Electronic Supplementary Material (ESI) for Materials Advances.

Supporting information

Intensifying solar sustainable water production by steam heat internal circulation

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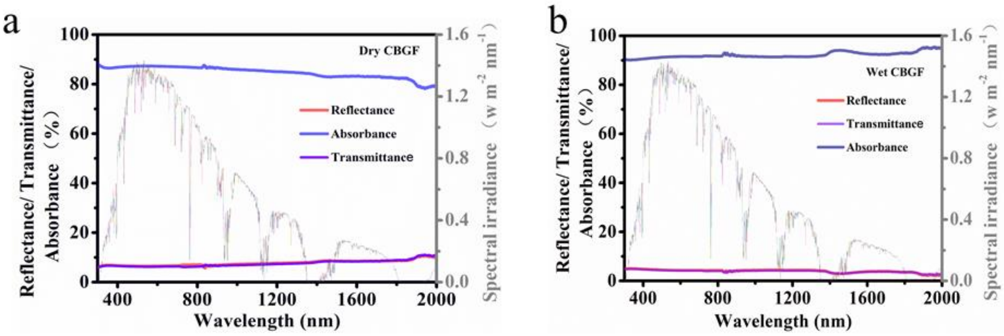


Figure S1. (a) The optical performance of dry CBGF. (b) The optical performance of wet CBGF.

Figure S2. Photo of CBGF floating on the water.

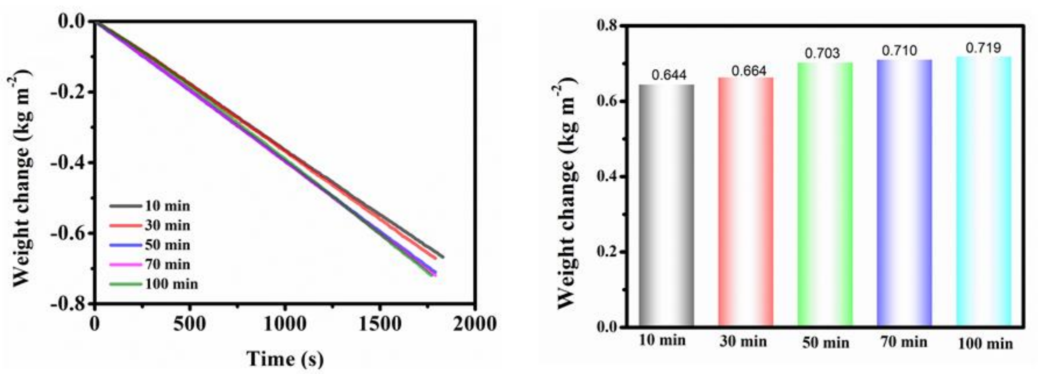


Figure S3. The photothermal evaporation performance of CBGF for different soaking time (10 min, 30 min, 50 min, 70 min and 100 min).

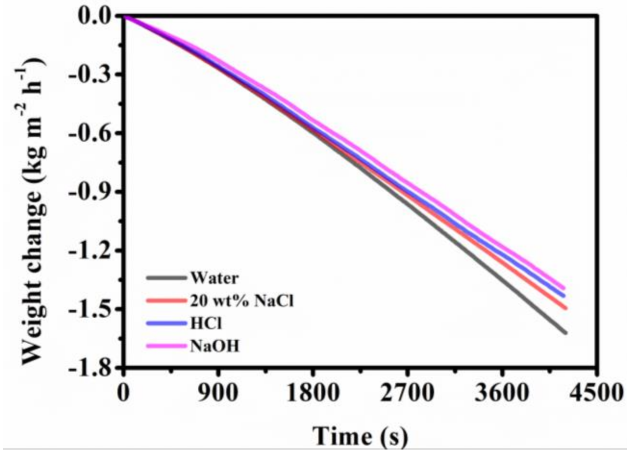


Figure S4. The evaporation performance of CBGF in highly concentrated salt water, acid solution (PH=1) and alkali solution (PH=14).

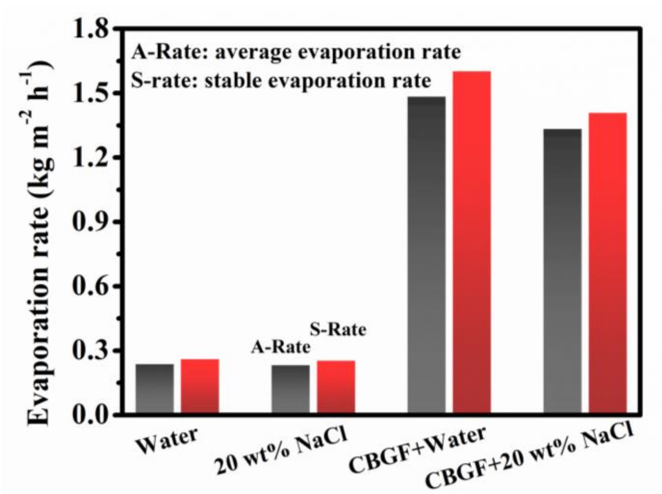


Figure S5. Evaporation performance comparison of CBGF in water and salt water under 1 sun.

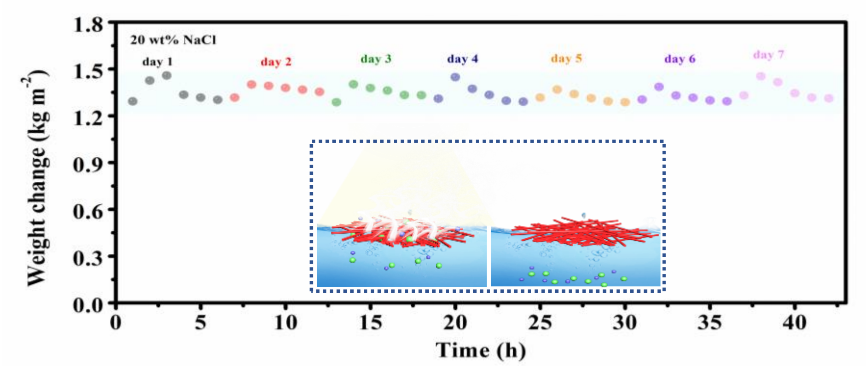


Figure S6. The long-term photothermal test of CBGF in high-concentration brine.

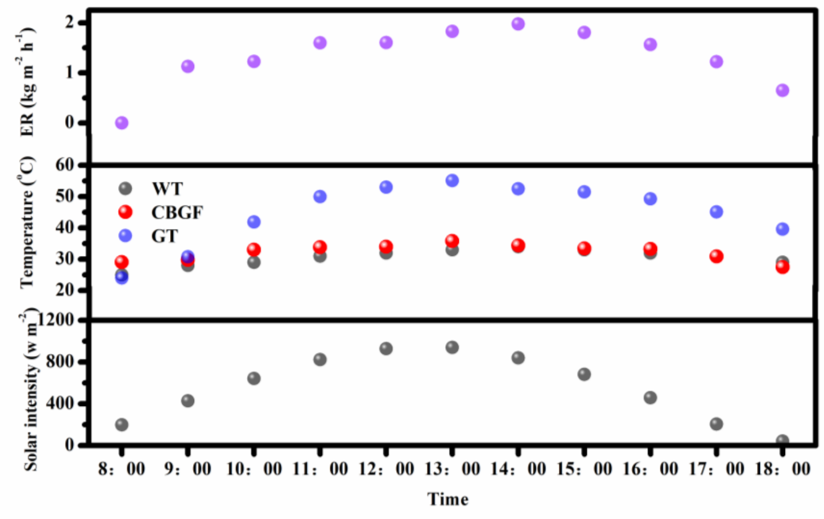


Figure S7. The outdoor experiment was performed on the roof of Hubei University (8:00-18:00, September 3, 2020. WT is the weather temperature, GF is ground temperature).

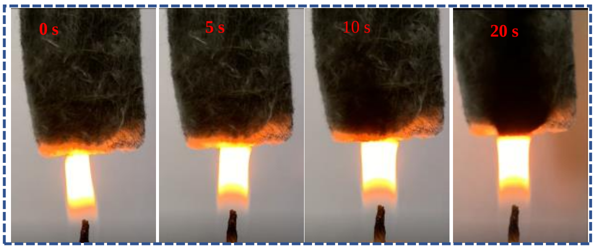


Figure S8. High-temperature resistance of CBGF.

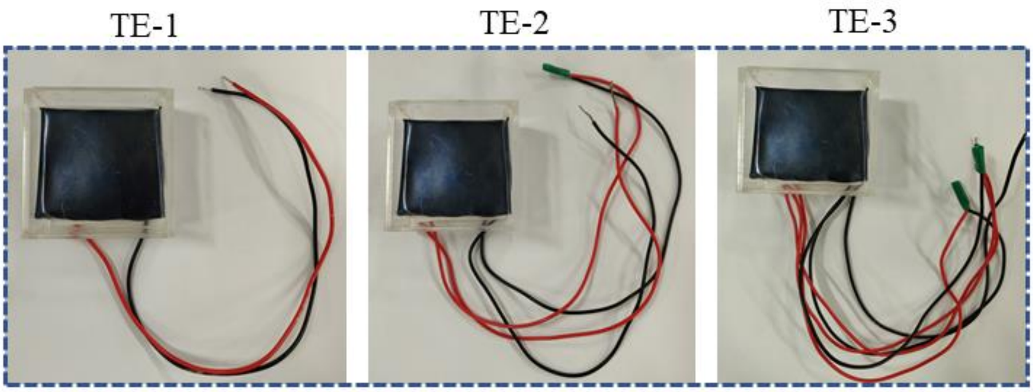


Figure S9. The photo of TE-1, TE-2 and TE-3 systems.

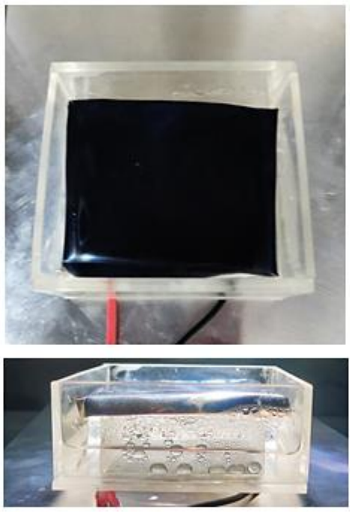


Figure S10. The photo of thermal-electricity system.

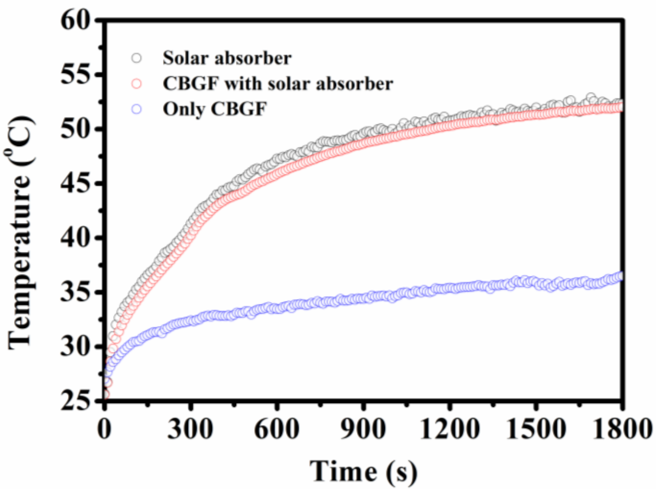


Figure S11. The surface of solar absorber and CBGF with solar absorber and without solar absorber under 1 sun. after half an hour, the surface of solar absorber and CBGF with solar absorber can reach ~52 ^oC, but the surface temperature of CBGF without solar absorber can reach ~36 ^oC, which suggesting the solar absorber can enhance the photothermal performance.

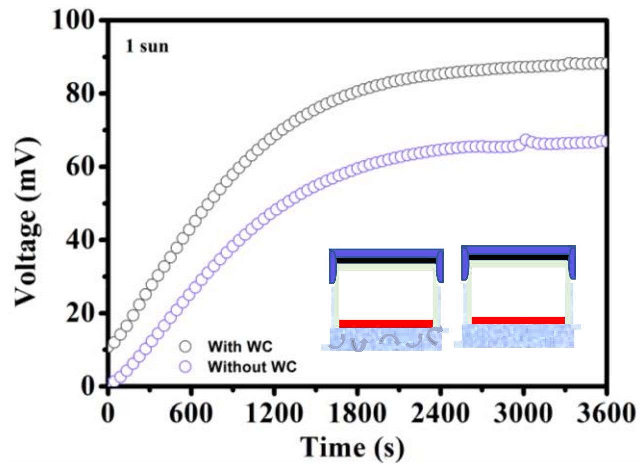


Figure S12. The voltage with water circulation and without water circulation platform.

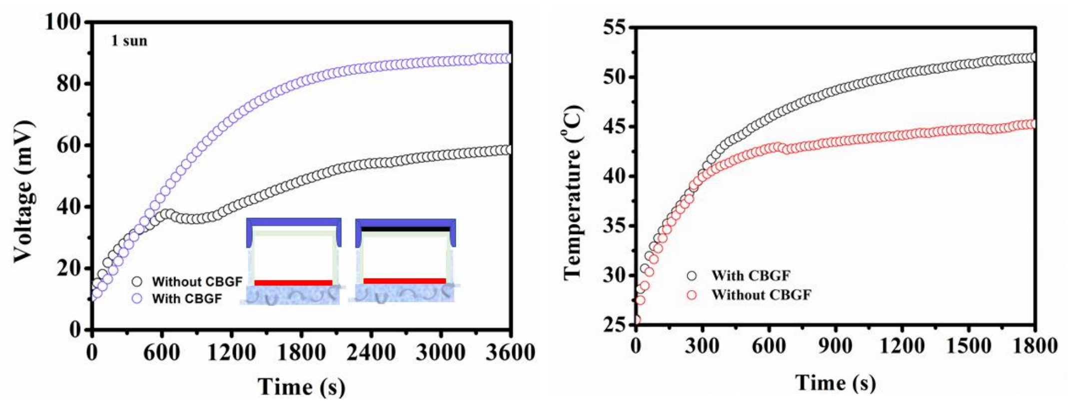


Figure S13. The voltage and evaporation surface temperature of system with CBGF and without CBGF under 1 sun. The voltage without CBGF get a lower value of only 58.3 eV than that of with CBGF, which may be mainly due to the higher temperature of the evaporation surface with CBGF than that of without CBGF. We think the possible reasons for higher surface temperature are: 1) CBGF absorbs part of the light to generate heat, and the part of the light comes from the light transmitted by the solar absorber. 2) CB is a thermally conductive material that can quickly transfer the high temperature generated on the surface of the solar absorber to the surface of the CBGF, and reduce the heat generated by the solar absorber lose to the external environment.

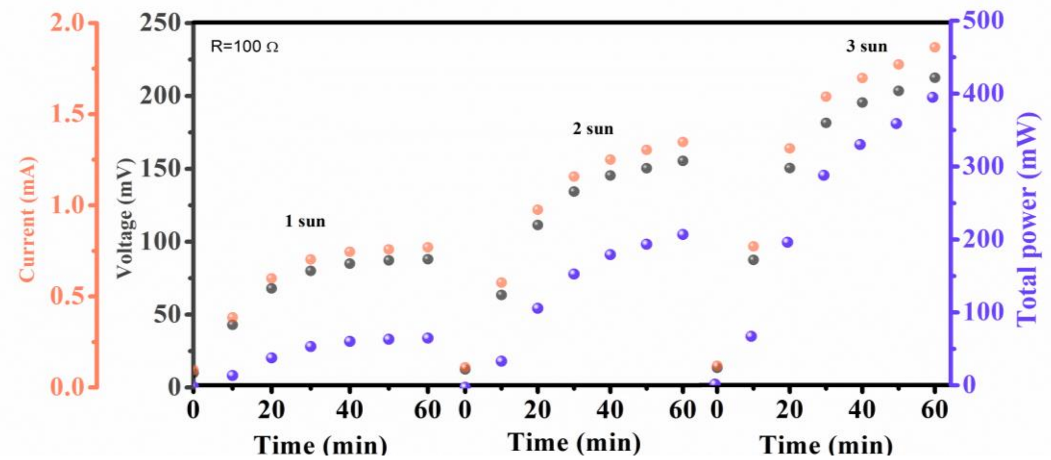


Figure S14. The total power of the system by a circuit connection under different light intensities.

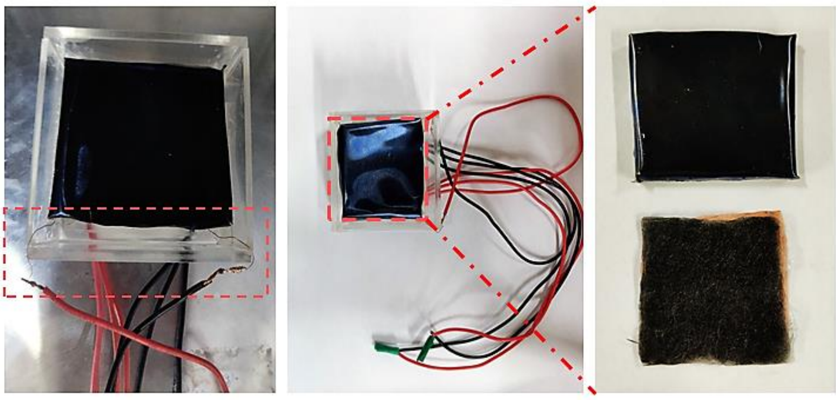
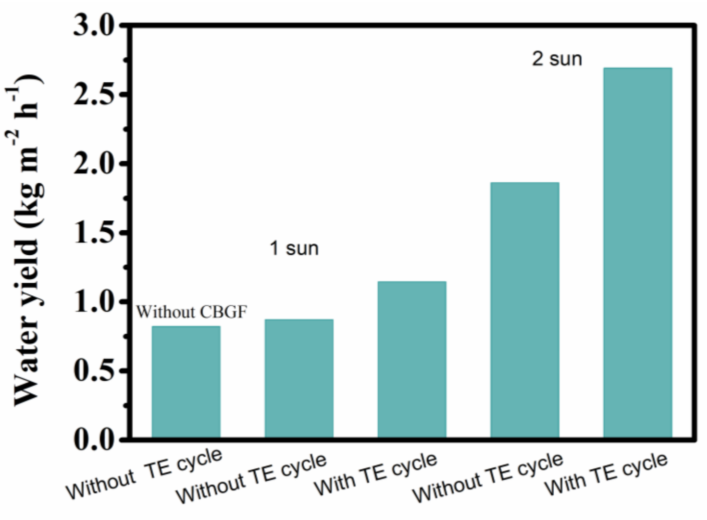


Figure S15. The photo of steam heat internal circulation system.



System	Weight change	Condensing rate	Solar intensity
Without CBGF and TE cycle	0.6571	0.821	1 sun
Without TE cycle	0.697	0.871	1 sun
With TE cycle	0.916	1.15	1 sun
Without TE cycle	1.49	1.862	2 sun
With TE cycle	2.153	2.691	2 sun

Figure S16. The water yield without TE cycle and with TE cycle.

The weight change difference of system without CBGF and TE cycle and without TE cycle is very small. The reason for this result may be the thickness of the evaporated water film. Although the introduction of CBGF can increase light absorption and photothermal effects, it will also cause the thickness of the water film at the photothermal evaporation interface to increase. Heating more water will inevitably reduce the evaporation rate. Therefore, under the combined influence, the evaporation rate did not increase significantly.

Table S1. The related works on energy storage for electricity

Materials	Light density (kW m^{-2})	method	Electricity production (mV)	Ref.
G-PDDA	1	Surface heat	78	1
PDA	1	Surface heat	520	2
Au@Bi2MoO6-CDs	1	Surface heat	203	3
CNT/CNC	1	Surface heat	60	4
Food waste	1	Surface heat	95	5
rGO	1	Steam heat	65	6
graphite/nonwoven	30	Steam heat	3.87	7
bamboo straw	1	Steam heat	90.7	8
CBGF	1	Steam heat	88.27	Our work

Table S2. Works related to joule heating promoting water evaporation

Materials	Light density (kW m^{-2})	Method	Electricity	Evaporation rate (kg m^{-2} h^{-1})	Ref.
PGS/GF	1	Solar cells	----	2.01-2.61	9
graphene–carbon cloth	0	DC source	3 V	4.17	10
GO	1	Solar cells	1 V	4.73	11

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