0$C$^4$)$^{-1}$, $T_{Hydrogel}$ is the temperature of the hydrogel and $T_{env}$ is the temperature of the adjacent environment.

The radiation heat loss if 1000 W/m$^2$ heat is given to the system ($Q'_{Radiation}$):

$\frac{Q_{Conduction}}{Q_{in}} \times 100 = \frac{20.3}{1000} \times 100 = 2.03$ %

Therefore, the percentage of evaporation occurs from the surface:

= 100 - $Q'_{Conduction}$ - $Q'_{Convection}$ - $Q'_{Radiation}$

= 100 – 17.6 – 2 – 2.03 = 78.37 %