Supporting information of Figures S1~S11:

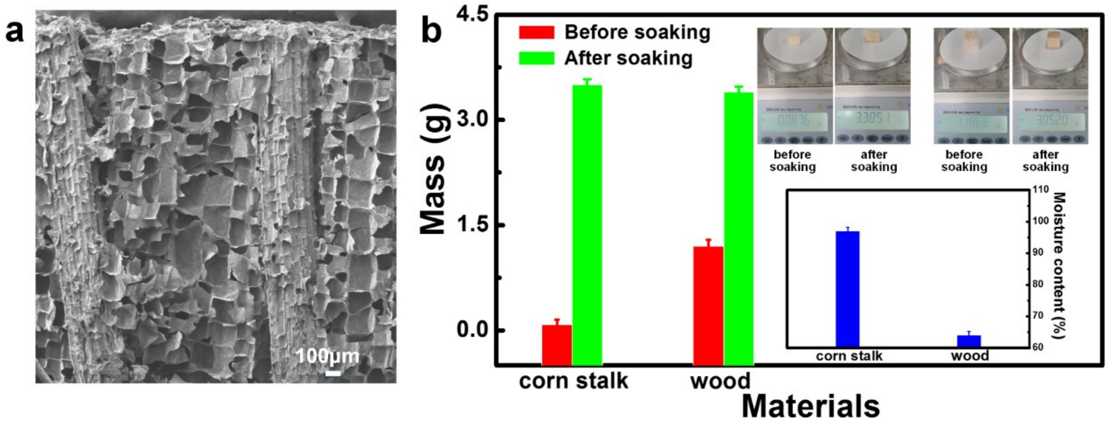

Figure S1. (a) SEM of corn stalks with coatings and (b) capacity amount of porous tissues at seawater and freshwater (sizes of 20 mm length and 20 mm width and 20 mm height for wood and corn stalk).

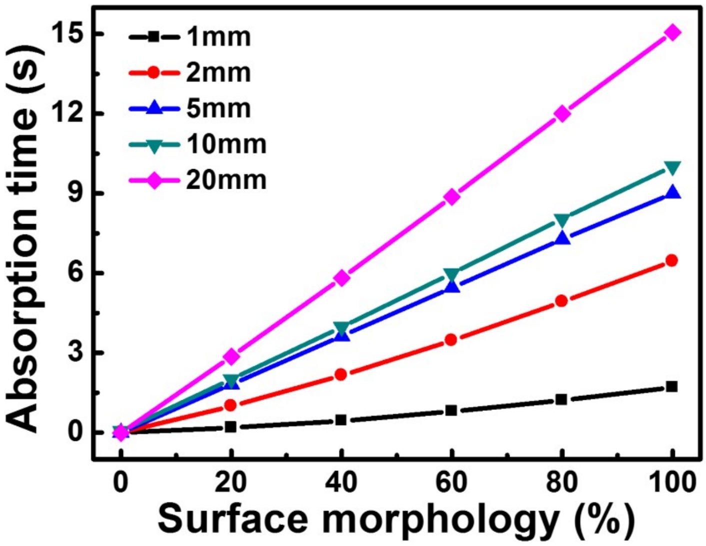

Figure S2. Water absorption velocity of stem marrow of corn stalks along the vascular bundles height direction.

Figure S3. Evaporation experiment of corn stalk-based evaporators on solar simulator: (a) evaporation experiment, (b) freshwater collection, (c) evaporation chamber.

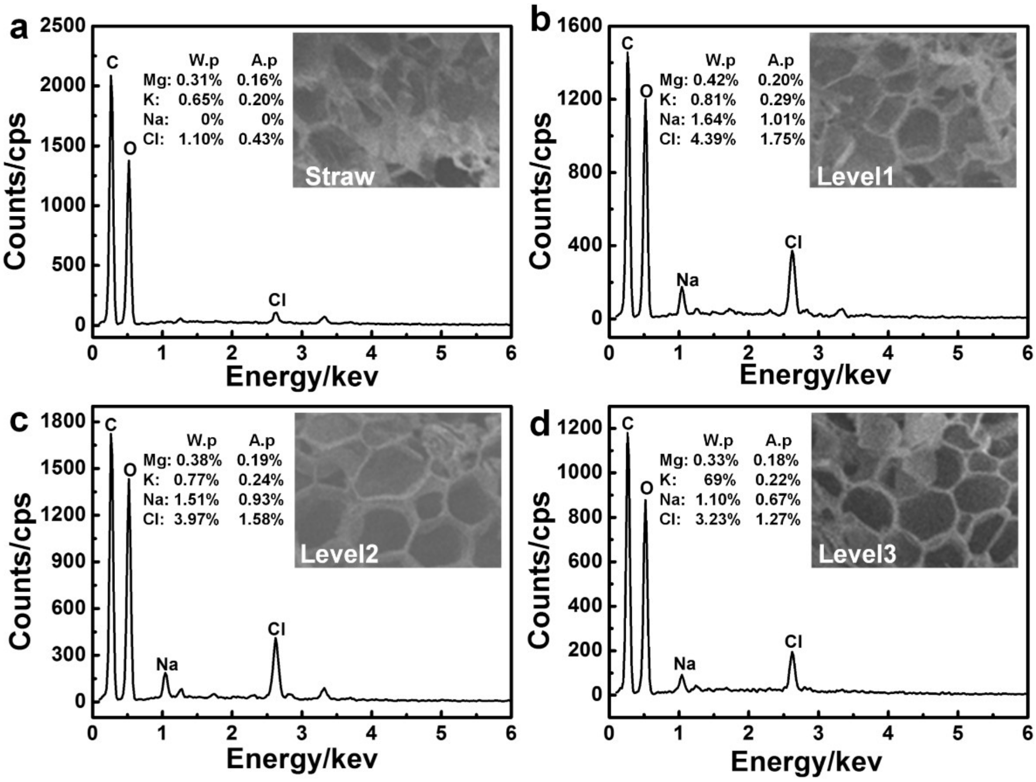

Figure S4. Energy spectrum analysis of stem marrow of corn stalks at different filtering positions: (a) pure stem marrow, (b) level 1, (c) level 2, (d) level 3.

Figure S5. solar desalination device and working principle: (a) overall device, (b) water vapor on attached glass, (c) condensers and liquid level sensors, (d) disk-shaped corn stalks evaporators, (e) seawater tank with corn stalks, (f) control system of water circulation system (g) thermometer.

As shown in Fig. 5S, solar desalination device mainly includes glasshouse, thermometer, disk-shaped corn stalks evaporators, variable DC power supply, steam condensation system, water circulation system, freshwater collection bucket and seawater supply bucket. ***The detailed structure and working principle of solar desalination device are as follows.*** The main glasshouse used for solar steam evaporation includes the following parts of seawater tank, freshwater tank, water vapor attached glass. The steam condensation system is operated by pumping a cold seawater from seawater supply bucket to condensers around a vapor-attached glass (by water pump 1), and this process is used to accelerate the rapid liquefaction of water vapor evaporated by disk-shaped corn stalks evaporators. Water circulation system is used for the supply of seawater and the collection of freshwater. When the liquid level in the seawater tank is lower than a certain value, the liquid level sensor is triggered to realize the operation of the water pump 2, and the seawater is transferred into the seawater tank from the seawater supply bucket. When the liquid level in the fresh water tank is higher than a certain value, the liquid level sensor is triggered to realize the operation of the water pump 3, and the freshwater is sent into the fresh water collection bucket. Thermometer is used to monitor changes in outdoor temperature and humidity. According to the direction of the high-efficiency direct sunlight, the water vapor attached glass has a certain oblique angle with the horizontal ground, which also facilitates the condensation and reflux of water evaporation.

The specific working principle of solar desalination device is explained as follows. The disk-shaped corn stalks evaporators were placed in the seawater tank for receiving the heat from the sunlight to realize the photothermal conversion, and the interface heat was applied to evaporate the seawater into freshwater vapors, which adhered to the surface of the glass plate to recirculate by steam condensation system. Freshwater droplets flowed into the freshwater tank. Finally, the supply of seawater in the seawater tank and the collection of freshwater in the freshwater tank were executed by the water circulation system.

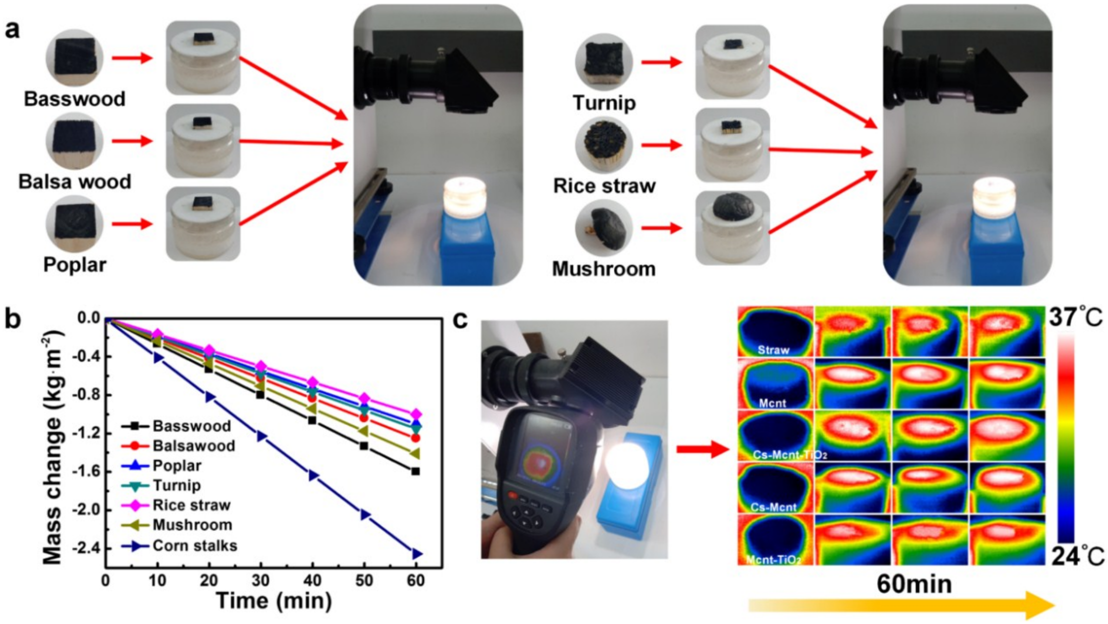

Figure S6. Evaporation mass and evaporator temperature of different evaporation substrates under the same coating: (a) schematic diagram of different evaporation substrates (bass, balsa, aspen, radish, rice, straw, shiitake, etc.) and evaporation experiments, (b) evaporation mass under 1 solar light intensity, (C) schematic diagram of infrared temperature measurement and evaporator temperature.

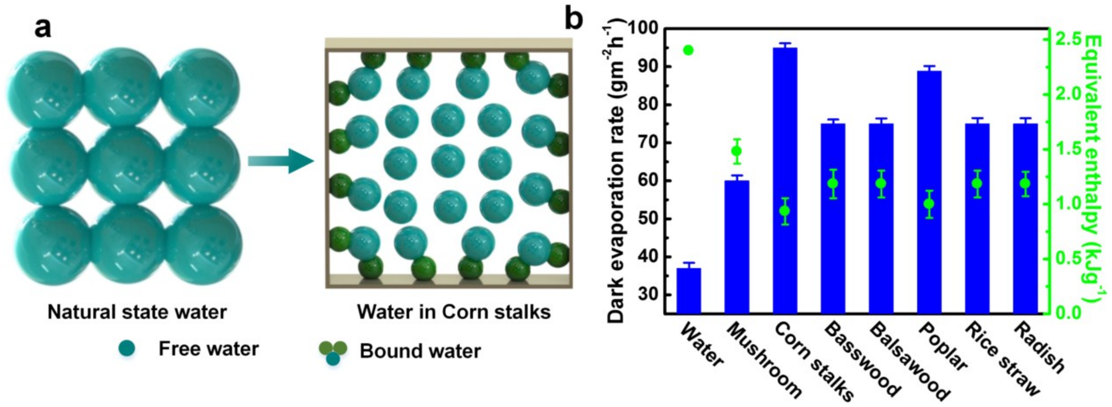

Figure S7. (a) schematic diagram of the change of distance between normal water and water molecules in corn stalks, (b) evaporation value and evaporation enthalpy of the water contained in corn stalk and tree plants in the dark environment.

The enthalpy change value of water evaporation in the dark environment with a temperature of 24 °C is 2.4 kJ g^{-1}. Fig. S6 shows the evaporation value and evaporation enthalpy of the water contained in corn stalk and aspen in the dark environment. The enthalpy change value of corn stalk was calculated to be 0.93 kJ g^{-1} by formula (S1), and the enthalpy change value of poplar was 1.12 kJ g^{-1}.

The enthalpy change (E_{equ}) of water in the evaporator can be calculated by equation (S1).

$$E_{equ}=R_m E_w \tag{S1}$$

Whereby, R_m is the ratio of the amount of evaporation of water contained in the evaporator to the evaporation of water per unit time in the dark. E_w is the enthalpy of water in the dark.

The intermolecular forces existing between water molecules in the natural state mainly include van der Waals forces and hydrogen bonds. The Fourier infrared diffraction experimental image of corn stalks in Fig. 3(d) can be analyzed to have a shrinkage between 3300 cm^{-1} and 3334 cm^{-1}. The process of seawater evaporation from different biomass substrates has a low evaporation efficiency. In addition to the lower evaporation ratio, when natural water enters the interior of the evaporation substrate, a part of the water combines with the hydrophilic tube energy group (-OH) contained in the evaporation substrate to form a free water, and the remaining water is bound water (Fig.S7 (a)). The formation of bound water in the interior of the evaporation substrates weakens the van der Waals force between the water molecules (the interaction between water molecules includes hydrogen bonding and van der Waals force). Therefore, the free water in the biomass evaporation substrate reduces the energy required for the process of forming water vapor, and the enthalpy value required therein is lowered (Fig.S7 (b)).

The energy loss of the evaporator mainly includes two aspects: (1) water loss; (2) air loss. Energy loss in water (Aq_{water}), energy loss in the air includes convection $Ah(T-T_{env})$ and radiation $A\varepsilon\sigma(T^4-T_{env}^4)$. The static air convection heat transfer coefficient (h) is 5 Wm^{-2}K. Regarding the radiant energy loss, the Stefan-Boltzmann constant (σ) used here is 5.67 Wm^{-2}, and the emissivity (ε) is measured as follows:

(1) The emissivity line of the infrared thermometer or the infrared camera is adjusted to 1.

(2) The measured object is kept at a constant temperature.

(3) The current standard temperature is measured with a standard contact thermometer.

(4) The infrared thermometer or infrared camera is used to measure the current measured temperature (note that the detection points are as consistent as possible)

(5) The two sets of data are taken into the formula: emissivity = measured value \ standard value. The emissivity (ε) is 0.7 when Mcnt-TiO_2 is used as the interface photothermal conversion film.

The energy loss of the evaporator in the water is calculated by equation (S2).

$$A\alpha P_0 = mE_{equ} + A\varepsilon\sigma(T^4-T_{env}^4) + Ah(T-T_{env}) + Aq_{water} \tag{S2}$$

Whereby, A is evaporation surface area of the evaporator. α is the absorption rate of sunlight. P_0 is a solar radiation power of solar radiation. m is the amount of water vapor produced. E_{equ} is the vaporization enthalpy of water in the evaporator, and ε is the emissivity of solar evaporator. σ is the Stefan-Boltzmann constant, and T_{env}^4 and T^4

is the temperature of the evaporation surface and the environment, h is the convective heat transfer coefficient, and q_{water} is the heat flux to the bottom water.

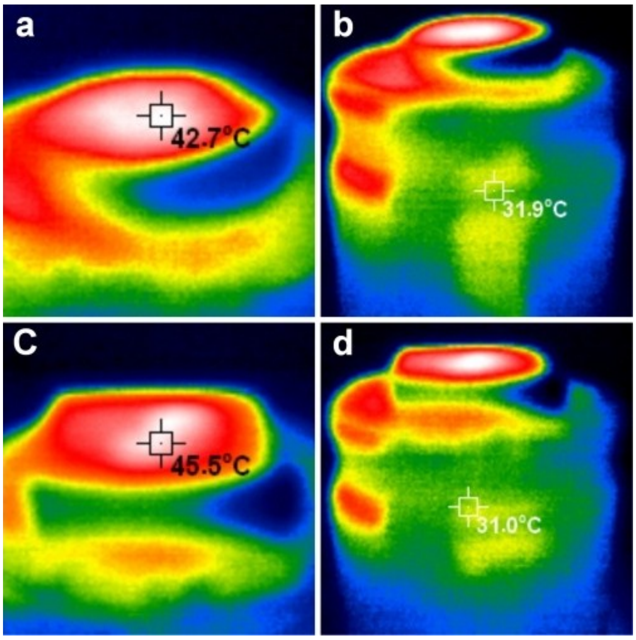

Figure S8. Evaporator surface temperature and working ambient temperature: (a) surface temperature when straw is used as an evaporator; (b) ambient temperature when straw is used as an evaporator; (c) surface temperature when aspen is used as an evaporator; d) ambient temperature when aspen is used as an evaporator.

Figure S8 shows the surface temperature (T^4) and ambient temperature (T_{env}^4)of corn stalk and aspen when they are used as evaporators. Although there are some differences in the thermal conductivity of different materials (especially for various types of wood, such as aspen (0.27 W m^{-1} K^{-1}), poplar (0.27 W m^{-1} K^{-1}), pine (0.32 W m^{-1} K^{-1}), cocobolo (0.34 W m^{-1} K^{-1})), corn stalks as a solar evaporator still shows excellent energy utilization advantages. Next, aspen and gels are used to explain the comparison of energy utilization.

Energy loss in water of evaporators of different materials (Table S1) can be obtained by calculation. The heat loss of corn stalk is lower than that of aspen (Joule, 2017, 1(3): 588-599), but higher than that of nano hydrogel LASH3 (ACS nano, 2019, 13(7): 7913-7919). Thus, it explains to some extent that corn stalk as a solar evaporator behaves lower heat loss than wood as a solar evaporator, which is mainly due to the small enthalpy change in moisture in the wet corn stalk.

Table S1. Energy loss in water of evaporators of different materials.

Materials	Convection loss(Wm^{-2})	Radiation loss (Wm^{-2})	Water loss (Wm^{-2})	Thermal conductivity ($W\ m^{-1}\ K^{-1}$)
Corn stalk	42	54	201	0.43
Aspen	56	72.5	300	0.27
LASH3	58	50	25	0.4

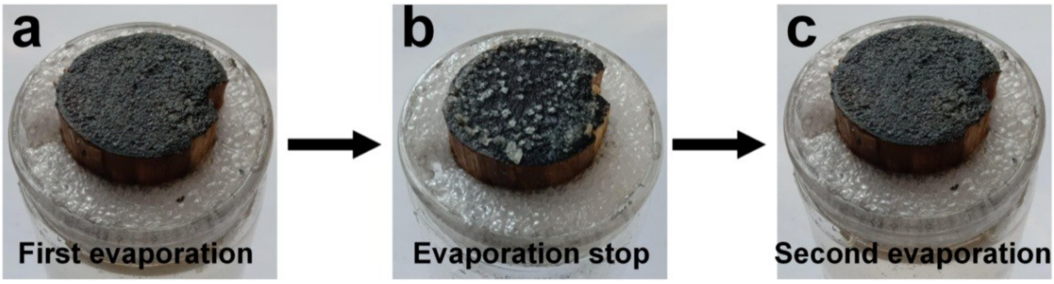

Figure S9. Self-cleaning of the straw evaporator: (a) continuous working state; (b) surface salting coverage in the natural state after the work is stopped; (c) coverage of the surface salting of the working surface again.

In the following work, we referred to the proposed method by reviewer's (*Advanced materials 1900498 (2019)*), and we found through a lot of experiments that this corn straw as a solar evaporator does not require any other means to deal with sea-salts separation with a certain self-cleaning ability (see Fig. S9). This self-cleaning effect is attributed to the internal porous vascular bundles can be similar to the designed artificial channel-array in a natural wood. After the first solar energy evaporation for a period of time, due to the change of the sea-salt concentration gradient, it is enriched in the straw surface layer, but when it is used again, it can be dissolved along with the gradient change and the solar evaporation experiment is performed again.

When the evaporation experiment is carried out for the second time, the surface of the straw will quickly gather a large amount of water to dissolve the surface sea-salts because of the natural porous structure of corn stalk itself. Due to the large sea-salts content on the upper surface (high concentration) and the small sea-salts content on the low surface (low concentration), the concentration difference between the upper and lower surfaces of the corn stalks is formed. Under the action of the natural porous structure of the straw and the gravity, the high concentration solution on the upper surface of the straw will diffuse rapidly downward, which bring the surface sea-salts to the lower concentration. Therefore, it shows the excellent self-cleaning ability of the straw itself.

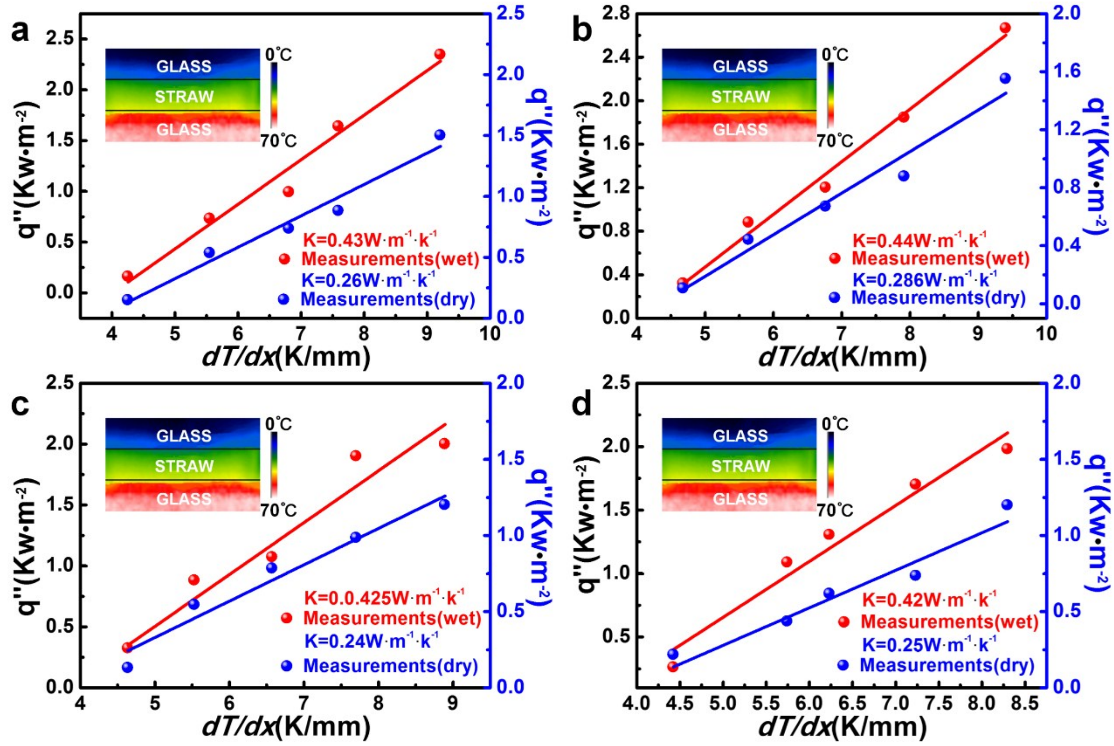

Figure S10. the thermal conductivity of the evaporator coated with different light absorbers: (a) MCNT coating, (b) Mcnt-TiO_2 coating, (c) Cs-Mcnt coating, (d) Cs-Mcnt-TiO_2 coating.

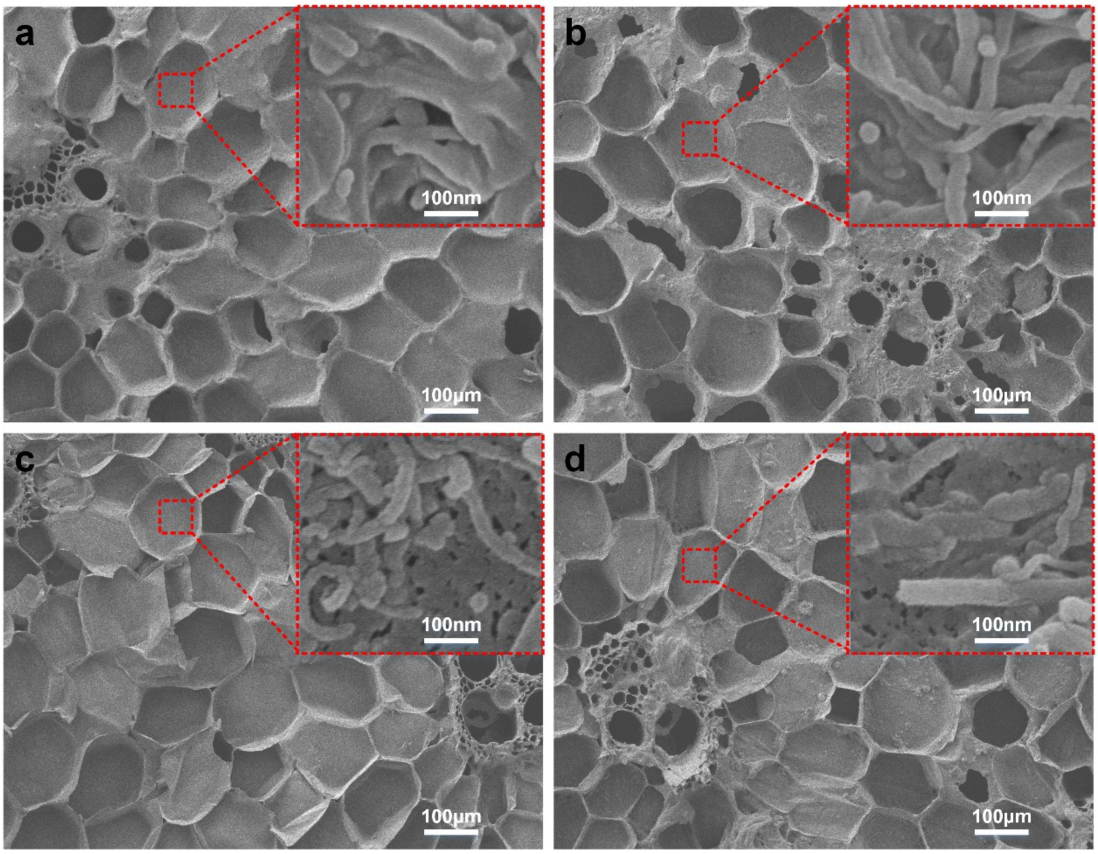

Fig. S11 Surface microscopic morphology of corn stalk evaporators with different coatings: (a) MCNT coating, (b) Mcnt-TiO_2 coating, (c) Cs-Mcnt coating, (d) Cs-Mcnt-TiO_2 coating.