# Supporting Information

# Bamboo fiber-reinforced chitosan sponge as a robust photothermal evaporator for efficient solar vapor generation

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**This supplement contains:**

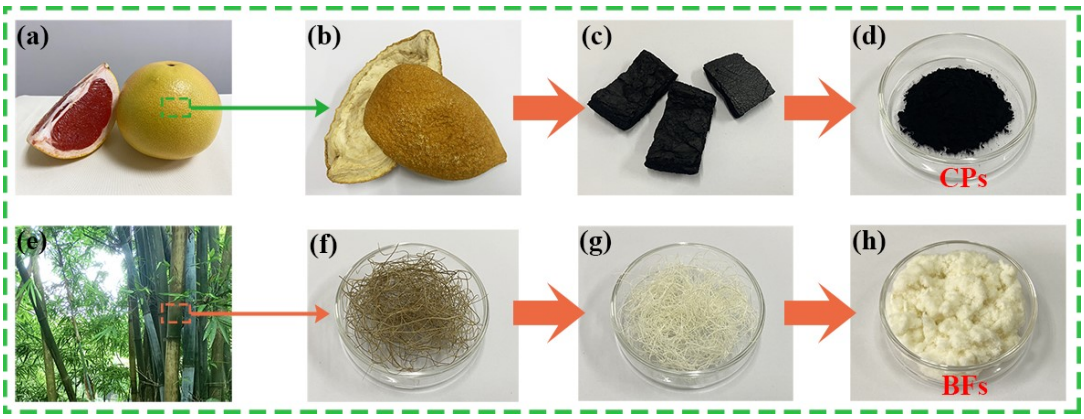


**Figure S1.** Preparation process of CPPs (a-d) and BFs (e-h). (a) Fresh pomelo. (b) Peeled pomelo peel. (c) Carbonized pomelo peel. (d) Carbonized pomelo peel particles. (e) Natural bamboo. (f) Bamboo silks. (g) Processed bamboo silks. (h) Bamboo fibers.

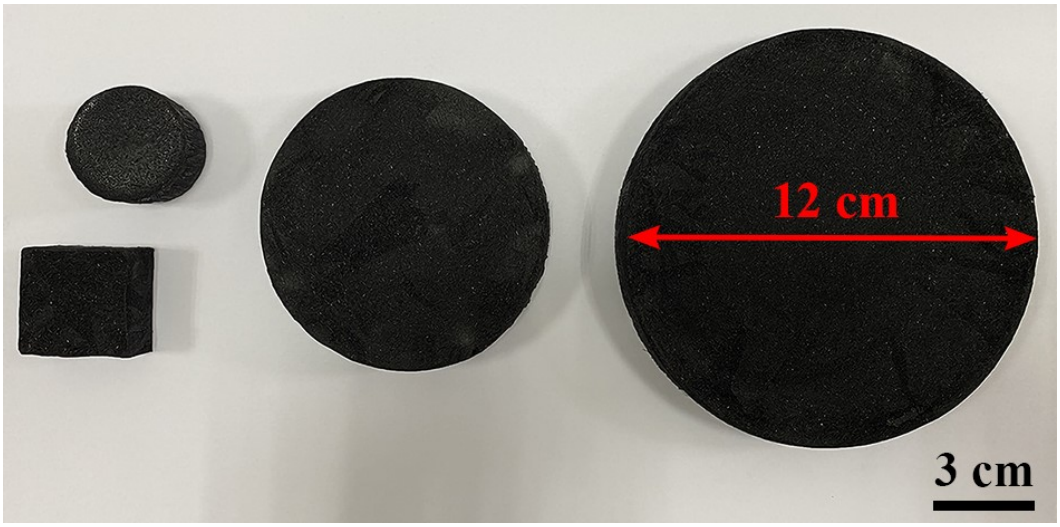


**Figure S2.** CS/BFs/CPPs sponge with various sizes and shapes.

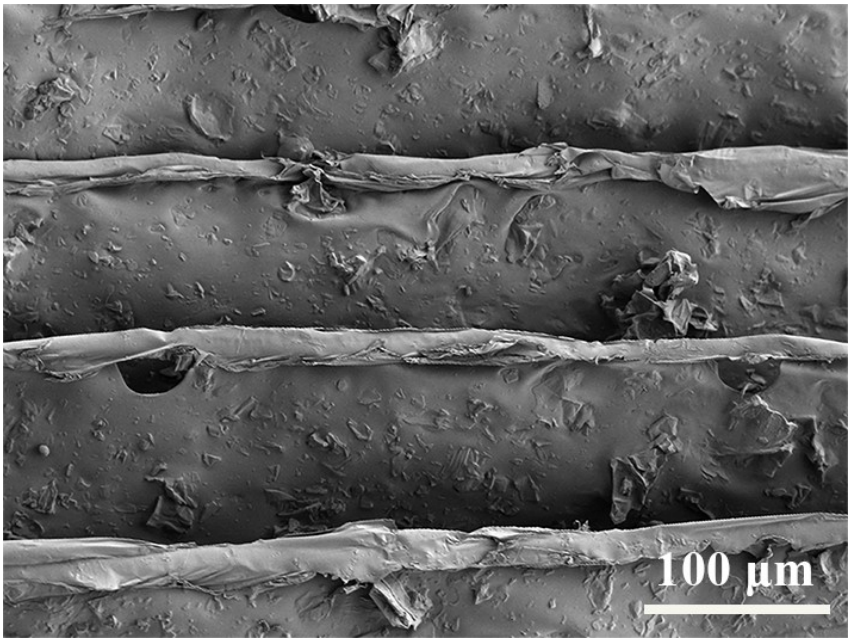


**Figure S3.** SEM images of CS/CPPs sponge. Large quantities of carbon particles were embedded on the surface of chitosan lamellas.

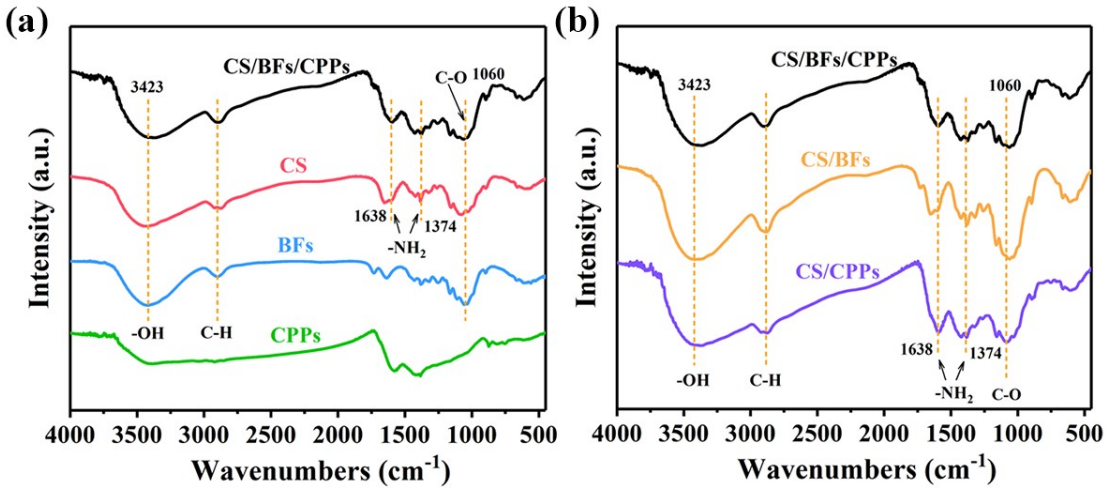


**Figure S4.** (a) FTIR spectra of CPPs (green curve), BFs (blue curve), chitosan (red curve), and the CS/BFs/CPPs sponge (black curve). (b) FTIR spectra of CS/CPPs sponge (purple curve), CS/BFs sponge (orange curve), and the CS/BFs/CPPs sponge (black curve).

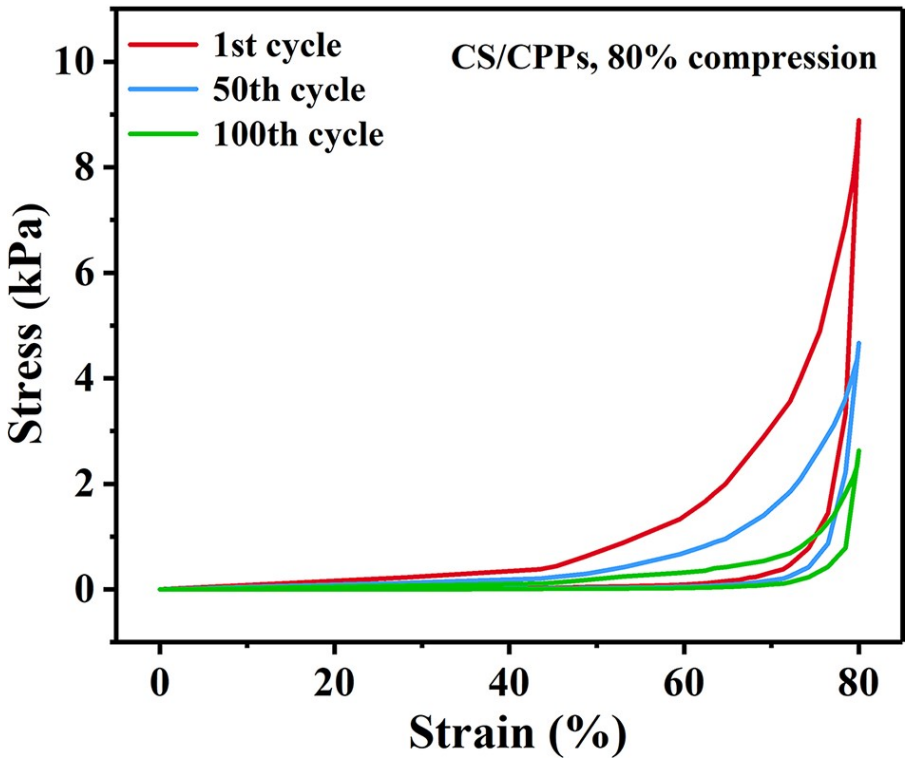


**Figure S5.** Compressive stress versus strain test for the CS/CPPs sponge in water environment.

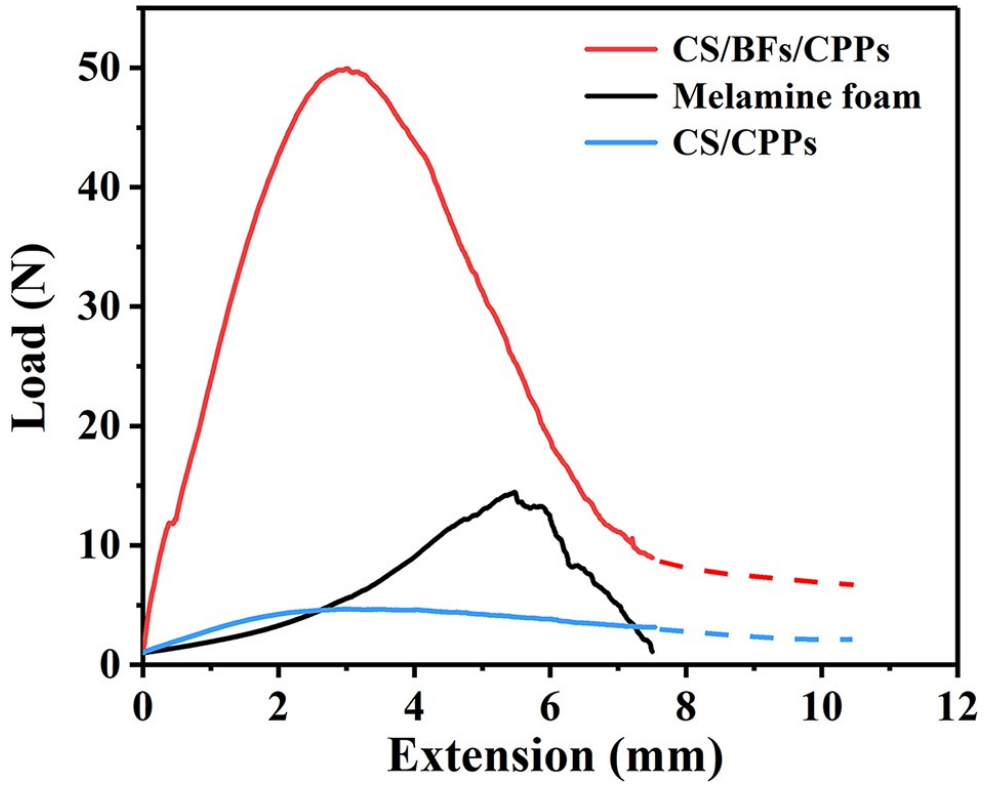


**Figure S6.** Mechanical properties of CS/BFs/CPPs sponge, CS/CPPs sponge, and melamine foam tested at the same extension rate.

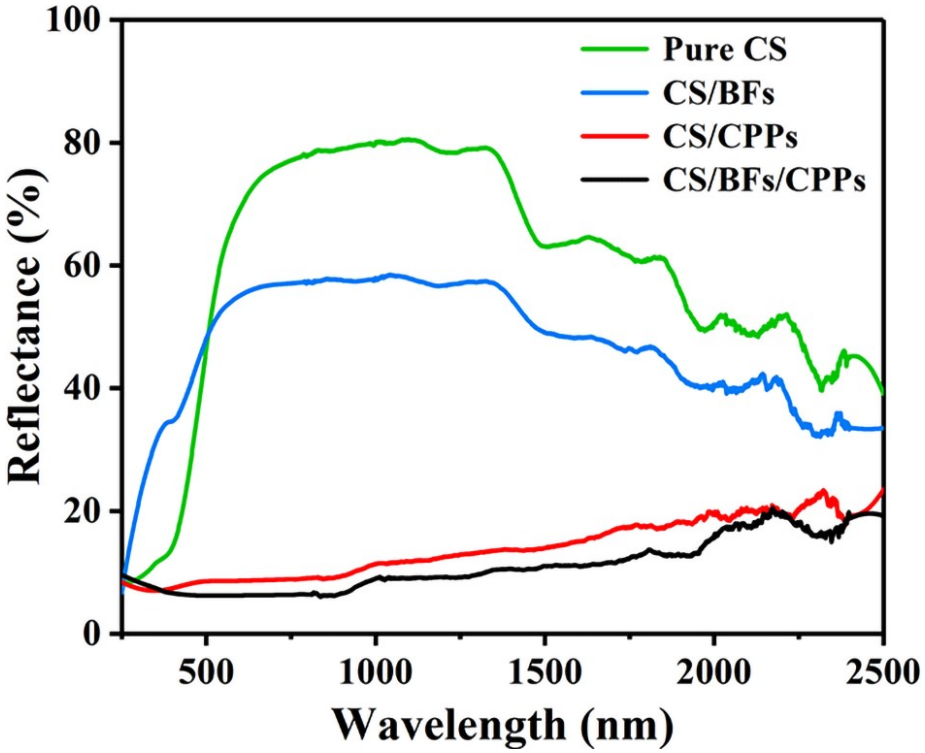


**Figure S7.** Light reflectance curve of CS sponge, CS/BFs sponge, CS/CPPs sponge, and CS/BFs/CPPs sponge from the range of 200 to 2500 nm.

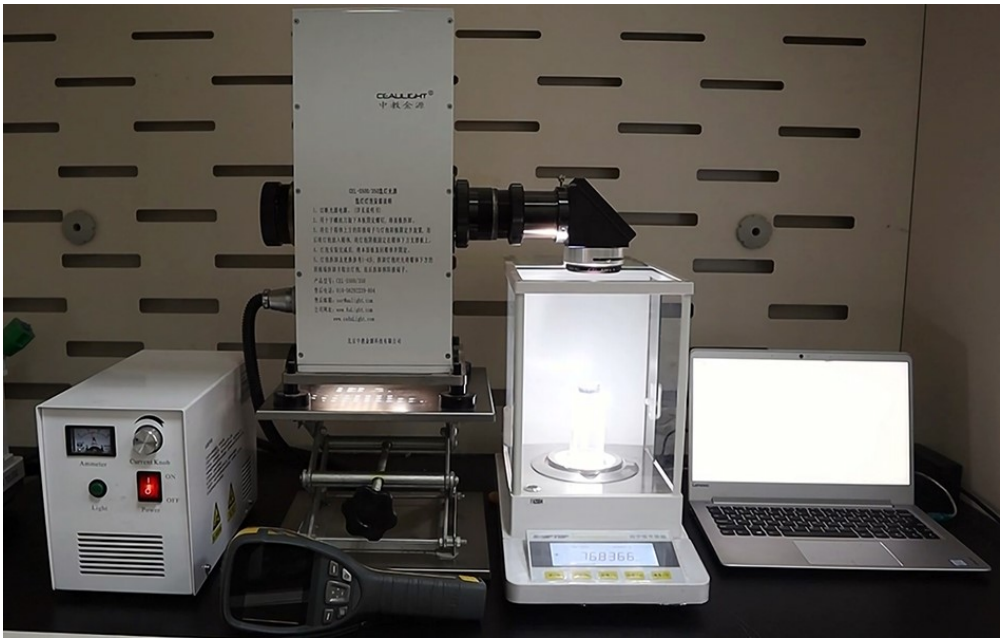


**Figure S8.** The optical image for solar–driven evaporation measurement platform.

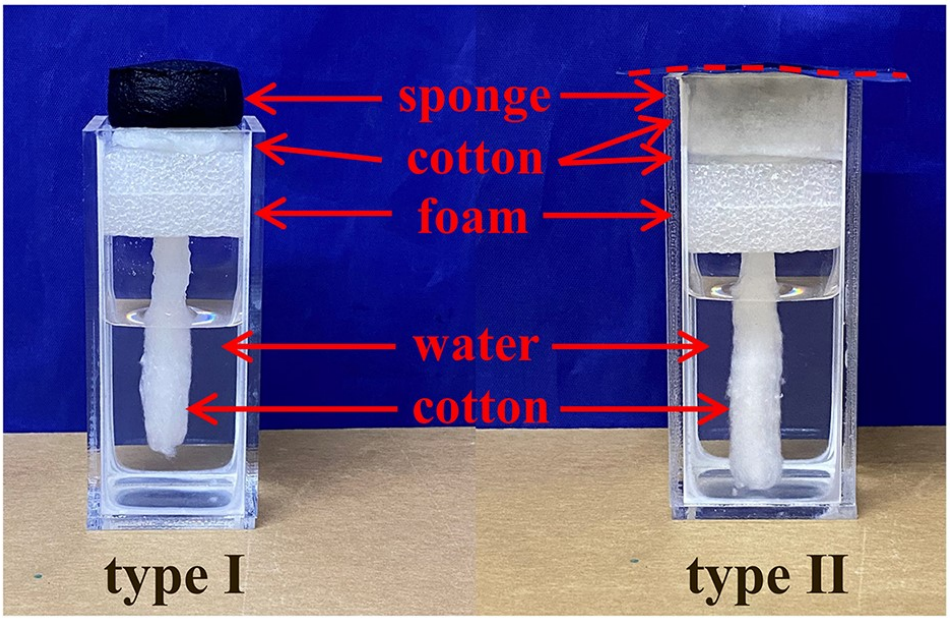


**Figure S9.** Two types of evaluating evaporation performance. Type II was set up to strictly control the light-receiving area and calculate the efficiency, Type I is closer to the practical application.

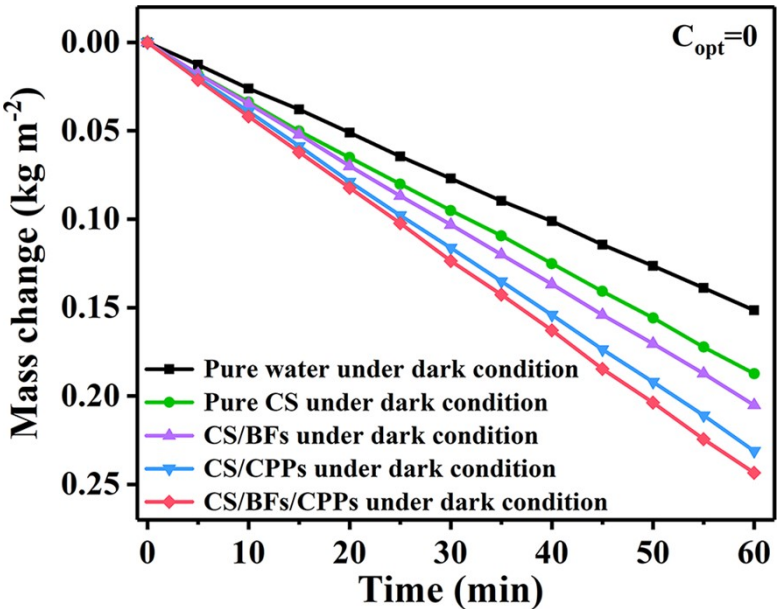


**Figure S10.** Mass change of water over time without optical illumination.

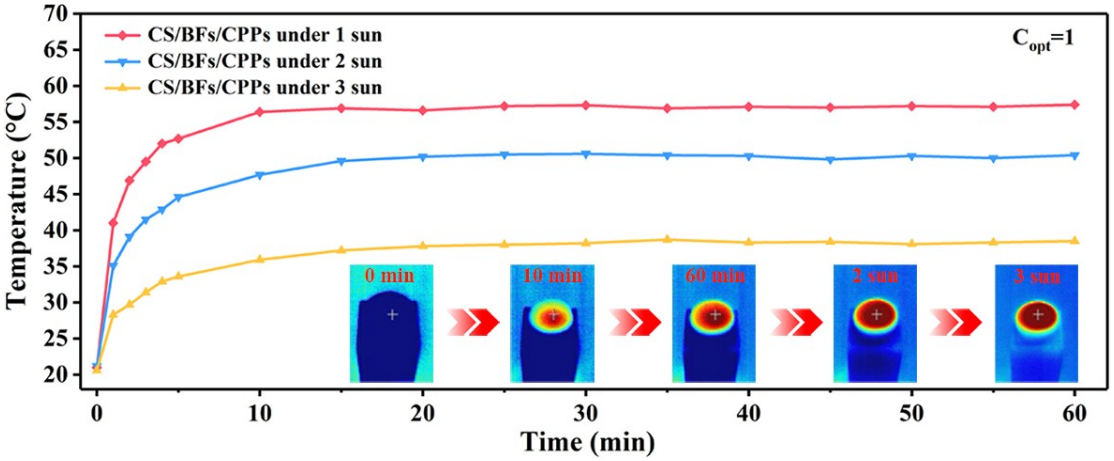


**Figure S11.** Temperature evolution of the evaporator surface under different circumstances (1, 2, and 3 sun). IR images of the sponge surface temperature variation with light intensity were recorded.

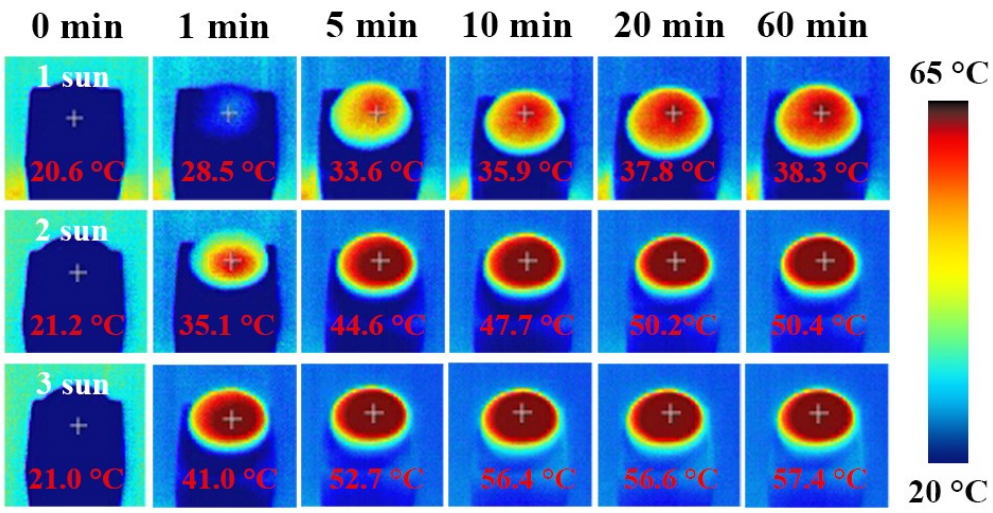


**Figure S12.** The infrared thermal images of CS/BFs/CPPs sponge under 1, 2, and 3 sun illumination within 1 h.

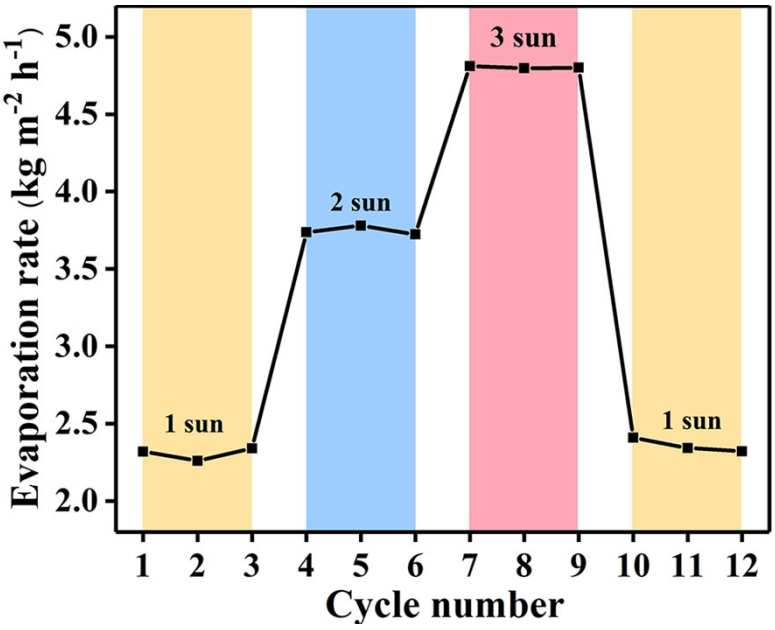


**Figure S13.** The cycles of evaporation performance of CS/BFs/CPPs sponge under different solar conditions.

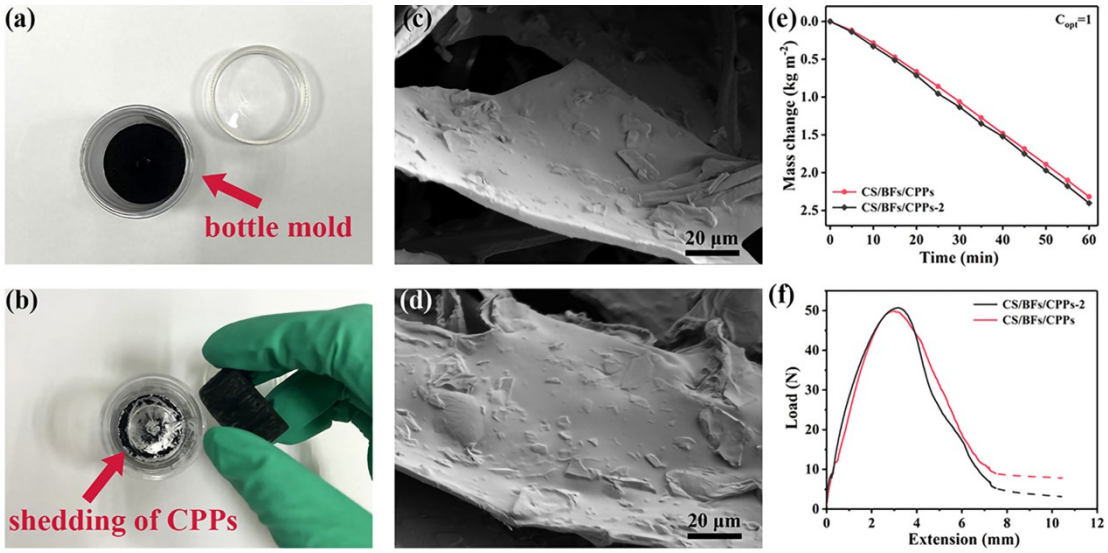


**Figure S14.** (a-b) The shedding of excess CPPs after liquid-phase one-pot freeze drying process. Distribution of CPPs on (c) CS/BFs/CPPs sponge and (d) CS/BFs/CPPs-2 sponge. (e) SVG tests and (f) tensile tests for CS/BFs/CPPs sponge and CS/BFs/CPPs-2 sponge.

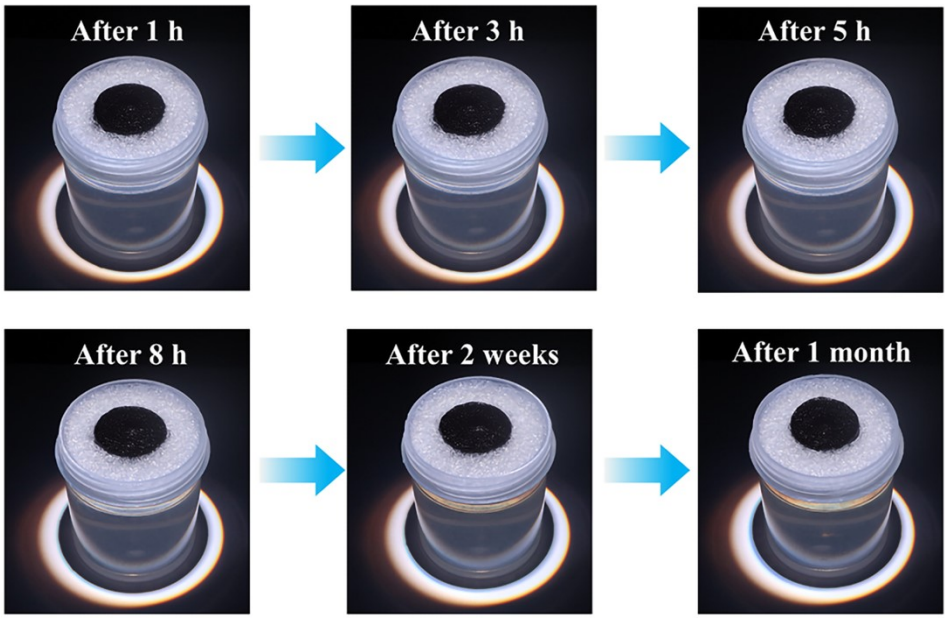


**Figure S15.** CS/BFs/CPPs sponge during the evaporation of 15 wt% brine under 1 sun.

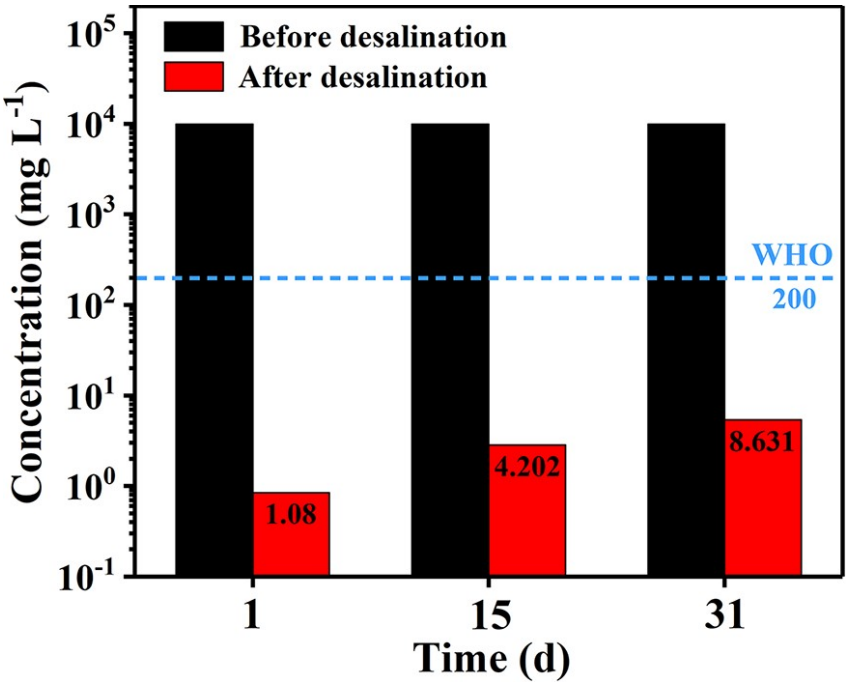


**Figure S16.** The change in sodium ion concentration before and after solar desalination.

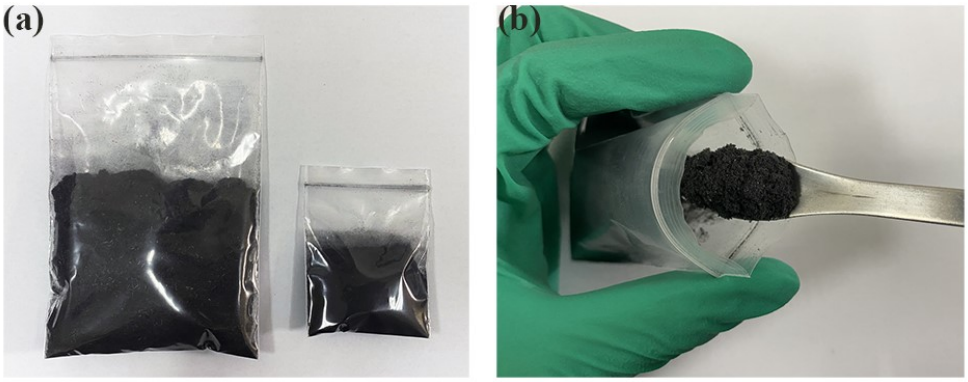


**Figure S17.** (a) Photograph of two kinds of CBC-BU. (b) Close-up view of the CBC-BU. The CBC-BU in the large sample bag still retained a large amount of BFs (named CBC-BU1), while the CBC-BU in the small sample bag was the mixture of fragments for chitosan and CPPs (named CBC-BU2), containing only a little BFs.

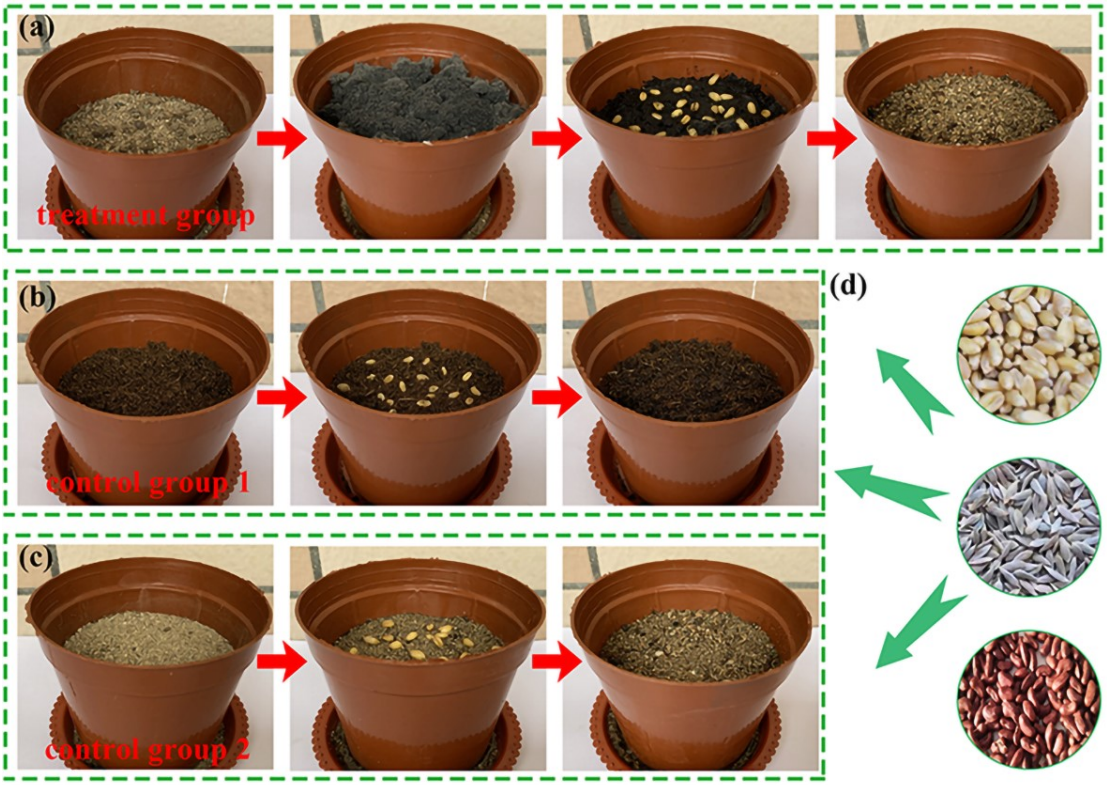


**Figure S18.** Cultivation processes of the (a) treatment group, (b) control group 1, and (c) control group 2. (d) Optical images of three types of seeds.

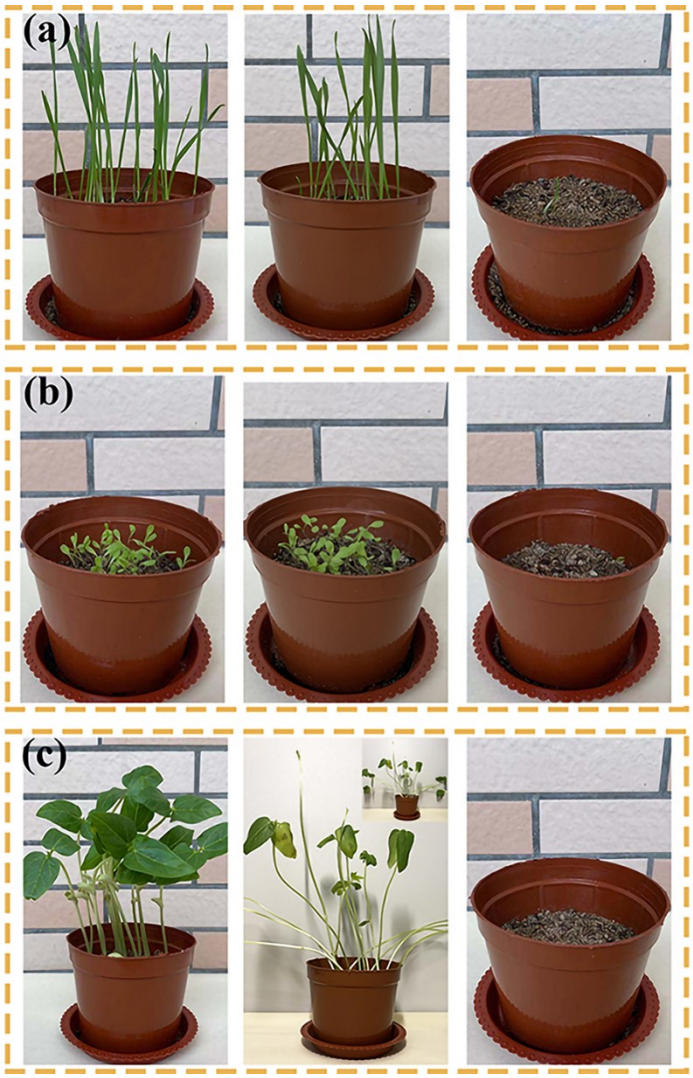


**Figure S19.** Comparison of seed germination after 7 days for (a) wheat, (b) lettuce, and (c) string beans in treatment group (left), control group 1 (middle), and control group 2 (right).

**Note S1**

**Detailed cultivation process.**

In the treatment group, wheat seeds were used as an example. Firstly, 650 g of fire-fighting sand was poured into a pot with a diameter of 10 cm. Secondly, 3.5 g of CBC-BU1 and 0.5 g of CBC-BU2 were put in. Next, the seeds were spread evenly on the CBC-BU and 30 ml of purified water collected in the experiment was added on every three days for a period of seven days. Finally, a thin layer of sand, about three times the diameter of the seeds, was covered over the seeds. Crops grown in normal soil were labeled as control group 1, while crops grown in sand served as control group 2. For each type of seed, a treatment group and two control groups were set up separately.

**Table S1. Evaporation performance, durability, and costs of various solar evaporators prepared from/partially from biomass materials.**

| Raw material prices and cost of equipment ($C_E$) and manpower ($C_M$) | Estimated single item cost ($/1*1*0.01 $m^{-3}$) | Total cost[a] ($/1*1*0.01 $m^{-3}$) | Evaporation rate (kg $m^{-2}$ $h^{-1}$) | Durability[b] (hour) | Ref. |
|---|---|---|---|---|---|
| -Ammonium molybdate | -$7.61 | 100.63 | 2.19 | 20 | 1 |
| -Glucose | -$1.09 | | | | |
| -Chitosan | -$56.58 | | | | |
| -Soluble starch | -$28.29 | | | | |
| -Extra $C_E$ & $C_M$ | -$10.06 (10%) | | | | |
| -Polyvinyl alcohol | -$2.19 | 47.33 | 2.185 | 20 | 2 |
| -Chitosan | -$38.25 | | | | |
| -Glutaraldehyde | -$0.16 | | | | |
| -Red mud | -$2 | | | | |
| -Extra $C_E$ & $C_M$ | -$4.73 (10%) | | | | |
| -$Ti_3AlC_2$ MAX | -$432.76 | 566.78 | 2.08 | 20 | 3 |
| -Dopamine hydrochloride | -$9.89 | | | | |
| -Lithium fluoride | -$1.72 | | | | |
| -Sodium chlorite | -$4.32 | | | | |
| -Balsa wood | -$33.07 | | | | |
| -Extra $C_E$ & $C_M$ | -$85.02 (15%) | | | | |
| -Pine block | -$23.18 | 418.79 | 2.07 | 10 | 4 |
| -Sodium dicyanamide | -$45.89 | | | | |
| -Pyrazine | -$49.93 | | | | |
| -$Ni(NO_3)_2 \cdot 6H_2O$ | -$139.98 | | | | |
| -Chitosan | -$76.05 | | | | |
| -Extra $C_E$ & $C_M$ | $83.76 (20%) | | | | |
| -Graphite flakes | -$0.39 | 1256.91 | 1.394 | 120 | 5 |
| -$H_2SO_4$, $H_3PO_4$ | -$8.91 | | | | |
| -$KMnO_4$ | -$23.67 | | | | |
| -$HAuCl_4 \cdot 3H_2O$ | -$939.3 | | | | |
| -Sodium citrate | -$0.19 | | | | |
| -Balsa wood | -$33.07 | | | | |
| -Extra $C_E$ & $C_M$ | -$251.38 (20%) | | | | |

| | | | | | |
|---|---|---|---|---|---|
| -Rice husk | -$14.48 | 907.73 | 1.77 | 84 | 6 |
| -Acrylamide | -$3.62 | | | | |
| -N,N'-methylenebisacrylamide | -$198.22 | | | | |
| -Sodium dodecyl sulfate | -$463.68 | | | | |
| -N,N,N',N'-tetramethylethylenediamin | -$0.32 | | | | |
| -$Na_2S_2O_8$ | -$48.29 | | | | |
| -$Na_2SO_3$ | -$7.39 | | | | |
| -Extra $C_E$ & $C_M$ | -$90.77(10%) | | | | |
| -Maize straw | -$0.76 | 210.77 | 2.71 | 4 | 7 |
| -Graphite flakes | -$0.06 | | | | |
| -$H_2SO_4$, $H_3PO_4$ | -$53.04 | | | | |
| -$KMnO_4$ | -$144.69 | | | | |
| -$Na_2SO_3$ | -$9.94 | | | | |
| -Sodium dodecyl sulfate | -$0.1 | | | | |
| -Ascorbic acid | -$2.18 | | | | |
| -Extra $C_E$ & $C_M$ | -$21.07 (10%) | | | | |
| -Pomelo peel | -$11.47 | 12.04 | 1.39 | 100 | 8 |
| -Extra $C_E$ & $C_M$ | -$0.57 (5%) | | | | |
| -Tannic acid | -$226.33 | 339.69 | 1.83 | 35 | 9 |
| -$FeCl_3 \cdot 6H_2O$ | -$8.45 | | | | |
| -Coconut husk | -$70.94 | | | | |
| -Extra $C_E$ & $C_M$ | -$33.97 (10%) | | | | |
| **-Chitosan** | **-$28.52** | **53.02** | **2.317** | **240** | **This work** |
| **-Bamboo silk** | **-$0.1** | | | | |
| **-Pomelo peel** | **-$6.55** | | | | |
| **-Sodium chlorite** | **-$9.9** | | | | |
| **-Extra $C_E$ & $C_M$** | **-$7.95 (15%)** | | | | |

[a] "Total cost" include not only the materials used, but also the usage and consumption of equipment and manpower during the experiment. The estimated single item costs of the materials are referenced from Macklin Biochemical Co., Ltd. (China), Aladdin Biochemical Technology Co., Ltd (China), Sinopharm Chemical Reagent Co., Ltd

(China), and Alibaba (China). The assumed equipment costs (CE) and manpower costs (CM) are 5%-20% of the total price, depending on the complexity and difficulty of the experimental process.

[b] "Durability" here refers to the minimum time for the evaporator to work effectively in practical applications, rather than the maximum time. In other words, the lifespan of evaporators may be higher than the values in Table S1.

**References**


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