Electronic Supporting Information

Femtosecond laser rapid induced robust Ti foam-based evaporator for efficient solar desalination

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This file contains Supplementary Figures S1-S12 and Table S1.

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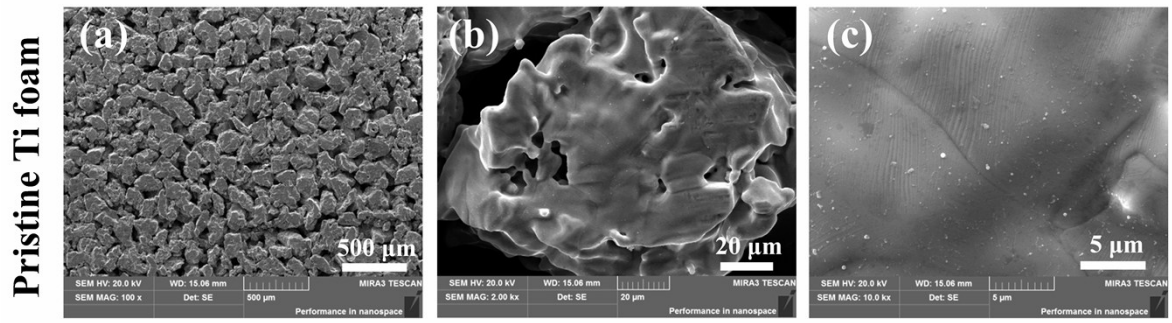

Figure S1. Various magnified SEM images of pristine Ti foam.

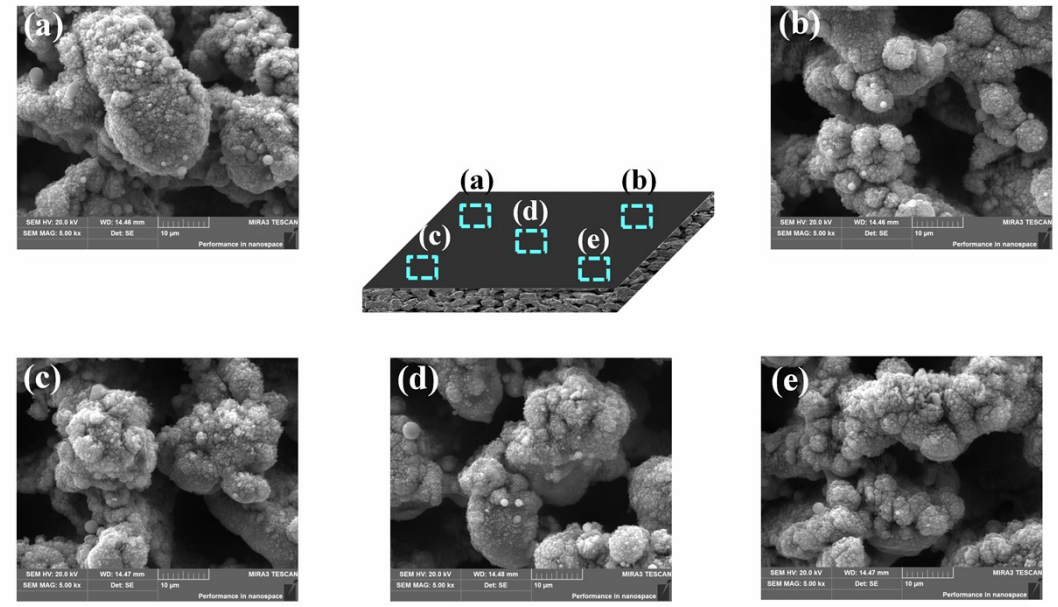

Figure S2. SEM images of different positions on the laser treated Ti foam.

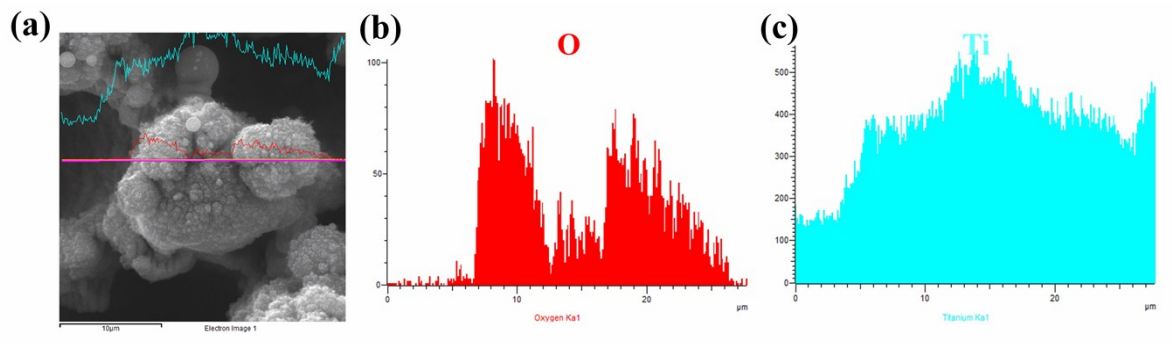

Figure S3. The element distribution of the laser treated Ti foam.

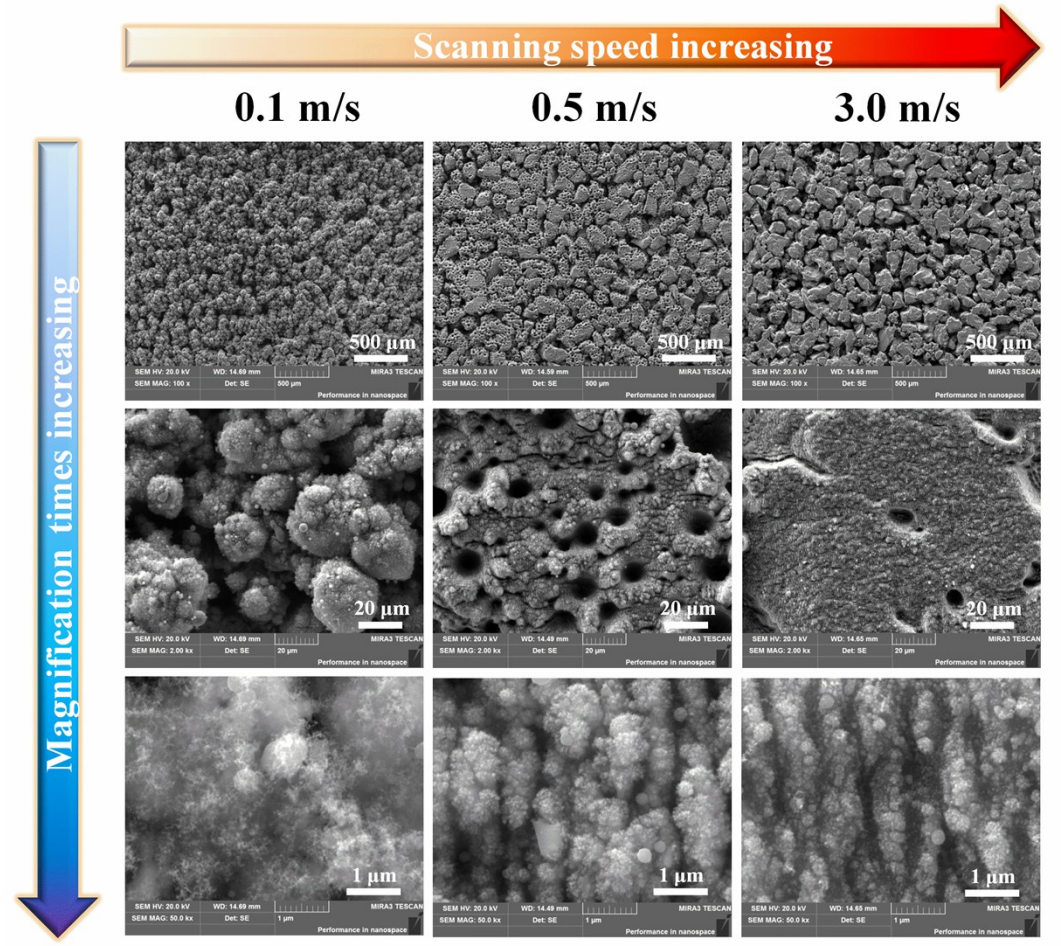

Figure S4. SEM pictures of different laser treated structures with various scanning speeds. The downsets are corresponding magnified pictures. (Laser power: 10 W)

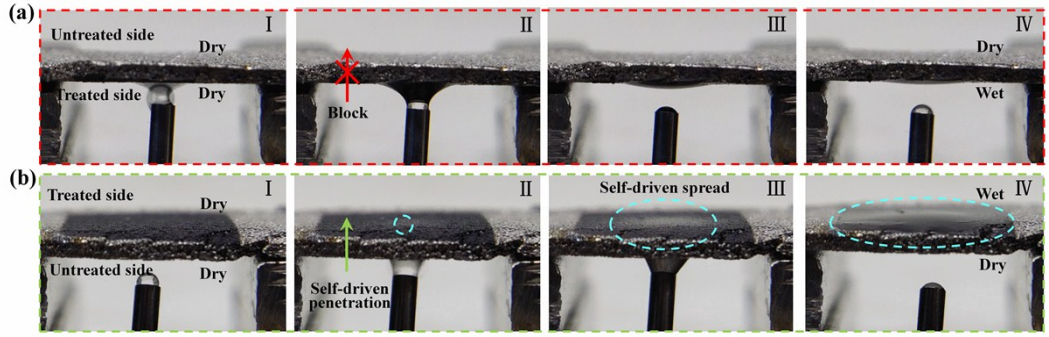

Figure S5. Sequence of digital photographs showing the upwards blockage (a, Treated side to Untreated side) and penetration (b, Untreated side to Treated side) of signle water droplet placed on the lower surface.

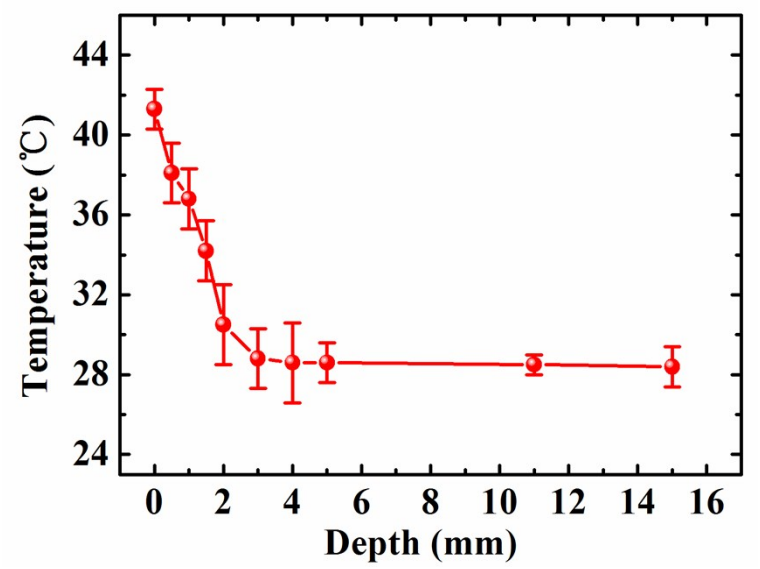

Figure S6. The temperature distribution on the vertical direction of the as-prepared device under one sun irradiation.

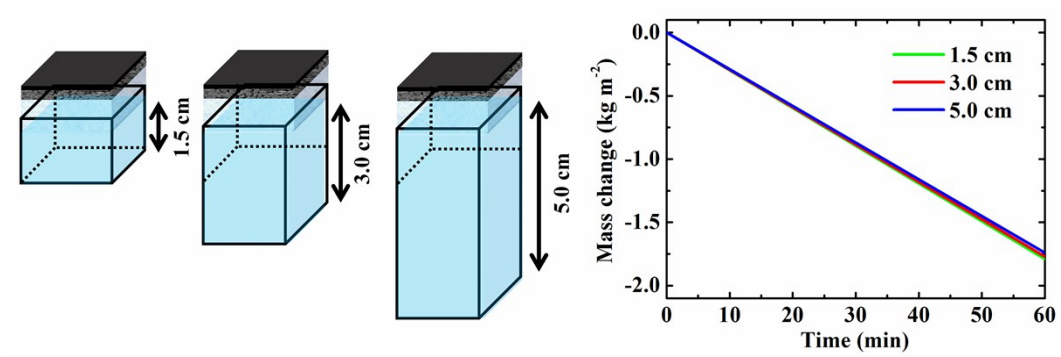

Figure S7. Mass changes over time with the as-prepared device using various water quantity.

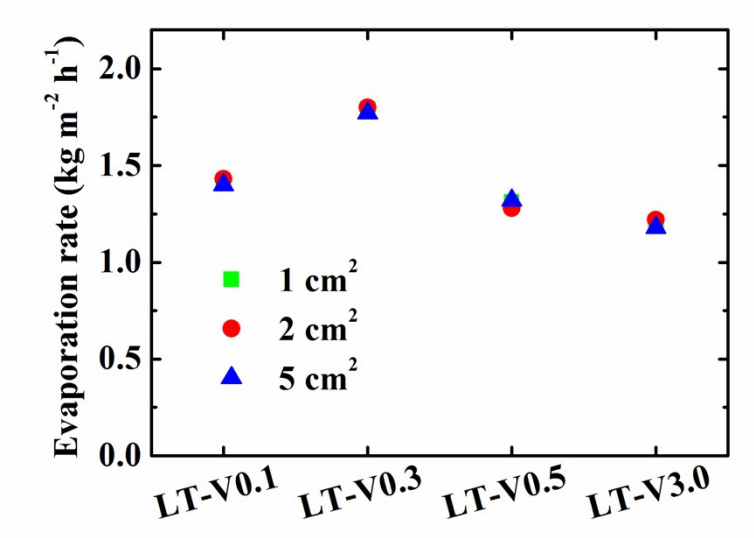

Figure S8. The water evaporation rate of various speed scanned devices with area 1, 2 and 5 cm^2 under one sun irradiation.

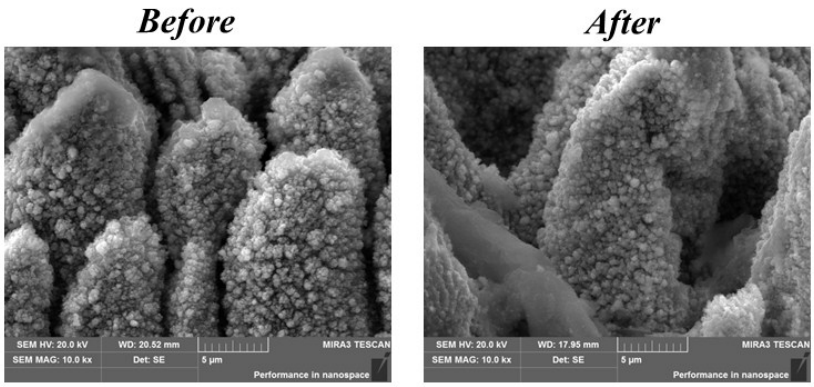

Figure S9. SEM images of laser treated Ti foam based evaporator before and after desalination

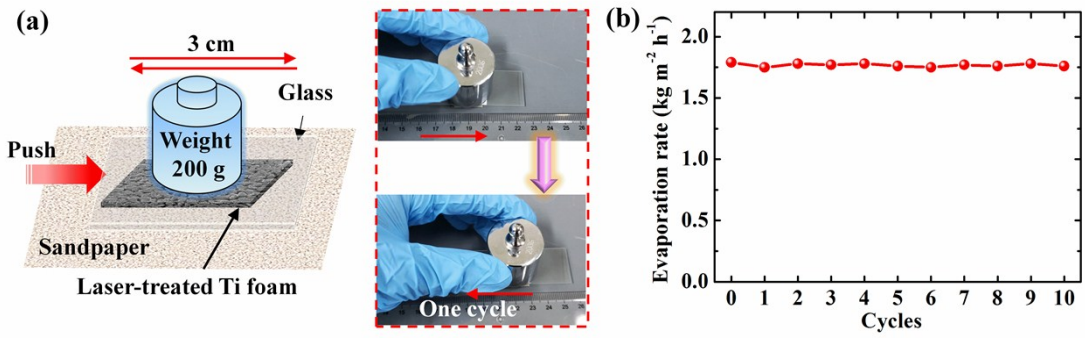

Figure S10. (a) Schematic of the sandpaper abrasion tests for the laser treated Ti foam. (b) Evaporation rate as a function of abrasion cycle number.

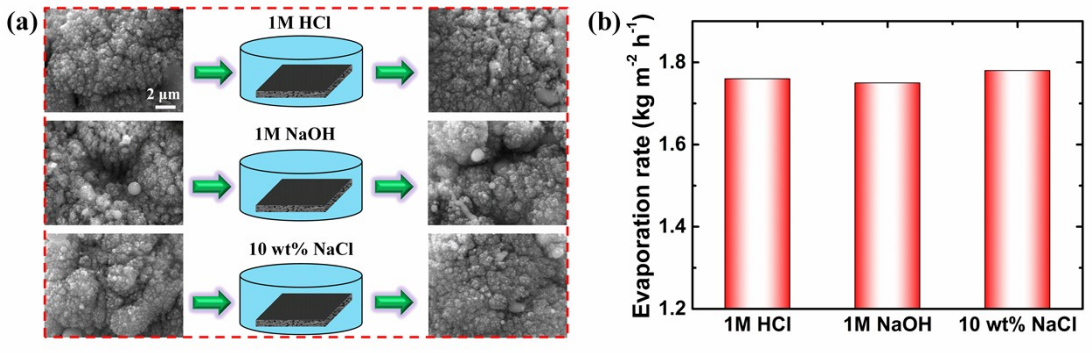

Figure S11. (a) SEM images of the laser treated Ti foam before and after immersion in 1 M HCl (upper), 1 M NaOH (middle), and 10 wt.% NaCl (lower) for 1 h. (b) Evaporation rate of the as-prepared device after immersion in the different solutions.

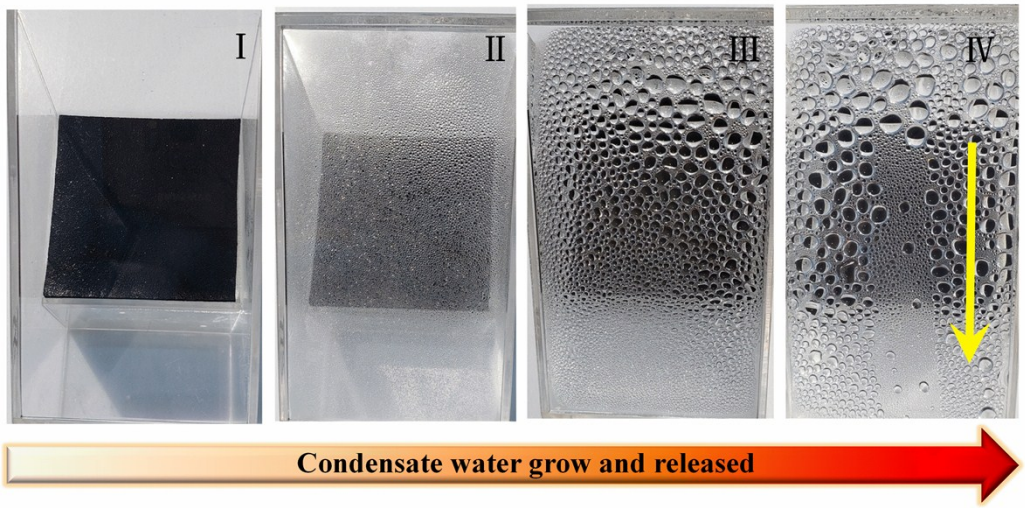

Figure S12. Images of condensate water on the upper glass under various times.

Table S1. The solar evaporation performance and preparation efficiency of this work compared with other materials and methods in small area under one sun

Sample	Evaporation rate ($kg\ m^{-2}\ h^{-1}$)	Efficiency (%)	Time consuming (min)	Ref.
Cu_2SnSe_3- membrane	1.66	86.6	990 (Several steps)	15
Au	0.67	57	60 (Several steps)	16
VAGSM	1.62	86.5	360 (Several steps)	17
RGO-SA-CNT	1.62	83	3660 (Several steps)	18
Carbon-coated paper	1.28	88	240 (Several steps)	19
Mxene-PVDF-PS	1.33	84	3270 (Several steps)	20
Graghite (DLS)	1.0	64	120 (Several steps)	21
CB/PAN-PVDF	1.2	82	4920 (Several steps)	22
3D-CG/GN	1.25	85.6	960 (Several steps)	23
Al NP/AAM	0.9	57	60 (Two steps)	24
CTH	2.5	95	1560 (Several steps)	13
srGA	1.78	91	4320 (Several steps)	46
Treated Ti foam based evaporator	1.79	90	<30 (Two steps)	This work

Note: Time consuming is the minimum time listed in the above ref.

Heat Loss Analysis

The heat loss of the solar evaporation device contains with three parts: (a) Radiation, (b) Convection (c) Conduction. [15,46]

a. Radiation:

The radiation loss is calculated by the Stefan-Boltzmann equation.

$$Q_{rad}=\varepsilon A\sigma\left(T_1^{\ 4}-T_2^{\ 4}\right) \quad (1)$$

Where Q_{rad} represents heat flux, ε is the emissivity, A denotes the surface area, σ is the Stefan-Boltzmann constant (5.67×10^{-8} W m^{-2} K^{-4}) , T_1 (315.15 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 (1), the radiation heat flux is ~30 W m^{-2}, which is ~3 % of the solar flux (1 sun = 1000 W m^{-2}).

b. Convection:

The convective heat loss is defined by Newton' law of cooling.

$$Q_{conv}=hA\left(T_1-T_2\right) \quad (2)$$

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=5 K). According to equation (2), the convection heat loss is calculated to be ~3 %.

c. Conduction:

$$Q_{cond}=Cm\Delta T \quad (3)$$

Where Q_{cond} is the heat energy, C is the specific heat capacity of water (4.2 J $^{o}C^{-1}$ g^{-1}), m (40 g) is the water weight, and ΔT (0.3℃) is the temperature difference of pure water after and before solar illumination under 1 sun solar flux for 1 h. Therefore, the conduction heat loss is calculated to be ~1 %.