Supporting Information

Extremely Black Vertically-Aligned Carbon Nanotube Arrays for Solar Steam Generation

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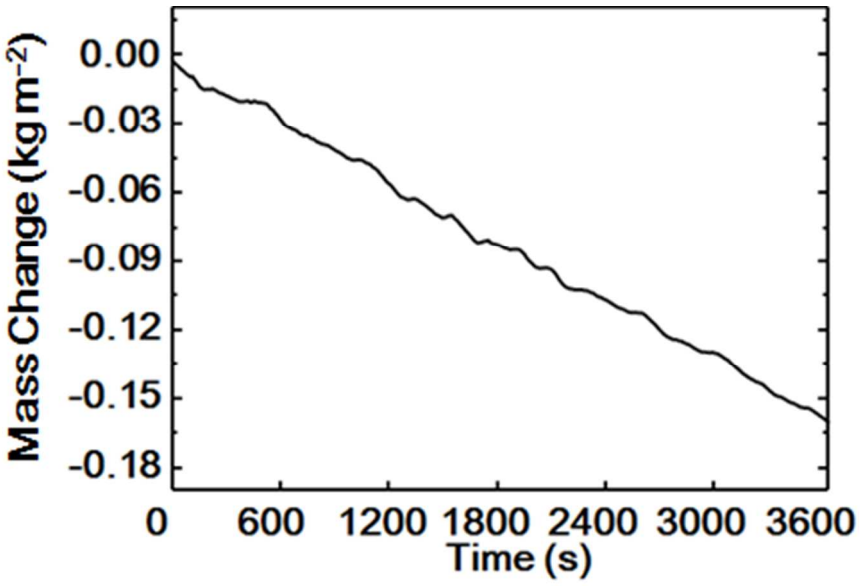

Figure S1. Water mass change under 0 kW m^{-2}. The dark evaporation rate is 0.16 kg m^{-2} h^{-1}. All experiments are conducted at 22±2 ^{o}C with a relative humidity of 36±2 %

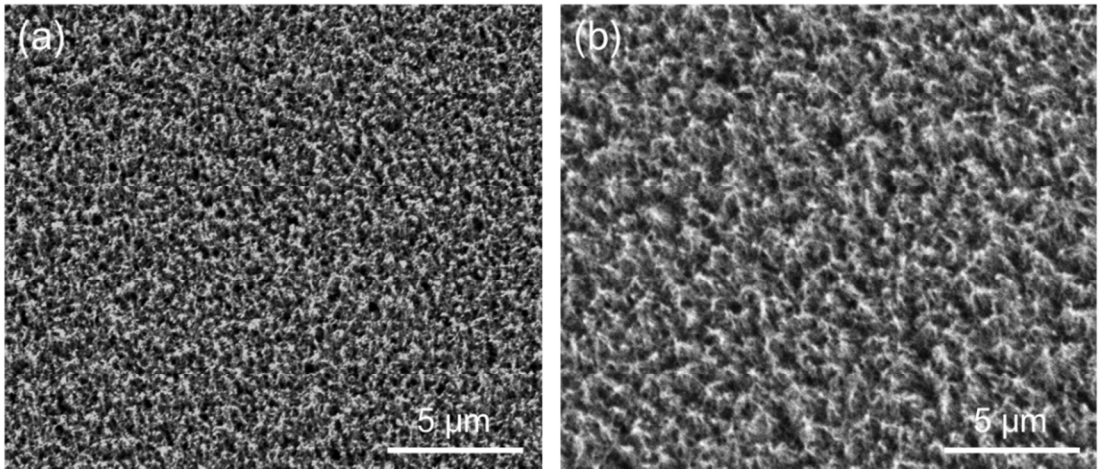

Figure S2. Topography of VACNT array via (a) weak oxidation, (b) acid corrosion.

Transfer and treatment of VACNT array

The strength of the CNTs' bond to the substrate is high, making it difficult to remove the forest from the silicon substrate. So we used two methods to solve the problem. The first solution is

weak oxidation.[1, 2] In brief, after CVD growth process, 2% of oxygen was introduced to provide a weak oxidation environment. Then VACNT arrays can be peeled off completely from the silicon substrate as a freestanding film. This step also aims to remove the amorphous carbon on the surface. Because even after reaction, the inner temperature is high and the unreacted ethylene may cause the formation of amorphous carbon that would destroy the thermal conductivity of VACNT arrays.[3]

Another method is using the hydrofluoric (HF) acid to erode the interlayer between VACNT arrays and substrate. After HF erosion, the sample was rinsed with deionized water several times and then we get the free standing VACNT arrays. The free standing VACNT arrays can be obtained via both solutions.

As we can see from Supplementary Fig. 2, several CNTs forms bundles on surface of the VACNT arrays. The morphology change of the structure can greatly reduce the surface CA. The calculation for CA can be defined as,[4]

$$\cos\theta^{*} = -1 + (1 + \cos\theta)\left(1 - \frac{l_{cr}}{s}\right) f$$

apparent contact angle θ^{*} is the function of the intrinsic contact angle θ (measured on flat solids) and the topography of the roughness. S is the ratio of perimeter to area size. f is the area fraction of the wet part of the solid. l_{cr} is an intrinsic or chemical length. The aggregation of CNTs causes the S increase, and thus the CA decreases according to a model we refered.[4]

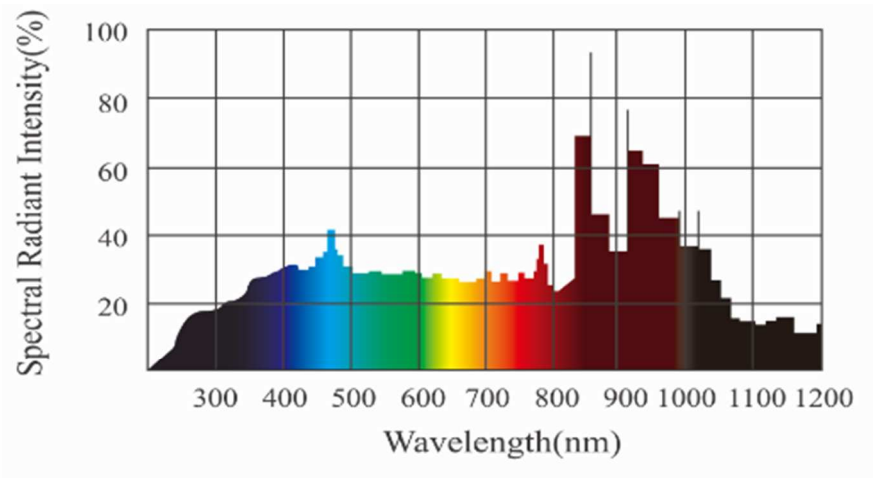

Figure S3. The spectral distribution of the employed light source. The spectral is obtained from the official website of CEAULIGHT.

References:

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2. Huang, J.; Zhang, Q.; Zhao, M.; Wei, F., The release of free standing vertically-aligned carbon nanotube arrays from a substrate using CO_2 oxidation. *Carbon* **2010**, 48, 1441-1450.

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4. Zheng, Q.; Lv, C.; Hao, P.; Sheridan, J., Small is beautiful, and dry. *Sci. China Phys. Mech. Astron.* **2010**, 53, 2245-2259.