Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.


# Supporting Information

## Heterostructure design of $Cu_2O/Cu_2S$ core/shell nanowires for solar-driven photothermal water vaporization towards desalination

*Liangri Ying, Han Zhu,* Huilin Li, Zhenfeng Zhu, Shuhui Sun, Xiaofan Wang, Shuanglong Lu, Mingliang Du**

Key Laboratory of Synthetic and Biological Colloids, Ministry of Education, School of Chemical and Material Engineering, Jiangnan University, Wuxi 214122, P. R. China

Email: zhysw@jiangnan.edu.cn; du@jiangnan.edu.cn

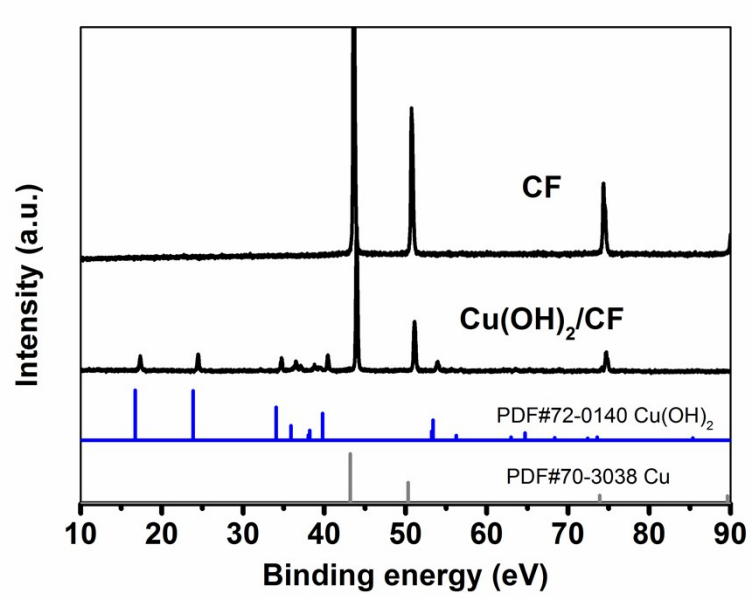


**Figure S1**. XRD patterns of the CF and $Cu(OH)_2$ /CF architectures.

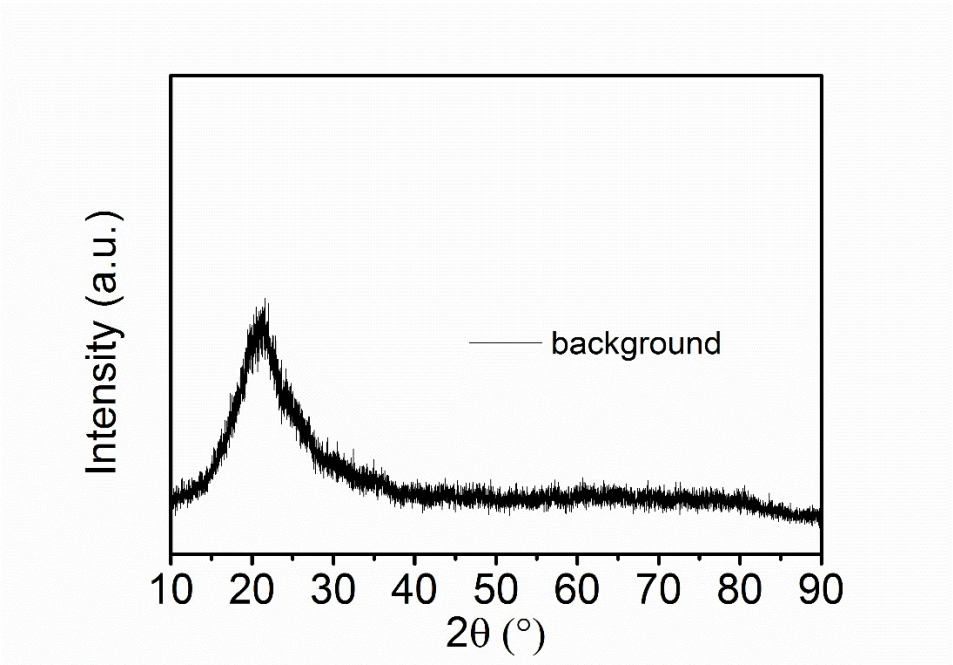


**Figure S2**. XRD patterns of the glass support floor.

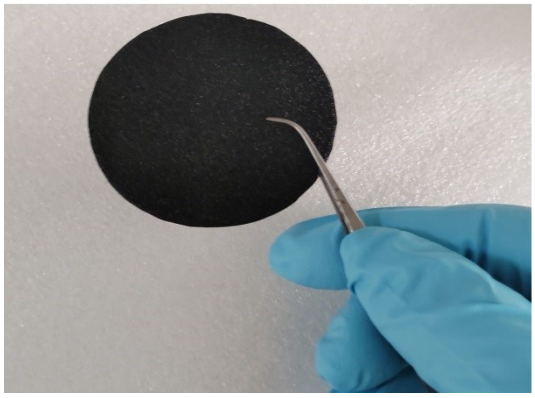

Figure S3. Optical photograph of $Cu_2S/Cu_2O/CF$.

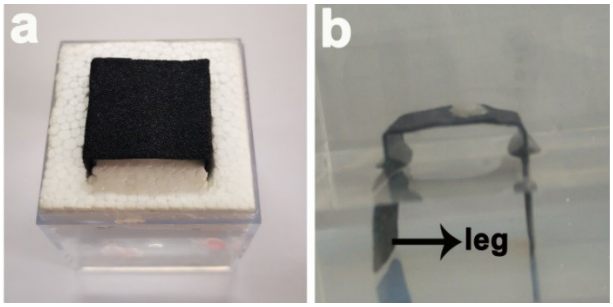


**Figure S4**. Optical photograph of the home-make water transfer device.

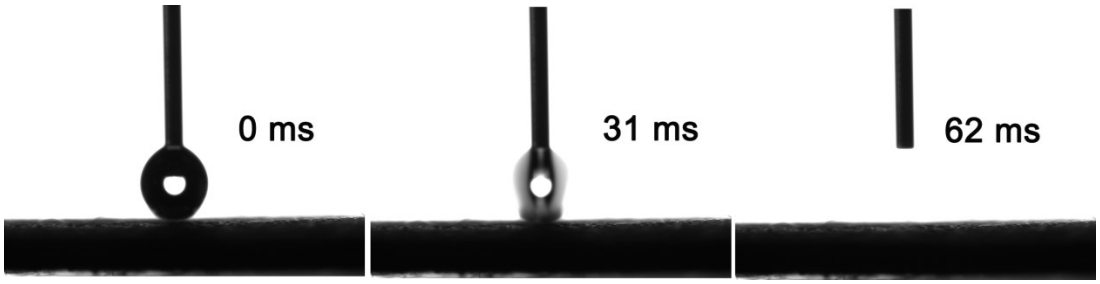


**Figure S5.** The dynamic contact angles of 5 μL sessile droplets on the $Cu_2S/Cu_2O$/CF.

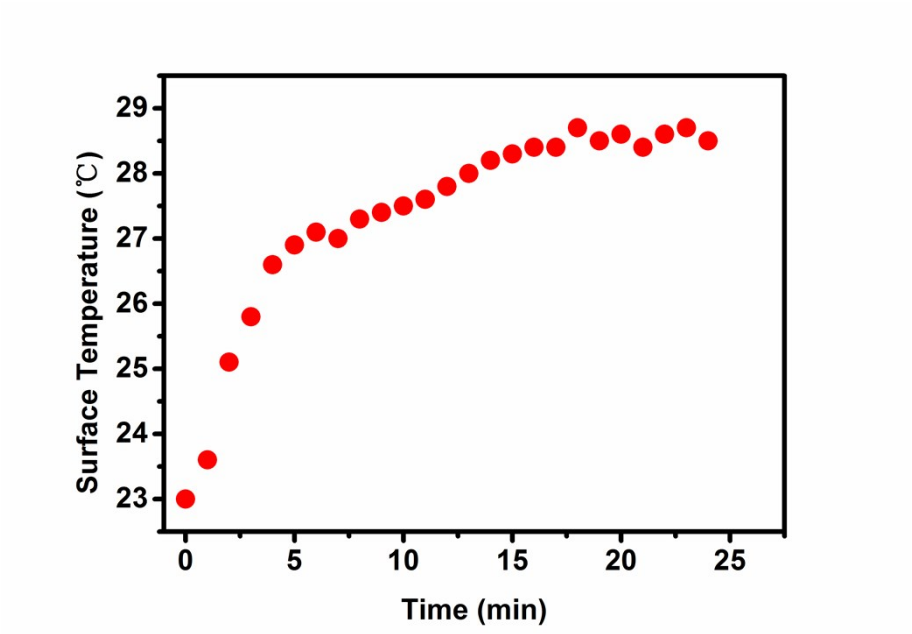


**Figure S6**. The surface temperature changes of cotton under one sun irradiation.

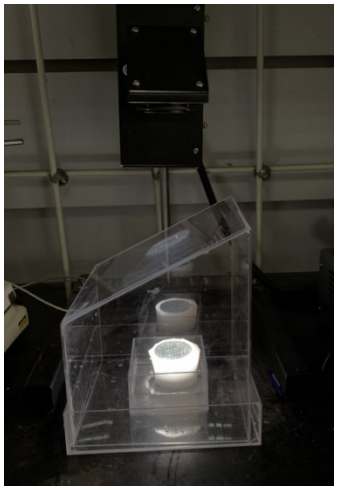

**Figure S7**. Digital photograph of the designed solar-thermal water evaporation device.

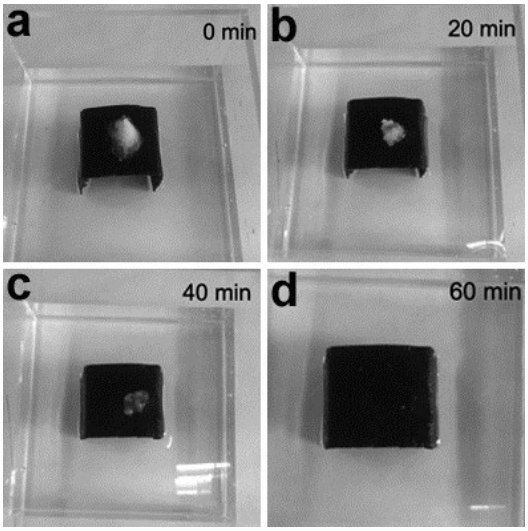


**Figure S8.** The design approach is shown in Figure S2, $Cu_2S/Cu_2O$/CF is placed in the solution with 3.5 wt% NaCl, the distance between evaporation surface and water is one centimeter.

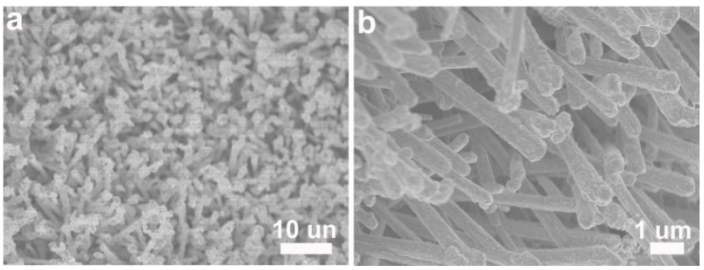

**Figure S9**. SEM images of the $Cu_2S/Cu_2O$/CF (a) after cycle desalination tests and (b) 1M NaOH treatment.

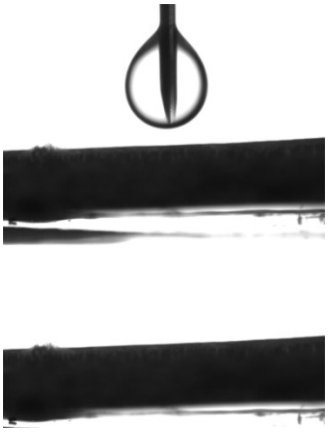

**Figure S10**. Underwater oil contact angle of CF.

**Table S1**. The composition of the prepared simulated water.

| NaCl | $NaHCO_3$ | $Na_2SO_4$ | KCl | $MgCl_2$ | $CaCl_2$ | $Mg(NO_3)_2$ | Water |
|---|---|---|---|---|---|---|---|
| 6.68g | 0.05g | 0.87g | 0.18g | 0.57g | 0.28g | 1.73g | 250g |

**Table S2.** Comparison of the water evaporation property of $Cu_2S/Cu_2O$/CF to the other photothermal materials.

| Photothermal materials | Light intensity (Kw $m^{-2}$) | evaporation rate (kg $m^{-2}$ $h^{-1}$) | η | reference |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| $Cu_2O/Cu_2S$/CF | 1 | 1.44 | 83.1% | This work |
| $Cu_7S_4$/Cu mesh | 1 | 1.41 | 88.1% | 1 |
| S-Ni foam | 1 | 1.29 | 83.6% | 2 |
| $W_{18}O_{49}$@PDMS membrane | 1 | 1.15 | 82% | 3 |
| ce-$MoS_2$/BNC | 5.53 | 6.15 | 81.4% | 4 |
| Ni–NiOx/Ni foam | 1 | 1.41 | 94% | 5 |
| PANI@PVDF | 1 | 1.41 | 85% | 6 |
| SnSe-$SnSe_2$ film | 1 | 1.28 | 84% | 7 |
| GO/PVA EFMs | 1 | 1.4 | 90% | 8 |
| Cu/PE membrane | 1 | 1.02 | 63.9% | 9 |
| MDPC/SS mesh | 1 | 1.22 | 84% | 10 |
| D-$HNb_3O_8$/PAM | 1 | 1.4 | 91% | 11 |

**References**


(1) Li, X.; Yao, Z.; Wang, J.; Li, D.; Yu, K.; Jiang, Z. A Novel Flake-like $Cu_7S_4$ Solar Absorber for High-Performance Large-Scale Water Evaporation. *ACS Applied Energy Materials* **2019,** *2* (7), 5154.

(2) Zhao, S.; Chen, L.; Zhang, C.; Hasi, Q. M.; Zhang, L.; Luo, X.; Li, A. Functional oil-repellent photothermal materials based on nickel foam for efficient solar steam generation. *Solar Energy Materials and Solar Cells* **2020,** *214*, 110574.

(3) Chang, Y.; Wang, Z.; Shi, Y. e.; Ma, X.; Ma, L.; Zhang, Y.; Zhan, J. Hydrophobic $W_{18}O_{49}$ mesocrystal on hydrophilic PTFE membrane as an efficient solar steam generation device under one sun. *Journal of Materials Chemistry A* **2018,** *6* (23), 10939.

(4) Ghim, D.; Jiang, Q.; Cao, S.; Singamaneni, S.; Jun, Y. S. Mechanically interlocked 1T/2H phases of $MoS_2$ nanosheets for solar thermal water purification. *Nano Energy* **2018,** *53*,

949.

(5) Wu, D.; Qu, D.; Jiang, W.; Chen, G.; An, L.; Zhuang, C.; Sun, Z. Self-floating nanostructured Ni–NiOx/Ni foam for solar thermal water evaporation. *Journal of Materials Chemistry A* **2019,** *7* (14), 8485.

(6) Zou, Y.; Chen, X.; Guo, W.; Liu, X.; Li, Y. Flexible and Robust Polyaniline Composites for Highly Efficient and Durable Solar Desalination. *ACS Applied Energy Materials* **2020,** *3* (3), 2634.

(7) Tahir, Z.; Kim, S.; Ullah, F.; Lee, S.; Lee, J. h.; Park, N. W.; Seong, M. J.; Lee, S. K.; Ju, T. S.; Park, S.et al. Highly Efficient Solar Steam Generation by Glassy Carbon Foam Coated with Two-Dimensional Metal Chalcogenides. *ACS Applied Materials & Interfaces* **2020,** *12* (2), 2490.

(8) Guo, X.; Gao, H.; Wang, S.; Yin, L.; Dai, Y. Scalable, flexible and reusable graphene oxide-functionalized electrospun nanofibrous membrane for solar photothermal desalination. *Desalination* **2020,** *488*, 114535.

(9) Shang, M.; Li, N.; Zhang, S.; Zhao, T.; Zhang, C.; Liu, C.; Li, H.; Wang, Z. Full-Spectrum Solar-to-Heat Conversion Membrane with Interfacial Plasmonic Heating Ability for High-Efficiency Desalination of Seawater. *ACS Applied Energy Materials* **2018,** *1* (1), 56.

(10) Ma, S.; Qarony, W.; Hossain, M. I.; Yip, C. T.; Tsang, Y. H. Metal-organic framework derived porous carbon of light trapping structures for efficient solar steam generation. *Solar Energy Materials and Solar Cells* **2019,** *196*, 36.

(11) Yang, M. Q., Tan, C. F., Lu, W., Zeng, K., Ho, G. W. Spectrum tailored defective 2D semiconductor nanosheets aerogel for full-spectrum-driven photothermal water evaporation and photochemical degradation. Advanced Functional Materials **2020**, 2004460.