Supporting information for:

Floating rGO-based Black Membrane for Solar Driven Sterilization

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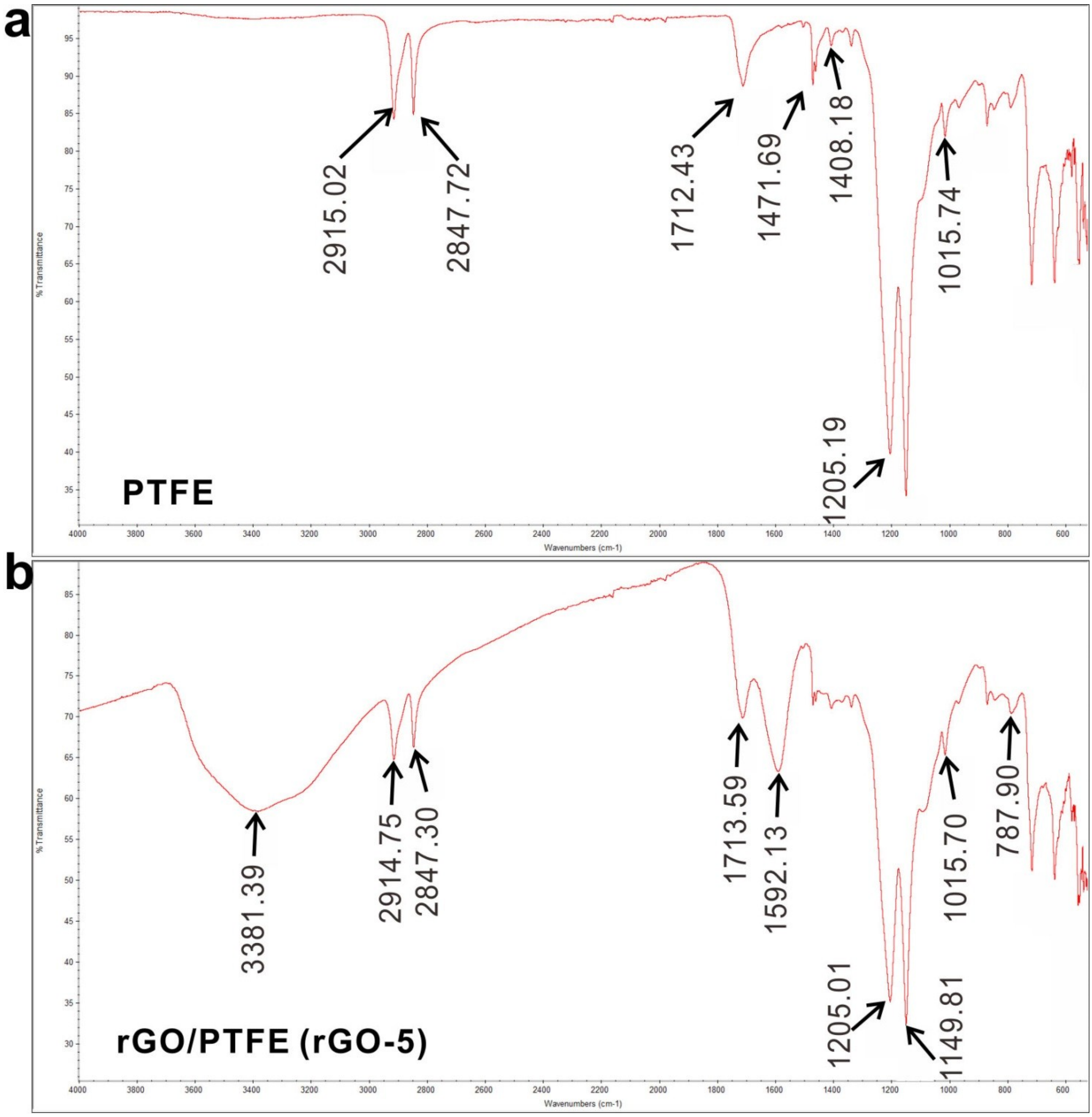
1. Supplementary Figures



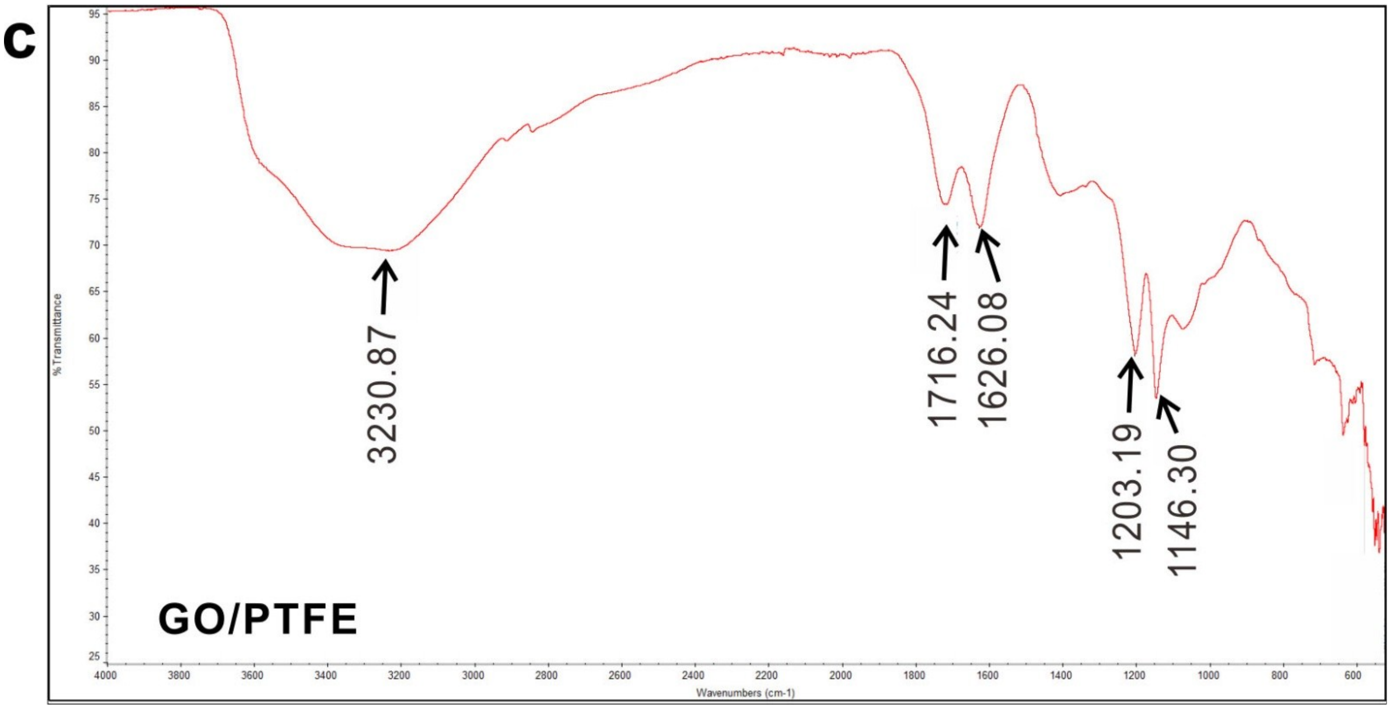


Figure S1. a), b) and c) are the FTIR spectra of PTFE film, rGO/PTFE (rGO-5) membrane and GO/PTFE membrane, respectively. The peak at 1712.43 cm^{-1} in (a) demonstrates the existence of carbon oxygen double bond (carbonyl group)[1, 2] on the PTFE film, and the peak at 3381.39 cm^{-1} in (b) demonstrates the existence of remained -OH groups on rGO[3, 4]. The C=O (1626 cm^{-1}) of –COOH group in GO (c) has been reduced to form C-H (2914 cm^{-1}, 2847 cm^{-1}) (b) during rGO formation process[5]. Typical aromatic graphene sheets form in the rGO (peak 1592 cm^{-1}) (b), which enhances the light-to-heat conversion of rGO compared to GO[6].

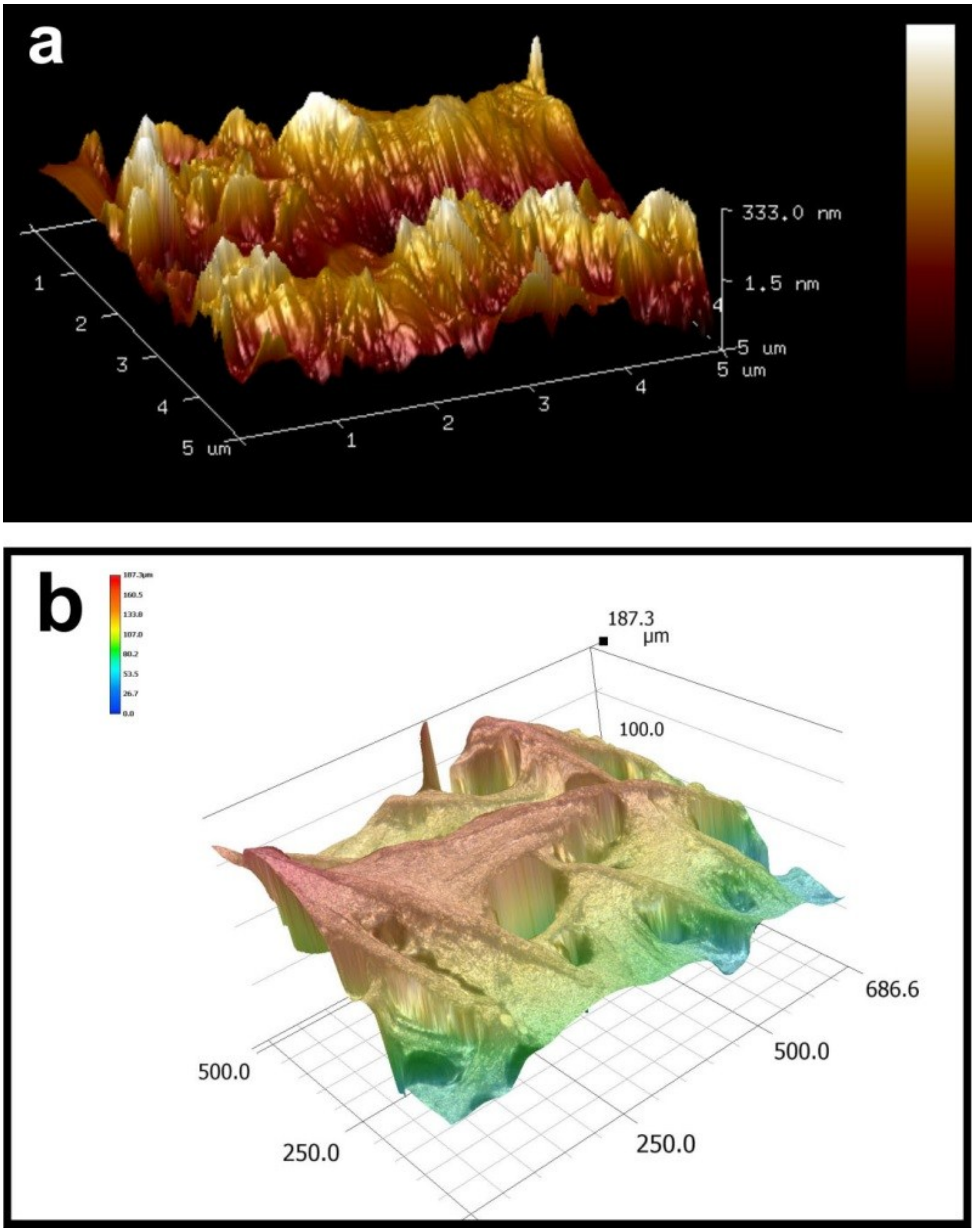


Figure S2. a) Atomic force microscopy (AFM) image exhibits the nanoscale surface roughness of the composite membrane in the range of five micrometers. b) 3D optical microscopy image of rGO-5 shows the microscale surface roughness of the composite membrane in the range of hundreds of micrometers.

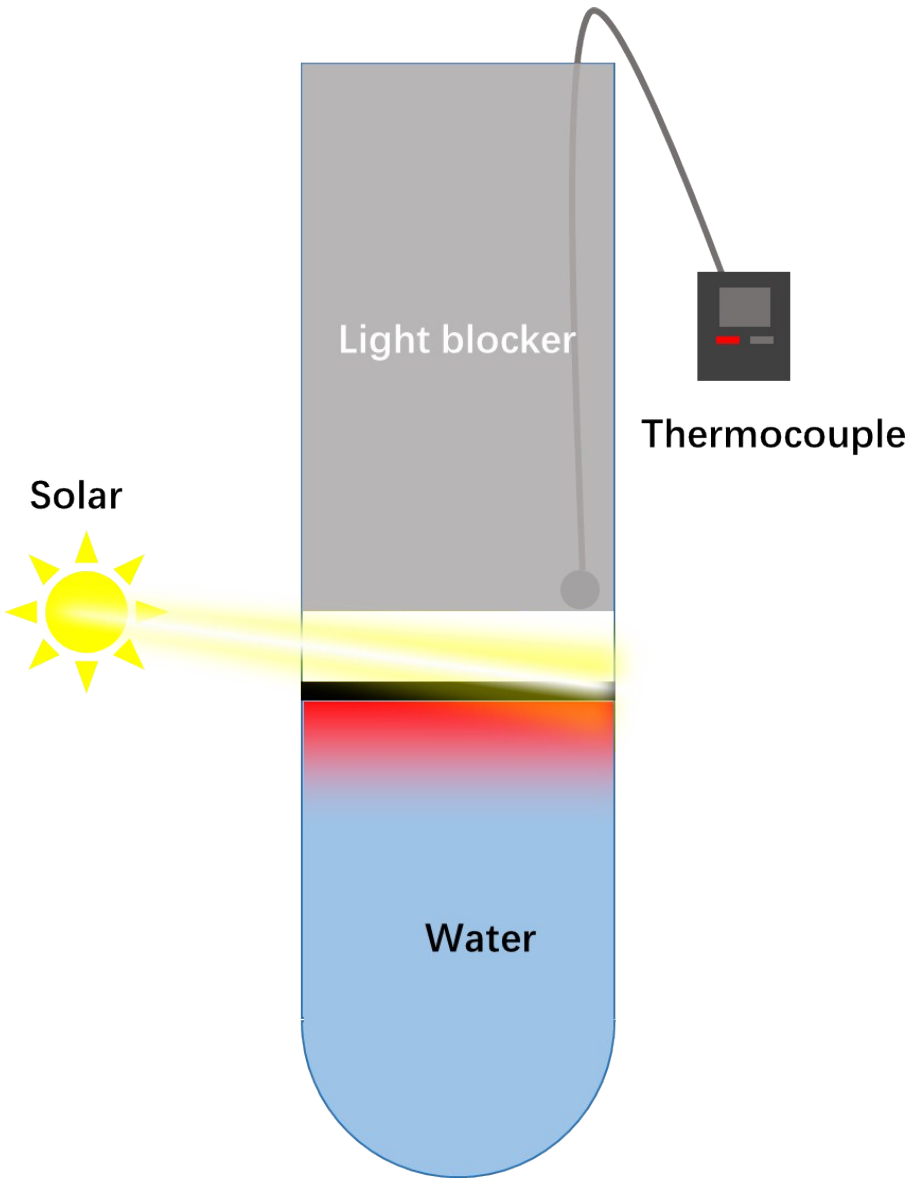


Figure S3. Schematic illustration of experimental setup of steam temperature measurement in the tube.

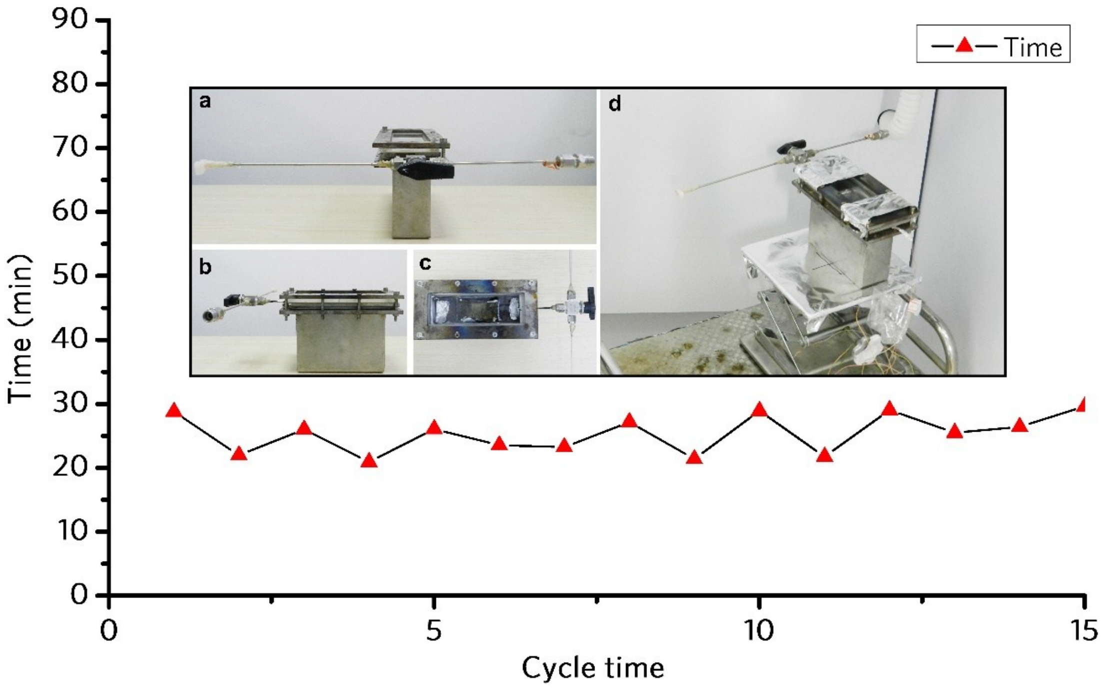


Figure S4. The cycle experiment of the composite membrane under simulated solar illumination. The experiment was performed in the device shown at the center of the figure. The y-axis is the time required for the temperature of steam rising from 30°C to 132°C under 2.5W/cm^2.

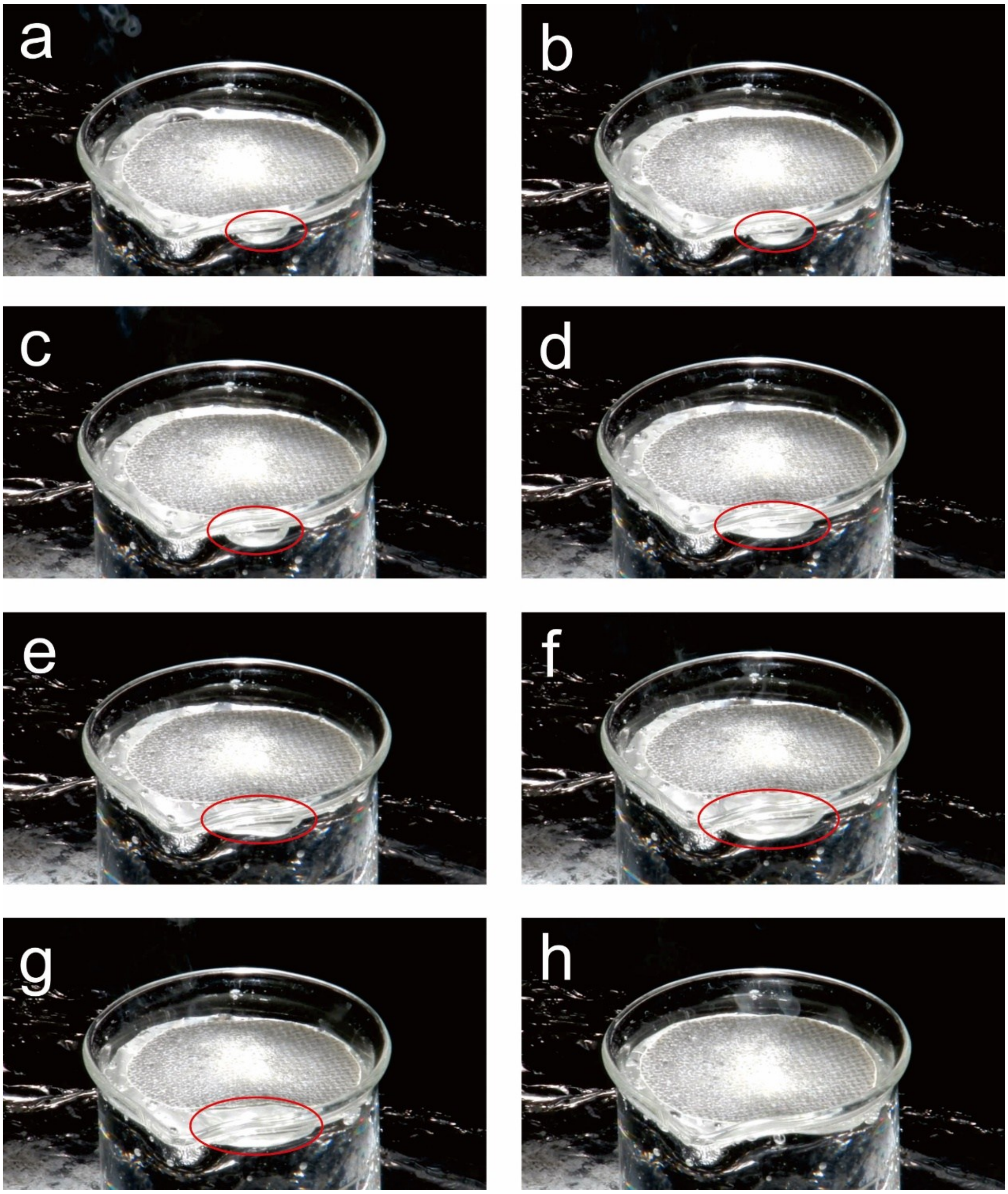


Figure S5. The formation, grow-up and release process of bubbles (labeled in red) beneath rGO/PTFE composite membrane. From a) to h) are the optical images arranged in time sequence. Bubbles progressively grew up and exploded within one second.

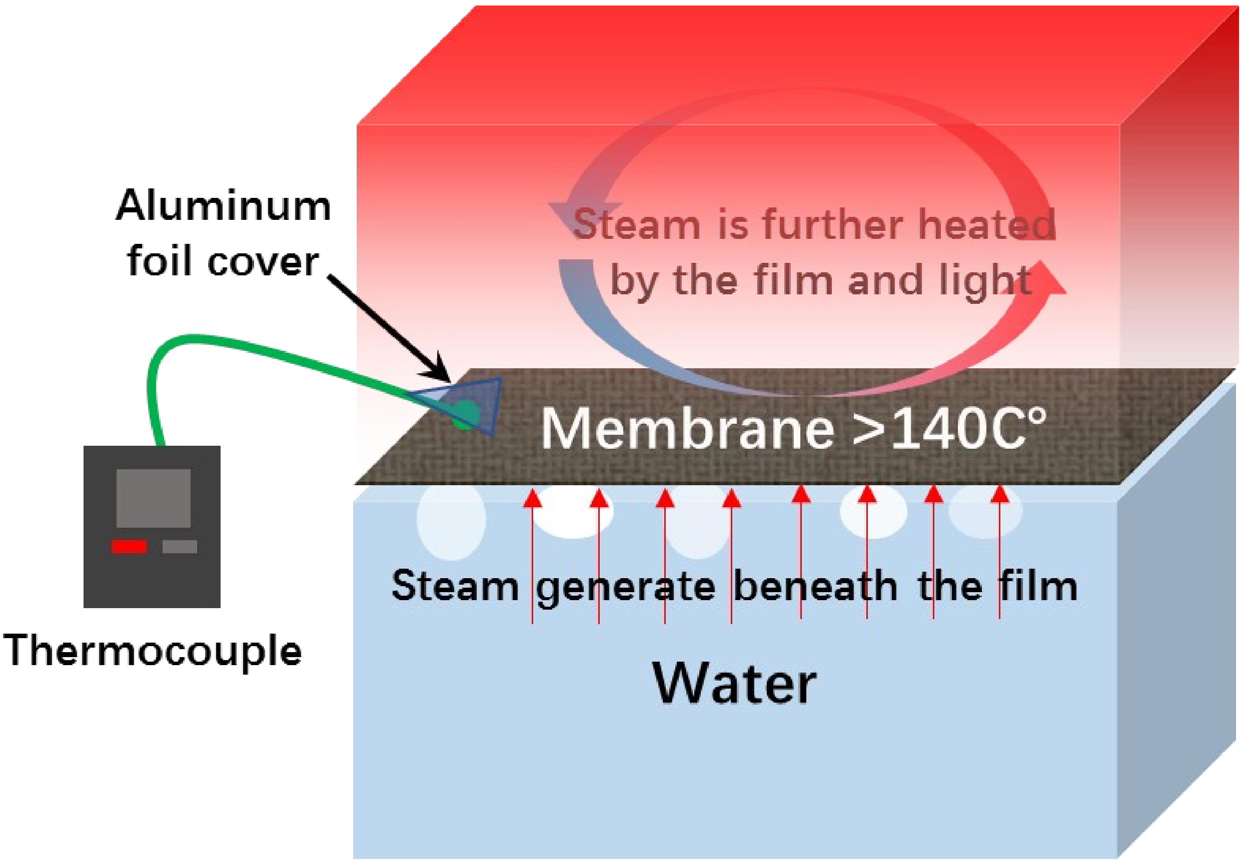


Figure S6. Schematic illustration of the mechanism that the generated water vapor was heated up over 100℃ under regular atmospheric pressure.

2. Calculation of Energy Conversion Efficiency

To calculate the photothermal conversion efficiency of the evaporation system, a rGO/PTFE film was floating at the surface of water in a beaker and then was illuminated by solar simulator with the light intensity of 2.56W/cm^2. The photothermal conversion efficiency was calculated by the equation below:

$$\eta = \frac{\dot{m} H_{LV}}{P}$$

where $\dot{m}$ is the mass flux of vapor, $\boldsymbol{H_{LV}}$ is the total enthalpy change of the liquid-vapor transform, and $\boldsymbol{P}$ is the light power density of solar simulator. The conversion efficiency of the rGO/PTFE was 84% under 25.6 suns.

3. Reference

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