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Supporting Information

Carbon nanotubes@silicone solar evaporators with controllable salt-tolerance for efficient water evaporation in closed system

Tao Hu [a#], *Kai Chen* [a#], *Lingxiao Li* [a] *and Junping Zhang** [a,b]

[a] Center of Eco-Material and Green Chemistry, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, 730000 Lanzhou, P.R. China

[b] Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences, Beijing 100049, P.R. China

[#] These authors contributed equally to this work.

* *E-mail address:* jpzhang@licp.cas.cn

Calculation of heat loss

The heat loss of the solar evaporation device is attributed to radiation, convection and conduction.

a) The radiative heat loss is calculated by the Stefan-Boltzmann equation.[1]

$$Q_{rad} = \varepsilon A\sigma(T^4-T_2^4) \quad \text{(S1)}$$

Where Q_{rad} represents heat flux, ε is the emissivity, A is the surface area, σ is the Stefan-Boltzmann constant (5.67×10^{-8} W m^{-2} K^{-4}), T (318.15 K) is the average surface temperature of as-prepared sample for a steady state of ~1 h, and T_2 (310.15 K) is the ambient temperature upward the absorber under 1 sun irradiation. According to equation (S1), the radiation loss is ~5 % of the solar flux (1 sun = 1000 W m^{-2}).

b) The convective heat loss is defined by Newton' law of cooling.[2]

$$Q_{conv} = hA(T-T_2) \quad \text{(S2)}$$

Where Q_{conv} denotes the heat energy, h is the convection heat transfer coefficient, which is ~5 W m^{-2} K. ΔT is the different value between the average surface temperature and the ambient temperature upward the absorber (ΔT=8 K). According to equation (S2), the convection heat loss is calculated to be ~4 %.

c) The conductive heat loss is calculated according to the following equation.[3]

$$Q_{cond}=Cm\Delta T \quad \text{(S3)}$$

Where Q_{cond} is the heat energy, C is the specific heat capacity of water (4.2 J $^{o}C^{-1}$ g^{-1}), m (80 g) is the water weight, and ΔT (0.6 ^{o}C) is the temperature difference of pure water after and before solar illumination under 1 sun for 1 h. Therefore, the conductive heat loss is calculated to be ~3%.

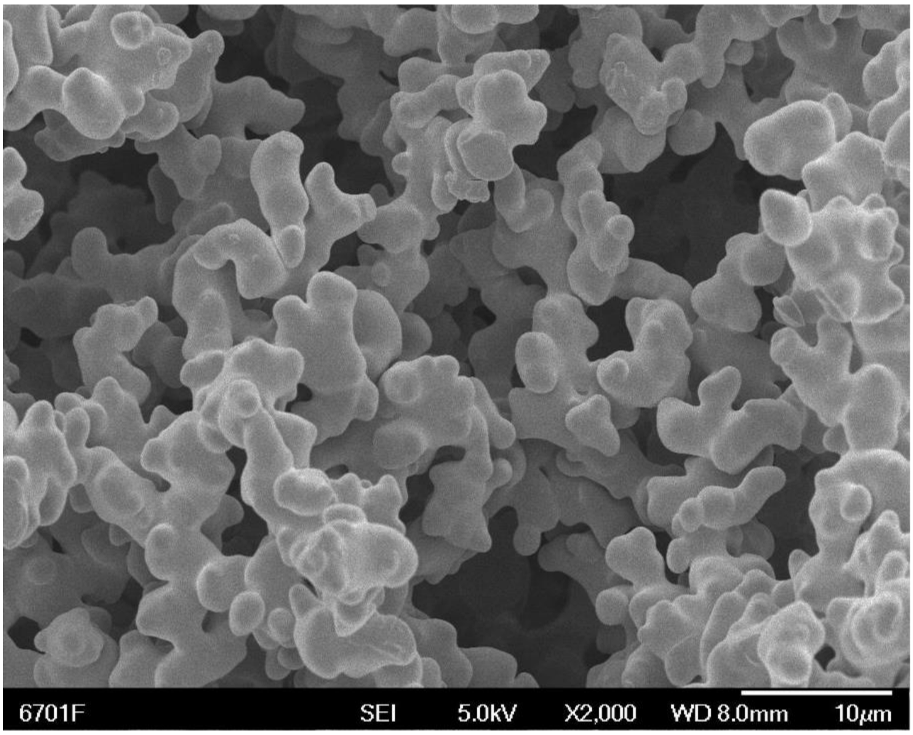

Fig. S1 SEM image of the silicone sponge.

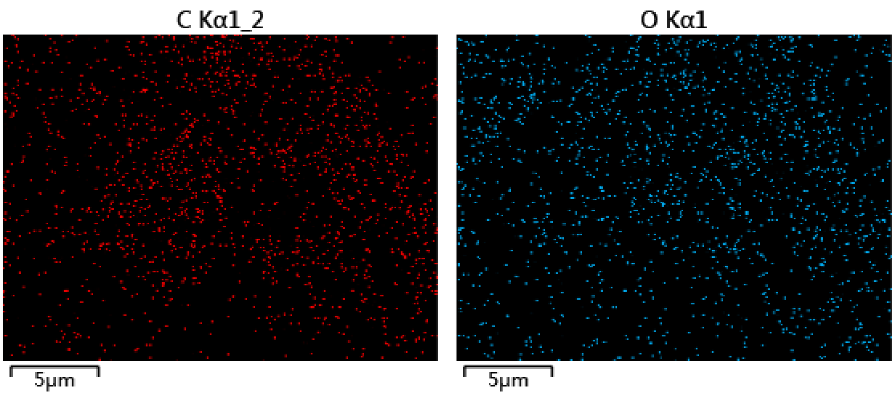

Fig. S2 Surface elemental mapping of the CNTs@silicone solar evaporator[6.0].

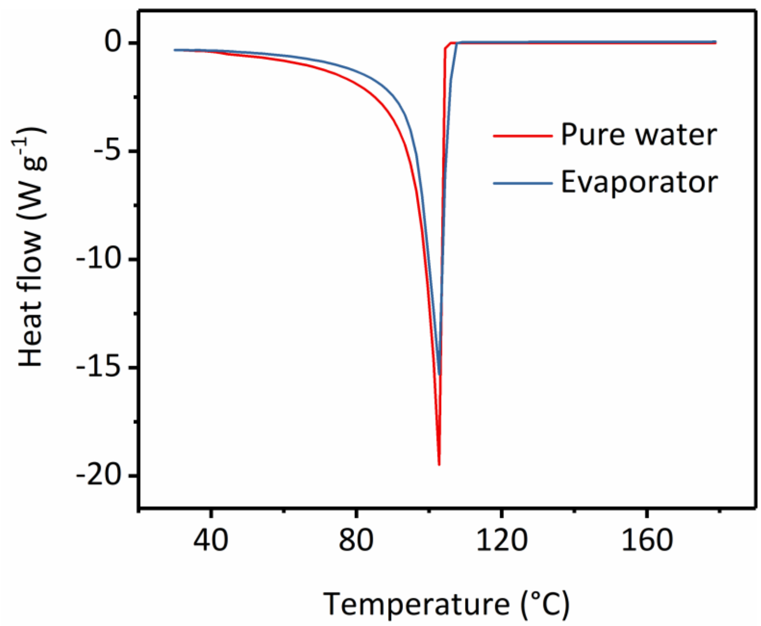

Fig. S3 Differential scanning calorimetry curves of pure water and water in the evaporator.

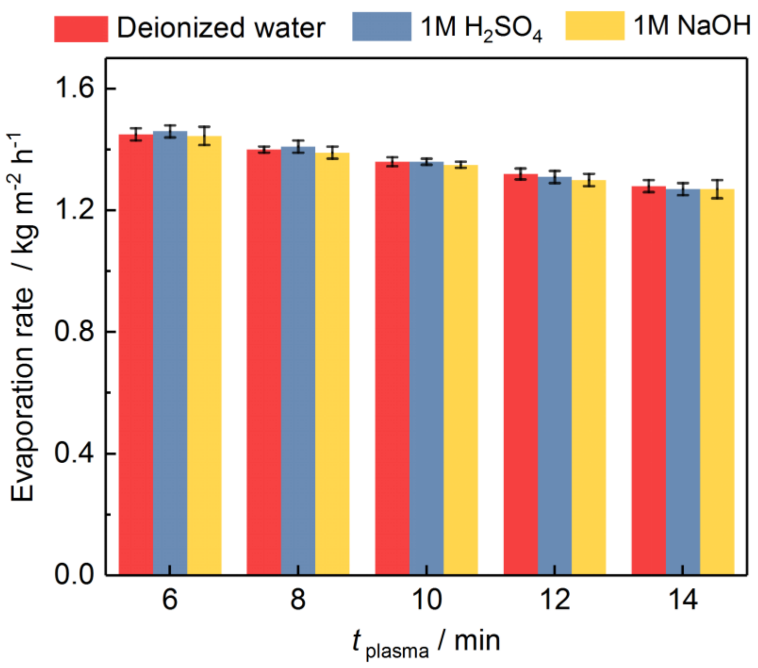

Fig. S4 Evaporation rate of deionized water, 1 M H_2SO_4 aqueous solution and 1 M NaOH aqueous solution under 1 sun illumination in 1 h in the presence of different CNTs@silicone solar evaporators.

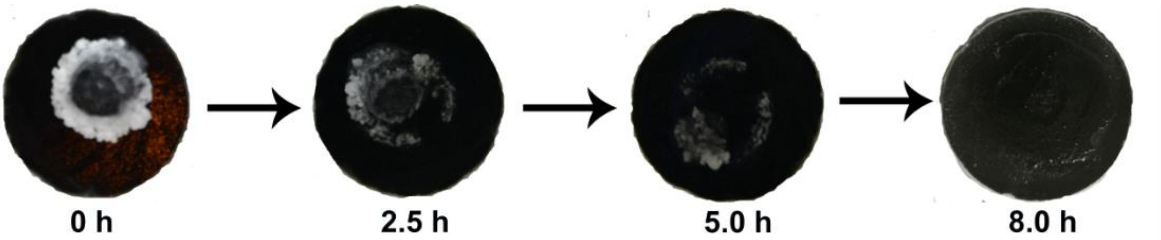

Fig. S5 Spontaneous dissolution & diffusion of the precipitated NaCl (during 10 h of continuous solar evaporation of 7.5 wt% NaCl solution under 1 sun) on the top surface of the evaporator$^{14.0}$ back to the bulk saline water (7.5 wt% NaCl solution) via the superhydrophilic shell under the light off condition.

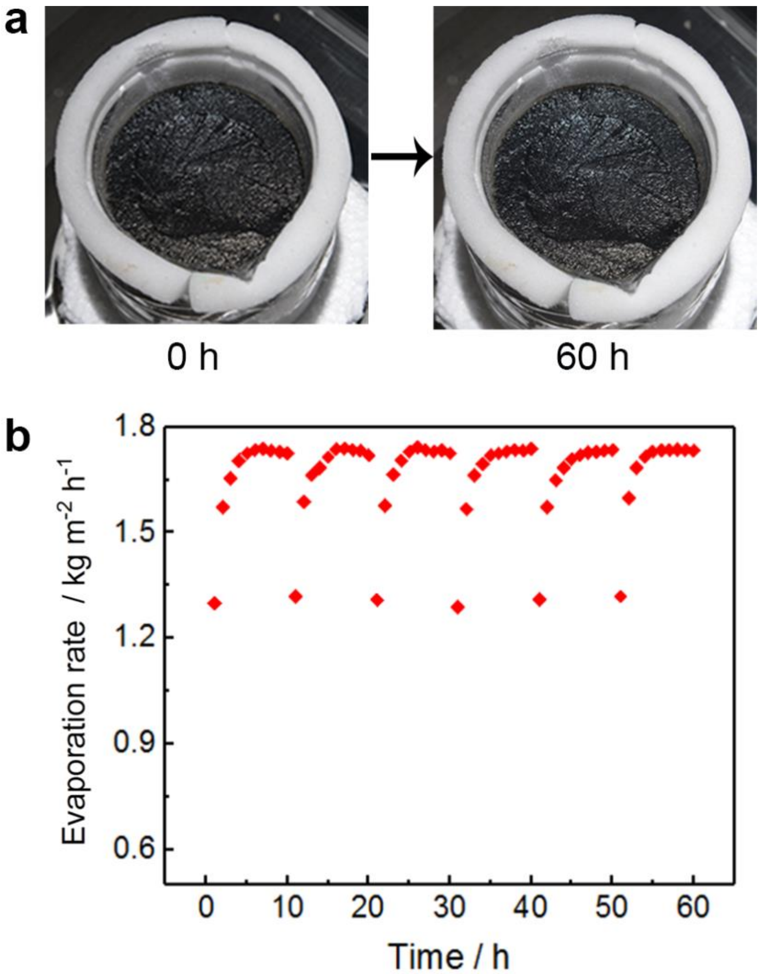

Fig. S6 (a) Photographs and (b) evaporation rate of the evaporator$^{12.0}$ during the 60 h continuous solar desalination of seawater (Bohai Sea) under 1 sun. The seawater was replenished every 10 h during the test.

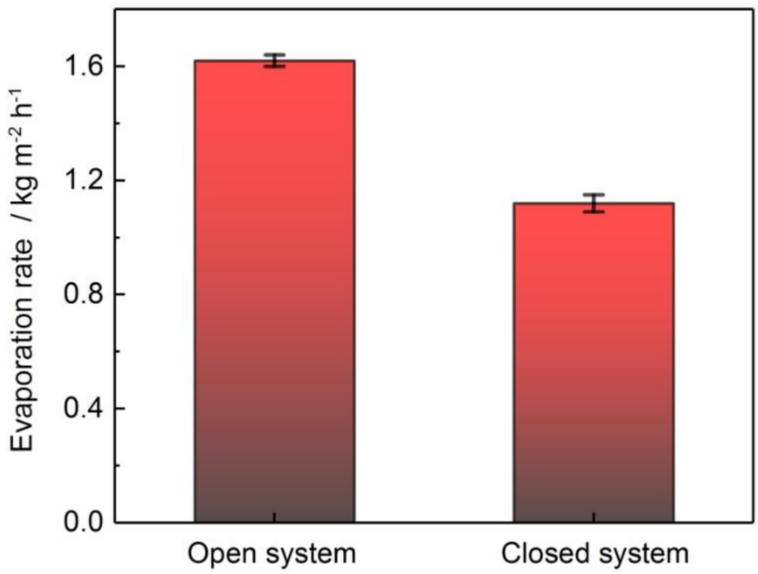

Fig. S7 Average evaporation rate of 3.5 wt% NaCl solution during 10 h of continuous solar evaporation under 1 sun in the presence of the evaporator$^{6.0}$ in the open and closed systems.

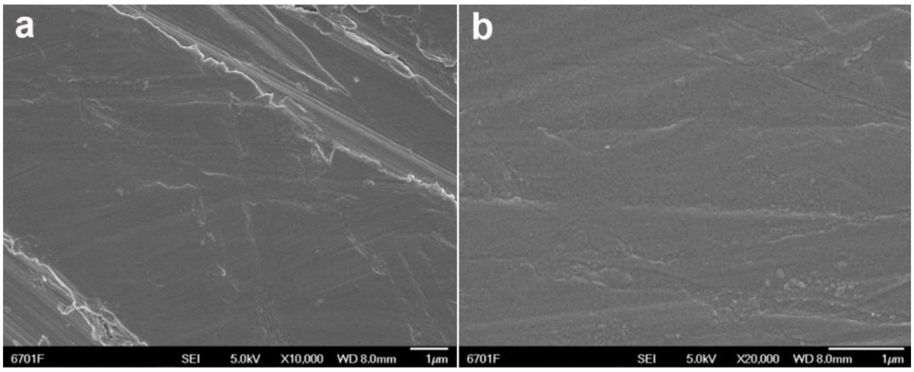

Fig. S8. SEM images of (a) bulk water and (b) collected water.

Table S1. Evaporation rate and solar-to-vapor efficiency of different CNTs@silicone solar evaporators.

Evaporators	Evaporation rate (kg m^{-2} h^{-1})	Dark evaporation rate (kg m^{-2} h^{-1})	Solar-to-vapor efficiency (%)
$Evaporator^{1.0}$	1.72	0.16	95.3
$Evaporator^{2.0}$	1.60	0.13	89.8
$Evaporator^{4.0}$	1.52	0.12	85.6
$Evaporator^{6.0}$	1.45	0.11	81.2
$Evaporator^{8.0}$	1.40	0.12	78.2
$Evaporator^{10.0}$	1.36	0.11	76.4
$Evaporator^{12.0}$	1.32	0.10	74.9
$Evaporator^{14.0}$	1.28	0.10	72.1

Table S2. The maximum salt-tolerance of different CNTs@silicone solar evaporators in the open and closed systems.

Evaporators	Maximum salt-tolerance / wt%	
	Open system	Closed system
$Evaporator^{6.0}$	1.0	3.0
$Evaporator^{8.0}$	1.5	4.5
$Evaporator^{10.0}$	2.5	5.0
$Evaporator^{12.0}$	3.5	6.0
$Evaporator^{14.0}$	5.0	7.5

Table S3. Concentration changes of the major cations in simulated seawater and wastewater after solar evaporation using the evaporator$^{4.0}$, and the corresponding removal efficiencies.

Cations	Initial concentration / (mg L^{-1})	Concentration in collected water / (mg L^{-1})	Removal efficiency / %
Na^{+}	10525	7.62	99.93
Mg^{2+}	1106	2.1	99.81
K^{+}	385	0.82	99.79
Ca^{2+}	398	0.75	99.81
Cu^{2+}	1280	0.1	99.99
Zn^{2+}	1300	0.125	99.99

References

1. G. Ni, G. Li, Svetlana V. Boriskina, H. Li, W. Yang, T. Zhang and G. Chen, *Nature Energy*, 2016, **1**, 16126.

2. K. Yin, S. Yang, J. Wu, Y. Li, D. Chu, J. He and J.-A. Duan, *Journal of Materials Chemistry A*, 2019, **7**, 8361-8367.

3. X. Li, W. Xu, M. Tang, L. Zhou, B. Zhu, S. Zhu and J. Zhu, *Proceedings of the National Academy of Sciences*, 2016, **113**, 13953-13958.