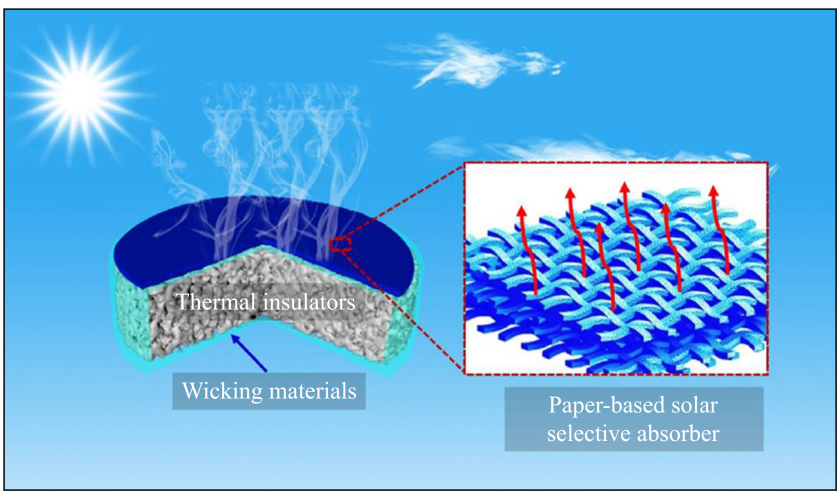
Porous TiNO solar-driven interfacial evaporator yields high-efficiency seawater desalination

To help address freshwater scarcity, Chao Chang and colleagues at Dalian Maritime University, China, have achieved a solar-driven desalination system based on TiNO, which is developed as the solar absorption material in the liquid–vapor interface of a still. They report their work in a recent issue of *AIP Advances* (https://doi.org/10.1063/5.0047390).

According to the researchers, TiNO has a high solar absorption rate, low thermal emittance, and the material can effectively convert solar energy into thermal energy. Using a sputtering method, they deposited a layer of TiNO on air-laid paper (which due to the different fabrication method is very bulky, porous, and soft). This layer constituted the solar-absorbing component, followed below by thermal insulators and wicking materials. Scanning electron microscope images from the TiNO layer revealed interwoven fibers. Yet pores and the properties of the material make this a unique arrangement for efficient solar-to-thermal energy conversion. Air-laid paper has strong mechanical strength and increases multiscattering of incident light, which translates to high solar absorption.



Schematic of the TiNO-based interfacial evaporator. Credit: *AIP Advances*.

The researchers tested the material's performance by using a solar simulator with adjustable sunlight power density, and by placing the TiNO-based interfacial evaporator on top of a balance (to record evaporation mass change). The water evaporation rate showed an average value of 1.3 kg/m^2h after testing for 20 cycles of 0.5 h, hence rendering the system (TiNO-based) as stable for water evaporation performance. Moreover, when comparing water evaporation with seawater evaporation, the system's performance remained almost unchanged. The research group further reported that there was no salt precipitation on the absorber material surface, and due to the material's porosity and hydrophilicity, it could wick water from bulk and quickly diffuse salt back into the water source. To measure efficiency, the researchers used an equation that equals the relation between the mass of collected water and power input into the system, which also takes into consideration the change in heat transfer and surface of the solar absorber.

This novel TiNO solar-based interfacial evaporator achieved a 46% efficiency and avoided salt precipitation on the absorber material surface in addition to being low cost and having a fast response.

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