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Journal Name

ARTICLE

# Electronic Supporting Information (ESI) for

# Molten salts promoting the "controlled carbonization" of waste polyesters into hierarchically porous carbon for high-performance solar steam evaporation

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**Table S1** Yield and $S_{BET}$ of carbon products prepared from the carbonization of PET at 450, 550 and 650 °C.

| Sample | Carbonization temperature (°C) | Yield (wt%) | $S_{BET}$ ($m^2/g$) |
|---|---|---|---|
| HPC-2-450 | 450 | 22.9 | 753.3 |
| **HPC-2-550** | **550** | **24.9** | **776.2** |
| HPC-2-650 | 650 | 19.3 | 792.9 |

Note: The mass ratio of $ZnCl_2$/NaCl eutectic salts to PET is fixed as 2. Considering the yield and $S_{BET}$ of the carbon product, the carbonization of temperature was selected as 550 °C.

**Table S2** Comparison of solar steam generation performance of HPC-2 with previous photothermal materials under 1 sun illumination.

| Entry | Photothermal material | Evaporation rate ($kg/m^2/h$) | Efficiency (%) | Reference in ESI |
|---|---|---|---|---|
| **1** | **HPC-2** | **1.68** | **97** | **This work** |
| 2 | CuS/PVDF | 1.58 | 90 | [1] |
| 3 | Geopolymer-biomass carbon composite | 1.58 | 85 | [2] |
| 4 | Porous N-doped graphene | 1.50 | 80 | [3] |
| 5 | GO/cellulose/PS | 1.45 | 80 | [4] |
| 6 | Mutilayer PPy | 1.38 | 92 | [5] |
| 7 | Mexene-PVDF-PS | 1.33 | 84 | [6] |
| 8 | 3D honeycomb graphene foam | 1.30 | 87 | [7] |
| 9 | Carbonized longitudinal wood | 1.08 | 74 | [8] |
| 10 | Au/D-NPT | 1.00 | 64 | [9] |
| 11 | Plasmonic woods | 1.00 | 68 | [10] |
| 12 | F-wood/CNTs | 0.95 | 65 | [11] |
| 13 | PPy/stainless steel | 0.92 | 58 | [12] |
| 14 | rGO-MCE | 0.84 | 60 | [13] |
| 15 | Black polyurethane sponges | 0.83 | 52 | [14] |
| 16 | Black gold membrane | 0.67 | 42 | [15] |
| 17 | GO-SA-CNT aerogel | 0.50 | 40 | [16] |
| 18 | F-crGO membrane | 0.47 | 48 | [17] |



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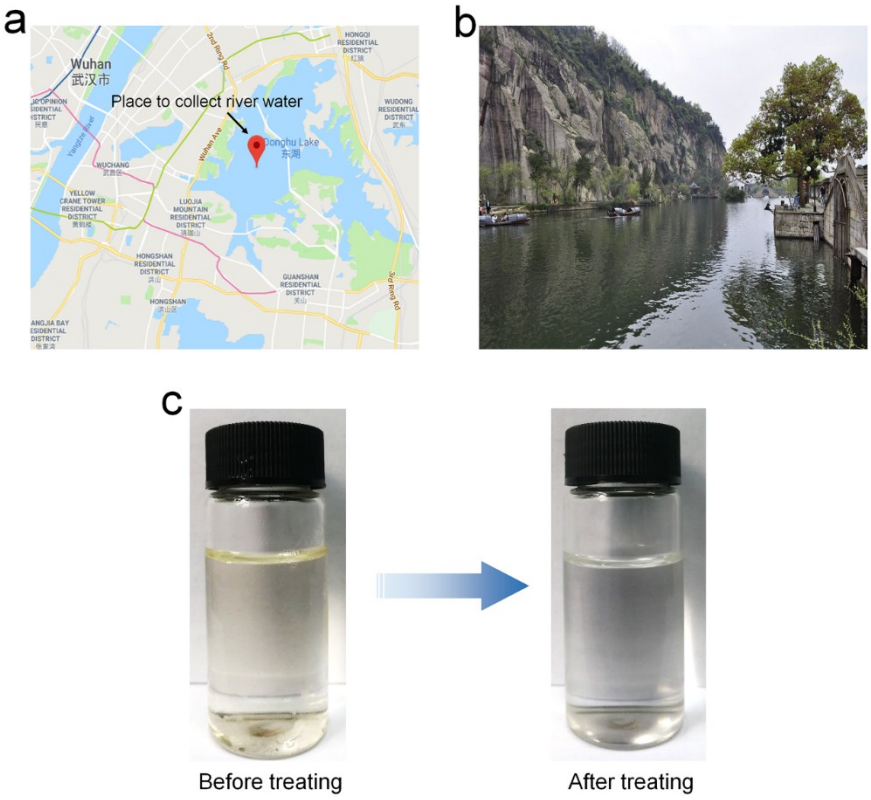


**Fig. S1** (a) The location and (b) photograph of the place to collect river water. (c) Photographs of the river water and the condensed water.

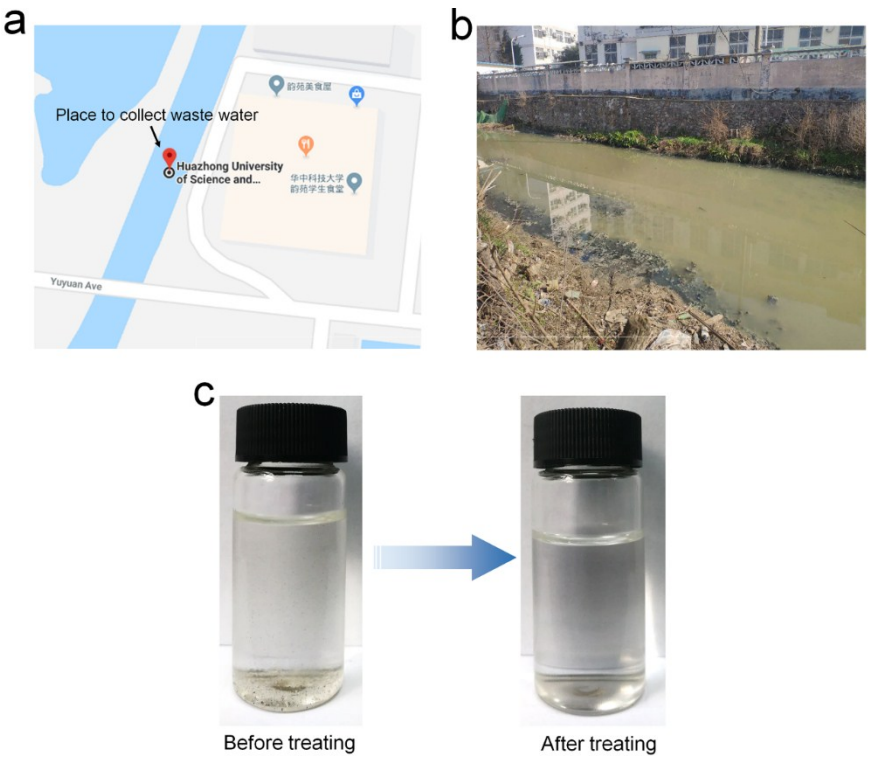


**Fig. S2** (a) The location and (b) photograph of the place to collect wastewater. (c) Photographs of the wastewater and the condensed water.



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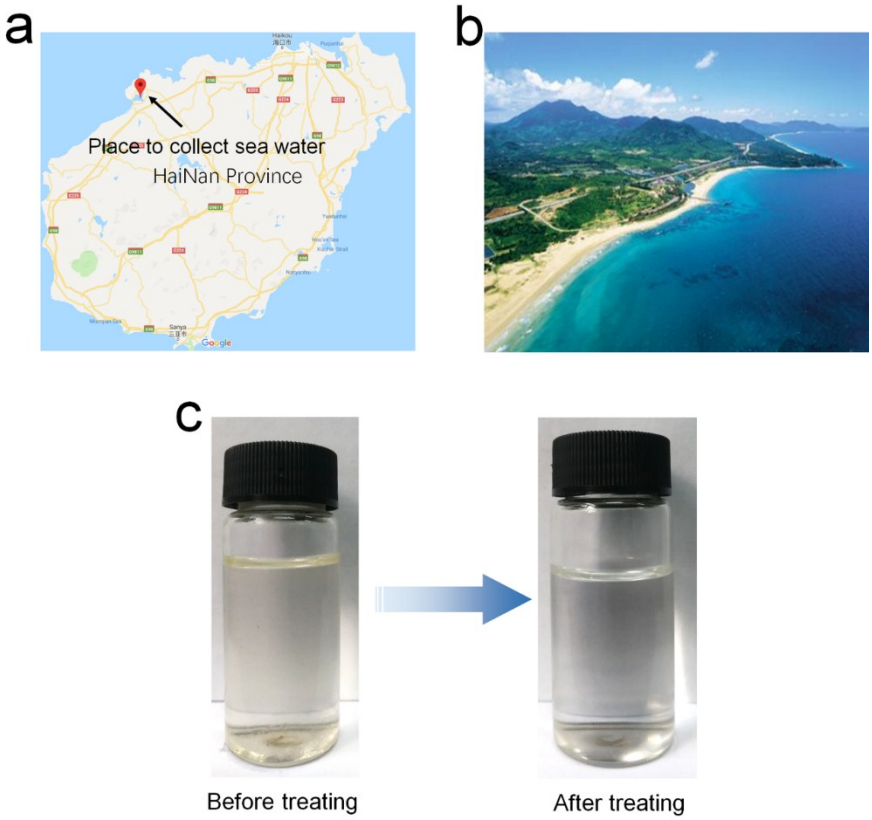


**Fig. S3** (a) The location and (b) photograph of the place to collect seawater. (c) Photographs of the seawater and the condensed water.

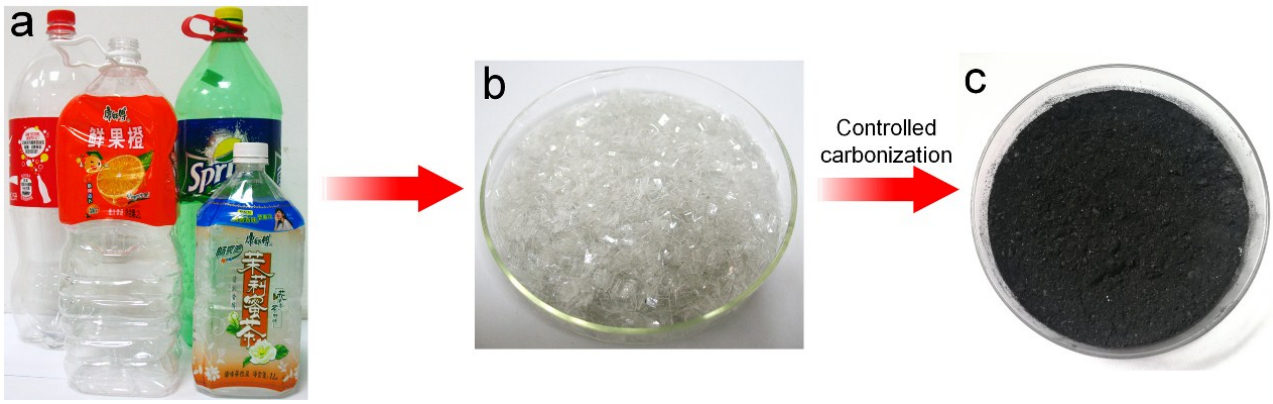


**Fig. S4** Photographs of (a) waste PET beverage bottles, (b) PET pieces, and (c) the obtained W-HPC-2 from waste PET using $ZnCl_2$/NaCl.



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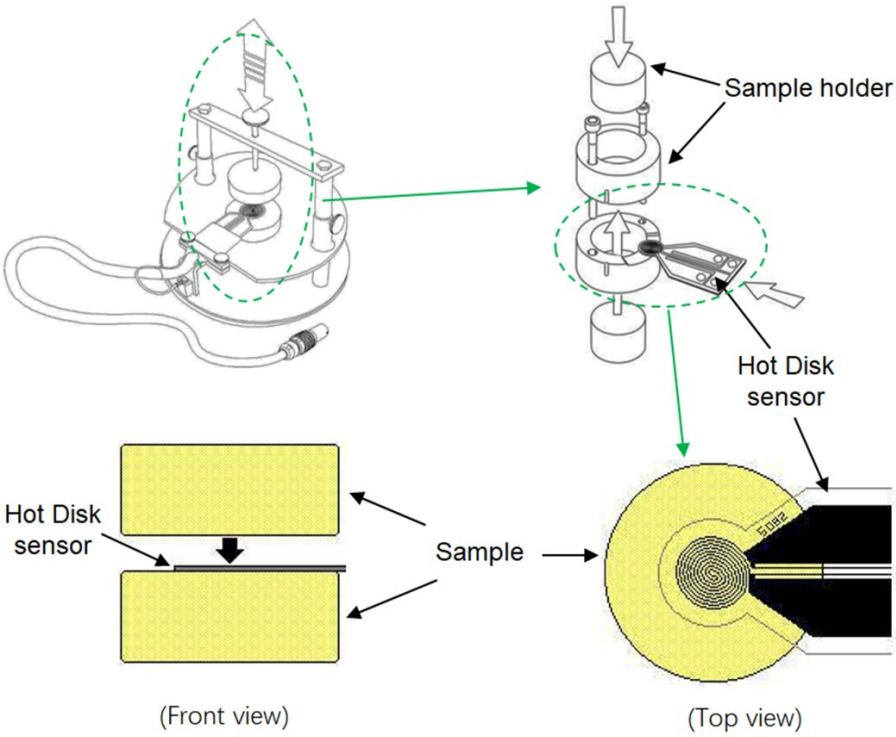


**Fig. S5** Scheme for the measurement of thermal conductivity of HPC-2 in Shiyanjia Lab.

**Measurement method:** When measuring a powder sample, the Hot Disk probe needs to be placed inside the sample so that it remains flat during transient recording. In addition, the mechanical pressure can be easily controlled by using the sample gripper.

**Calculation method (Transient Plane Source Method):** During the test, the probe is placed in the middle for the test. When the current passes through nickel (some probes are made of nickel), it produces a certain temperature rise, and the heat generated simultaneously diffuses to the sample on both sides of the probe depending on the thermal conduction characteristics of the material. By recording the temperature and probe response time, the thermal conductivity and thermal diffusion rate can be directly obtained through the mathematical model.

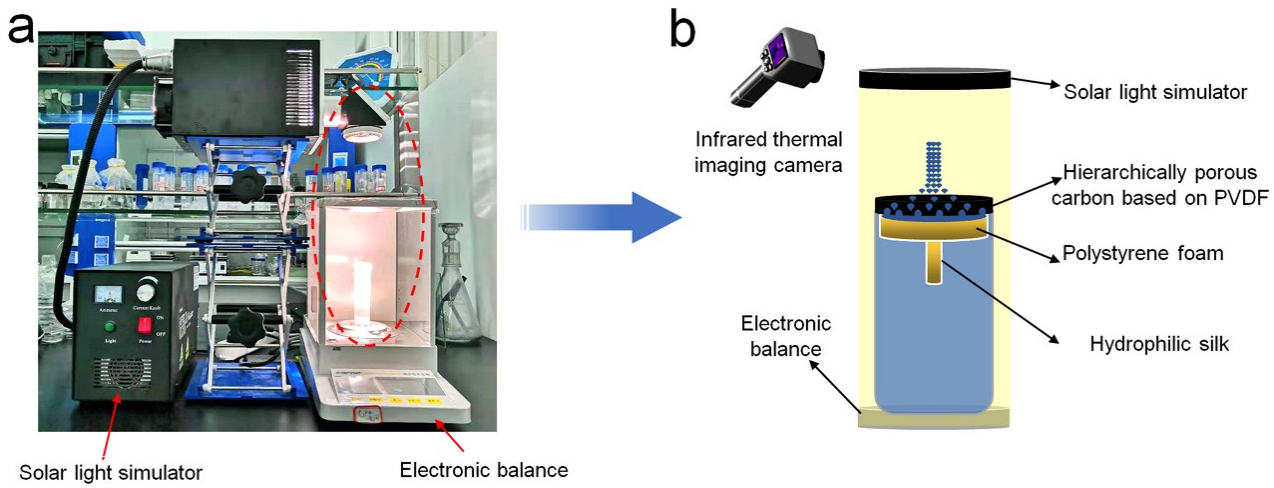


**Fig. S6** (a) Photograph and (b) schematic illustration of the solar steam generation instrument used in this work.



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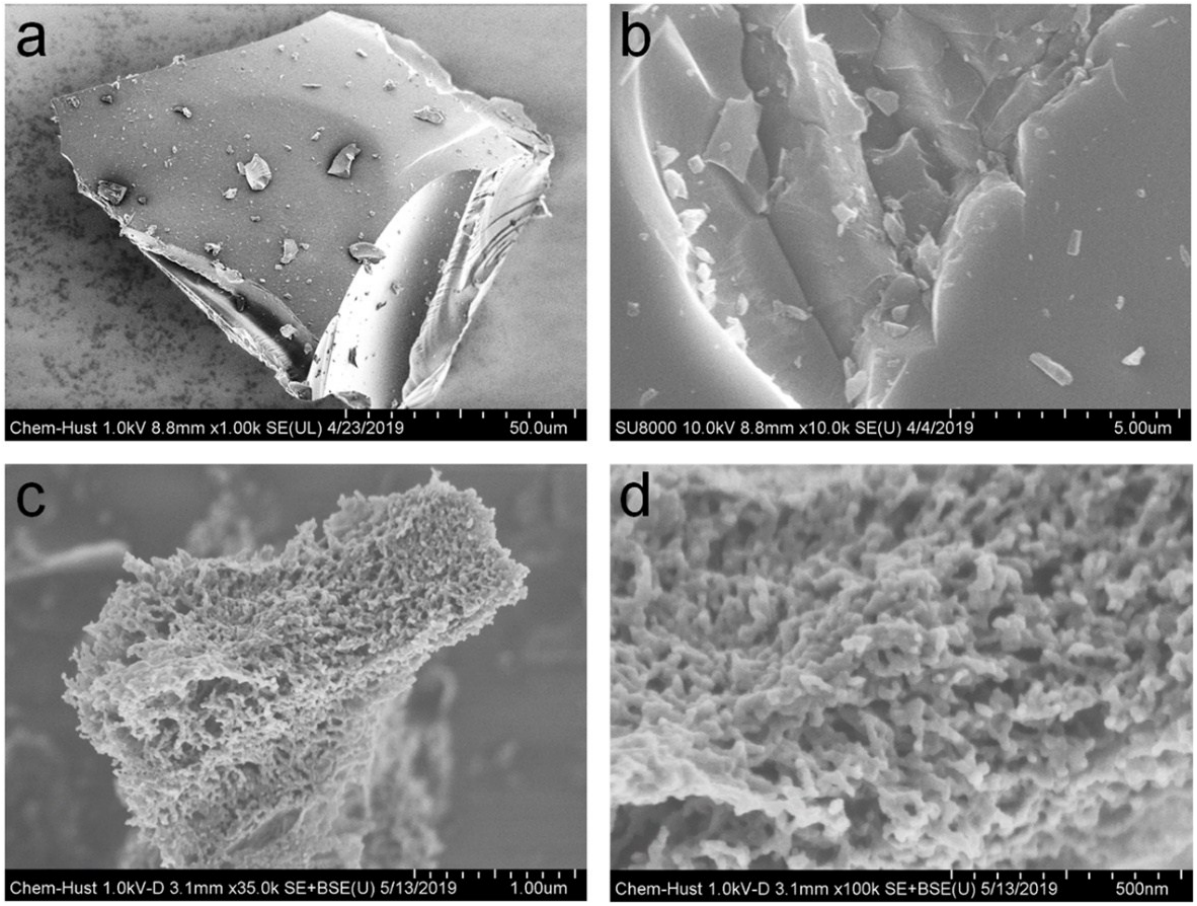


**Fig. S7** SEM images of (a and b) HPC-0 and (c and d) HPC-2.

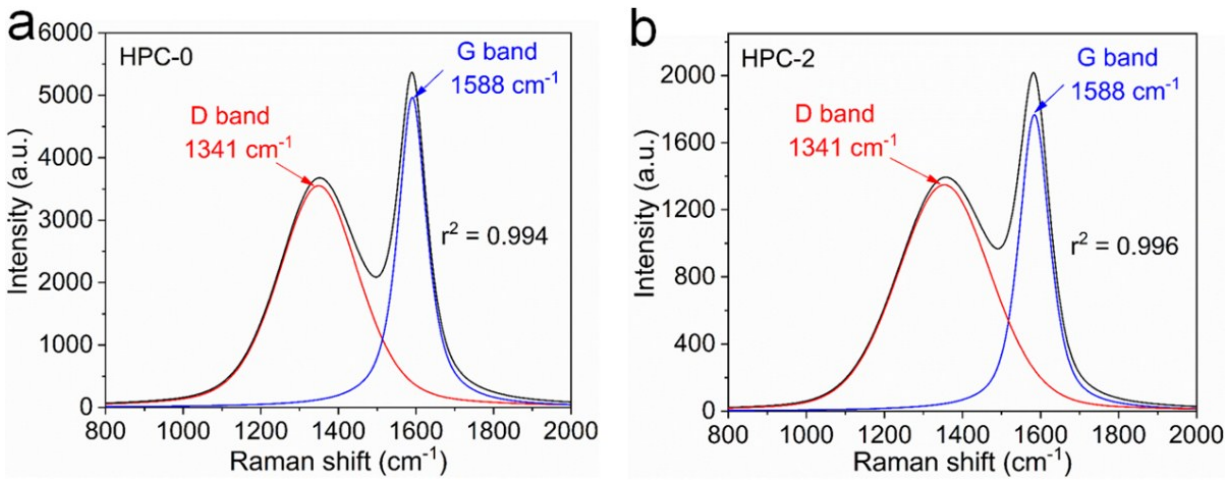


**Fig. S8** The fitting results of Raman spectra of (a) HPC-0 and (b) HPC-2 using the PeakFit.



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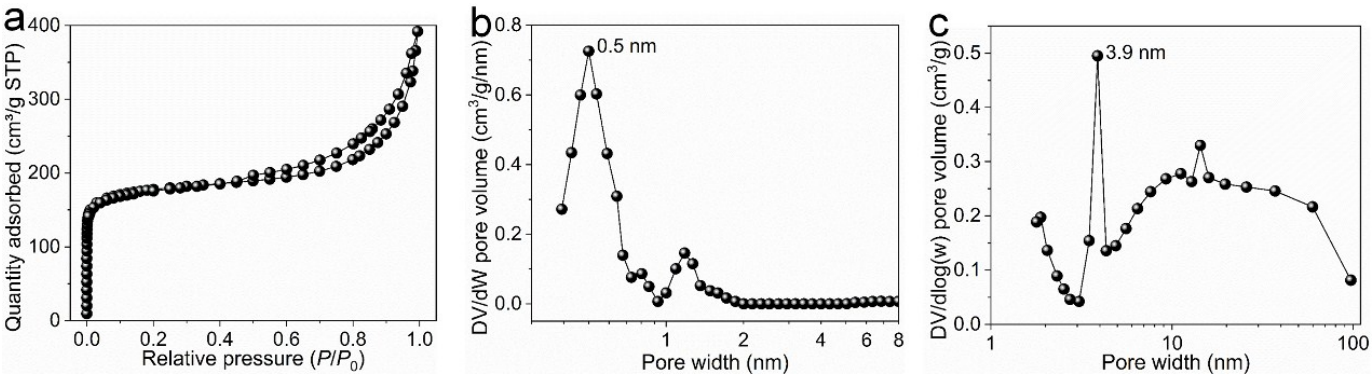


**Fig. S9** (a) Nitrogen adsorption-desorption isotherms of W-HPC-2 at 77 K. Pore size distribution plots of W-HPC-2 using (b) DFT and (c) BJH models.

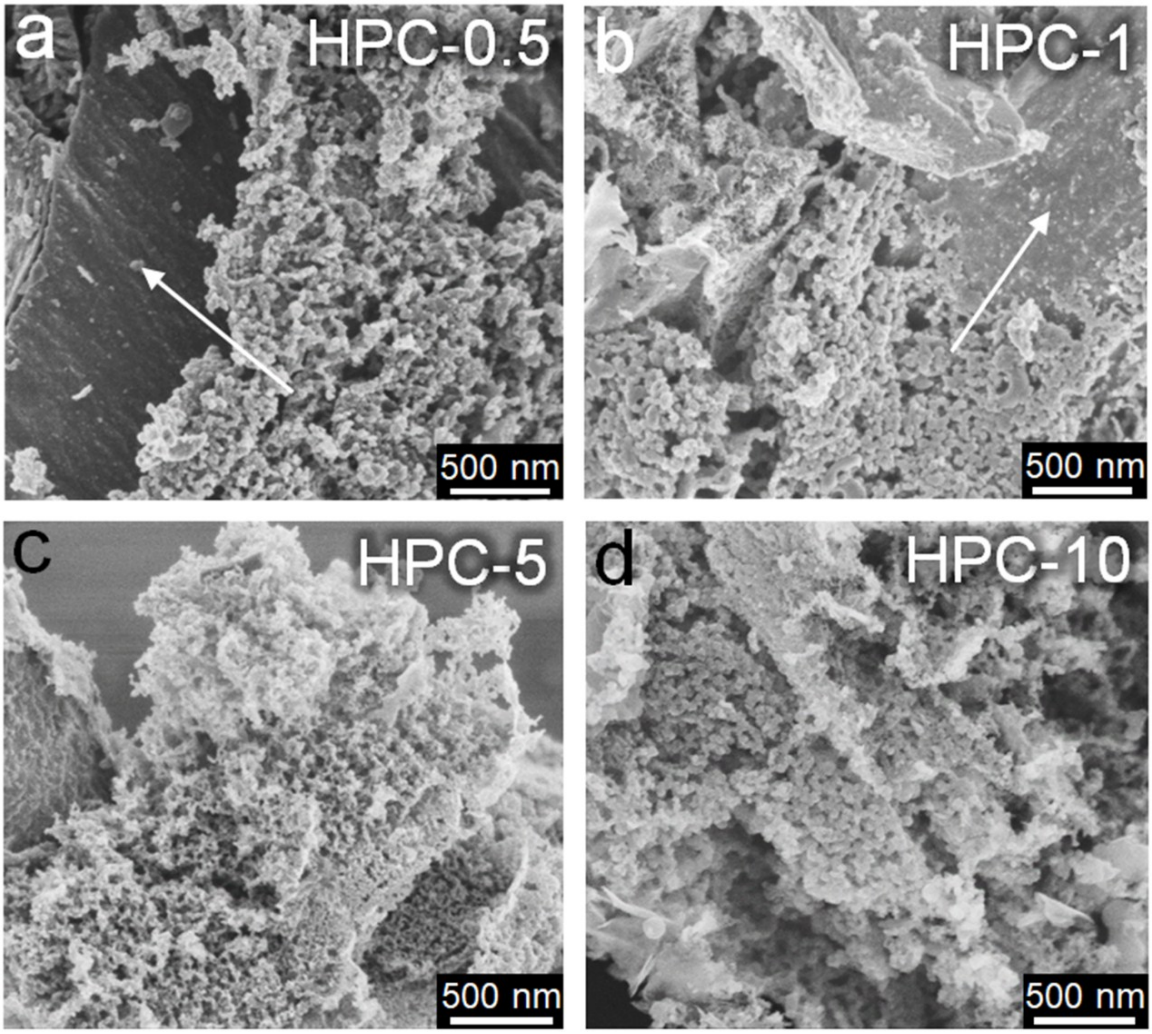


**Fig. S10** SEM images of (a) HPC-0.5, (b) HPC-1, (c) HPC-5, and (d) HPC-10.

Note: some macroparticles (indicated by white arrows) are also found in HPC-0.5 and HPC-1, indicating the insufficiency of $ZnCl_2$/NaCl eutectic salts for the carbonization of PET. However, these macroparticles are absent in HPC-5 and HPC-10, and more nanoparticles are observed.



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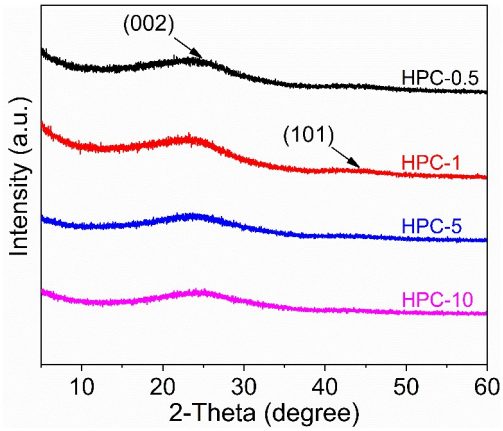


**Fig. S11** XRD patterns of HPC-0.5, HPC-1, HPC-5 and HPC-10.

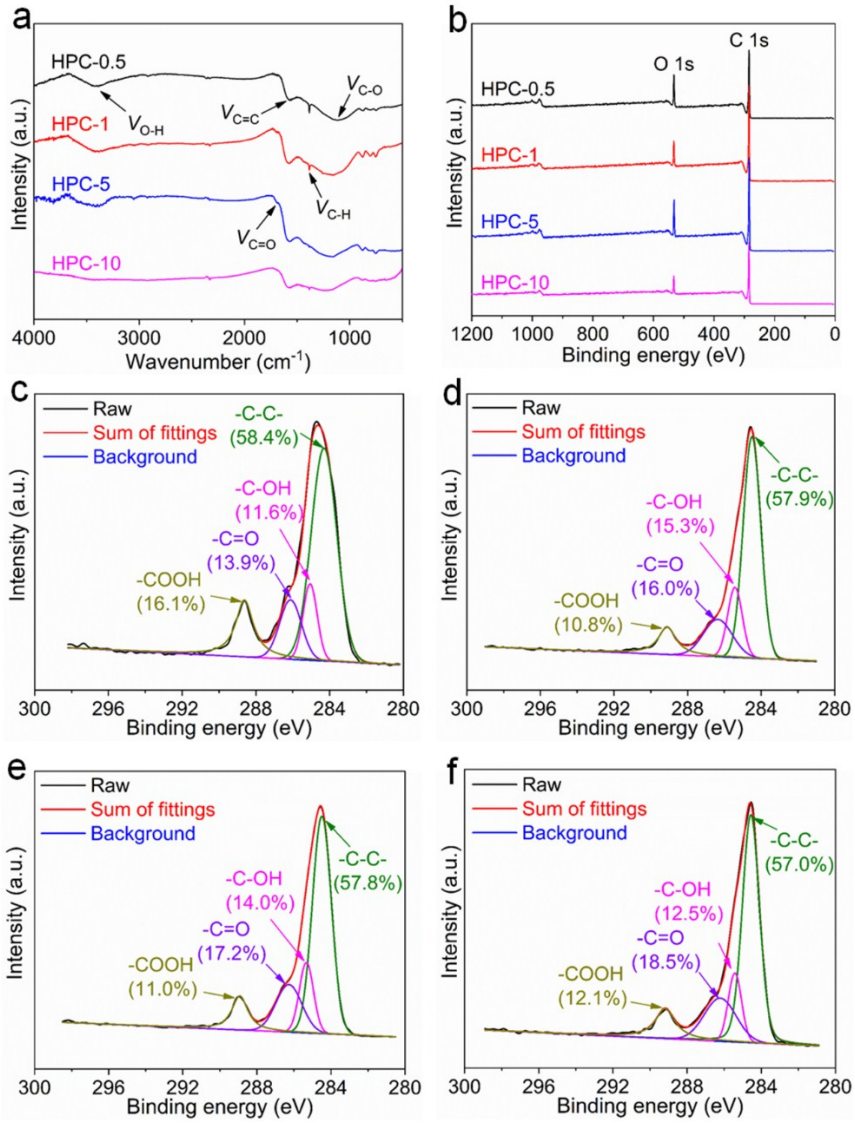


**Fig. S12** (a) FT-IR curves of HPC-0.5, HPC-1, HPC-5 and HPC-10. (b) XPS spectra of HPC-0.5, HPC-1, HPC-5 and HPC-10, and high-resolution C1s XPS spectra of (c) HPC-0.5, (d) HPC-1, (e) HPC-5 and (f) HPC-10.



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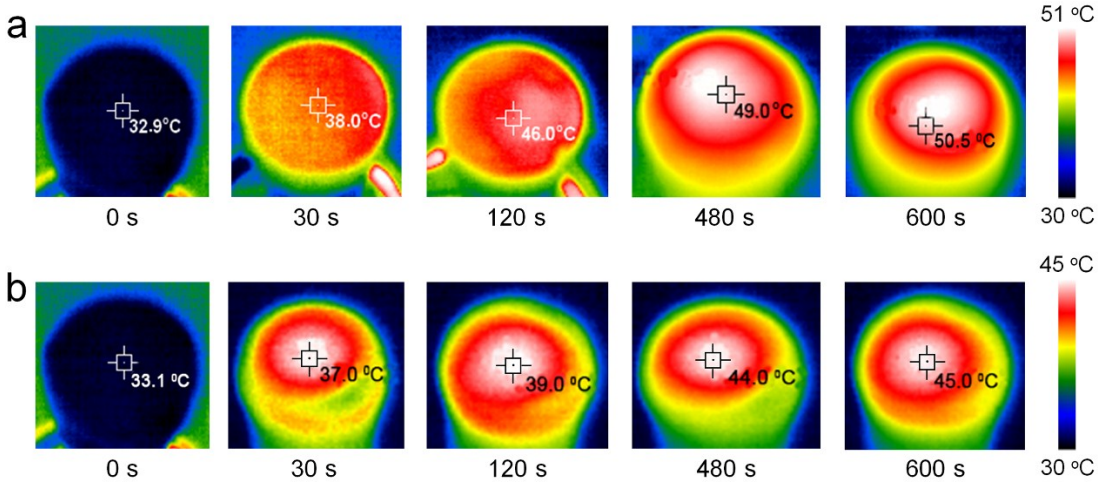


**Fig. S13** Infrared images of (a) HPC-0 and (b) PVDF membranes over different time under 1 kW/m$^2$ solar light irradiation.

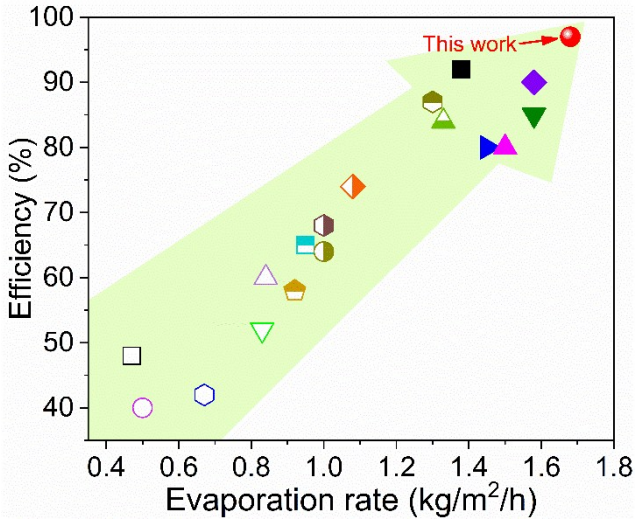


**Fig. S14** Comparison of the solar energy-driven steam generation performance of HPC-2 with some previously reported photothermal materials (see Table S2 for detailed information).

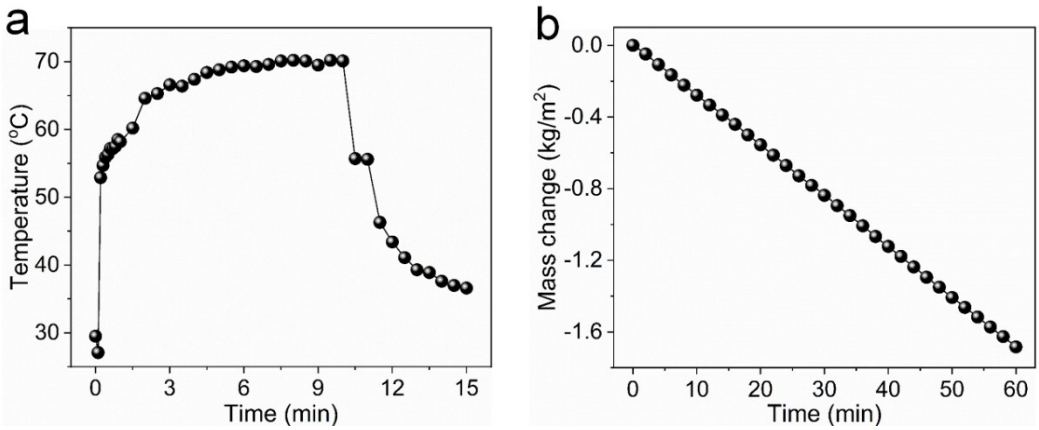


**Fig. S15** (a) Surface temperature of W-HPC-2 under 1 kW/m$^2$ solar light irradiation in different time, and (b) cumulative mass change of water using W-HPC-2 over time.



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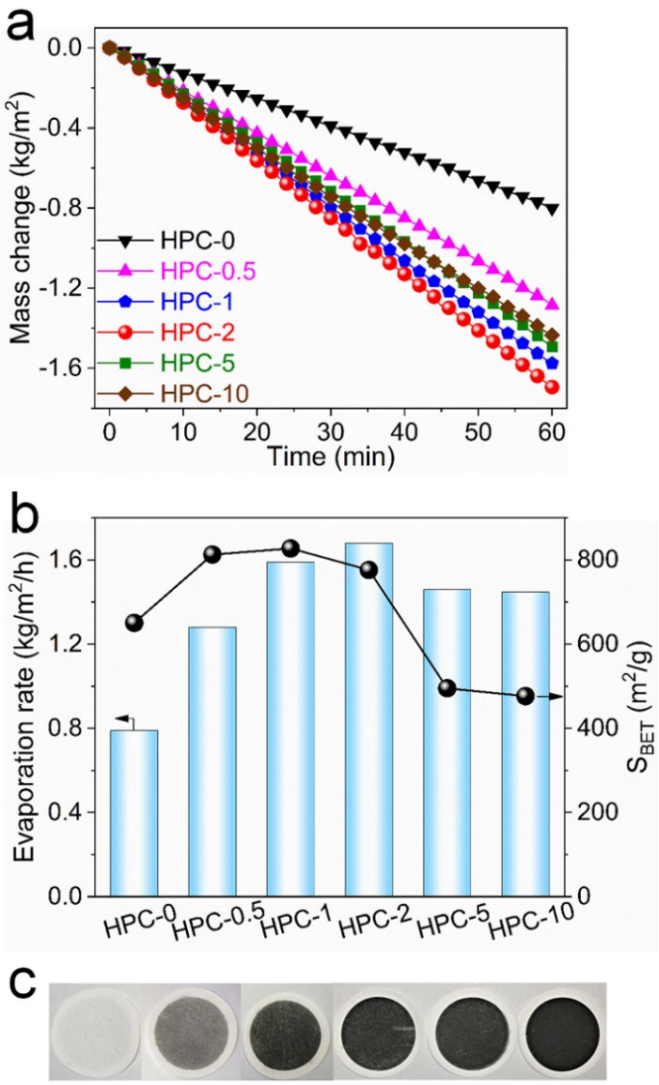


**Fig. S16** (a) Cumulative mass changes of water over time under 1 kW/m$^2$ solar light irradiation using HPC-*x*. (b) Evaporation rate and $S_{BET}$ of HPC-*x*. (c) Photographs of HPC-0, 0.5, 1, 2, 5 and 10 membranes (from left to right).

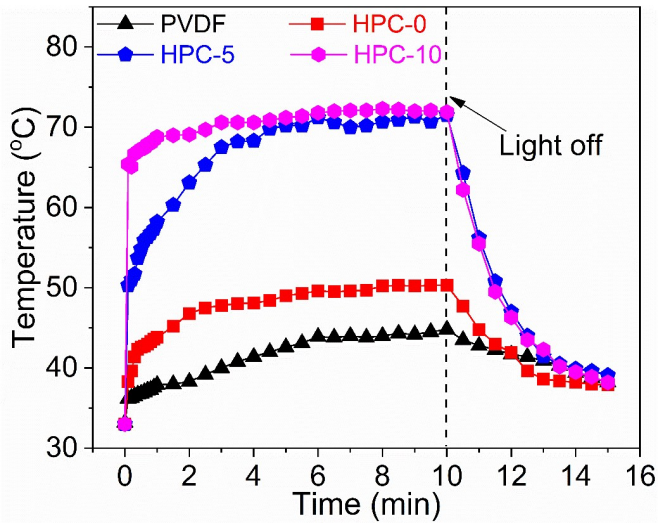


**Fig. S17** Surface temperature of PVDF, HPC-0, HPC-5 and HPC-10 under 1 kW/m$^2$ solar light irradiation over different time.



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