# Supporting Information (SI)

# Self-Regenerating Solar Evaporation System for Simultaneous Salt Collection and Freshwater from Seawater

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**Note S1. Experimental Setup**

Several solar intensities up to 3 kW $m^{-2}$ were simulated using a solar simulator (PLS-FX300HU). It was determined that an optical filter was used in conjunction with a standard 1.5 G AM spectrum. The fabricated HB@NF evaporator was positioned on the simulated seawater (3.5 wt%) surface in a beaker, and the beaker was placed over an electronic balance (Mettler Toledo, ME204) fortified with a 0.001 g resolution. The whole setup is exposed under simulated solar radiation (1 kW $m^{-2}$ or one sun) to evaluate the evaporation rate. In order to evaluate the evaporation rates, as well as the conversion efficiency of the solar evaporator under one sun illumination, the whole evaporation system was stabilized. To compare salt concentrations before and after the treatment of the water, we used inductively coupled plasma-optical emission spectrometry (ICP-AES, E.P. Optimal 8000). We conducted all experiments under ambient environmental conditions, with a temperature of 27°C and a humidity of 49 percent. An optical hand-held meter model was used to measure surface temperatures.

**Note S2. Heat transfer simulation**

Heat transfer module (HTM) simulations were conducted to simulate the high thermal sustainment achieved by HB@NF solar evaporators under solar-driven conditions. Here are the equations that were used to assess the steady-state heat transfer simulations[1,2]:

$$Q = \left(\rho C_p\right)_{\text{eff}} + \rho C_p u \cdot \nabla T + \nabla \cdot q \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (S1)$$

$$q = -k_{\text{eff}} \nabla T \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (S2)$$

$$\left(\rho C_{\text{p}}\right)_{\text{eff}} = \theta_{\text{p}} \rho_{\text{p}} C_{p,\text{p}} + \left(1 - \theta_{\text{p}}\right) \rho C_p \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. \ldots (S3)$$

$$k_{\text{eff}} = \theta_{\text{p}} k_{\text{p}} + \left(1 - \theta_{\text{p}}\right) k \ldots\ldots\ldots\ldots\ldots\ldots\ldots..\ldots.\ldots\ldots..\ldots.. (S4)$$

Here $Q$ (W m$^{-3}$) is the flux of heat, $C_{\text{P}}$ *denotes the heat capacity of water* (4200 J kg$^{-1}$ K$^{-1}$), while $\rho$ is the density of water which is ≈1000 kg m$^{-3}$. Where $u$ *is* the Darcy velocity expressed in terms of fluid volume flow per unit *cross-sectional area (ms$^{-1}$) and* $(\rho C_{\text{P}})_{\text{eff}}$ is the effective volume heat capacity at constant pressure. The velocity of the water through the smoke filter is given by the $u_{\text{L}} = u/\theta_{\text{P}}$, here $\theta_{\text{P}}$ is the water passage through the interfacial surface of non-woven fabric. $\nabla T$ shows the temperature gradient (Km$^{-1}$), and $q$ *denotes the vector flux of heat* (W m$^{-2}$). While $k_{\text{eff}}$ and $k_{\text{P}}$ are the effective and thermal conductivities of the HB@NF solar evaporator, respectively.

**Supporting References**


[1] Khawaji, A.D.; Kutubkhanah, I.K.; Wie, J.-M. Advances in Seawater Desalination Technologies. *Desalination* 2008, 221, 47–69.

[2] Saleque, A.M.; Saha, S.; Ivan MN, A.S.; Ahmed, S.; Alam, T.I.; Hani, S.U.; Tsang, Y.H. Reduced graphene oxide/TiTe2 quantum dot coated waste face mask recycled for highly efficient solar steam generation. *Sol. Energy Mater. Sol. Cells* **2023**, *253*, 112232.