

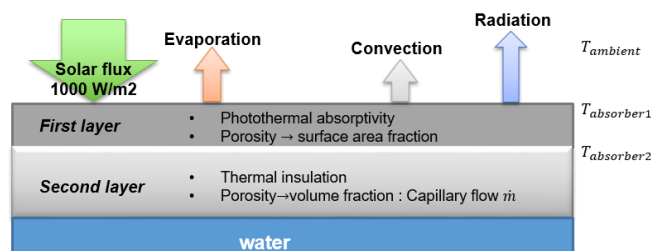
## Enhanced steam generation based on a bilayer water and light absorber: Modelling and optimization of capillary imbibition and water evaporation.

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Enhanced steam generation is a robust and promising process for water purification. This is a method of increasing the evaporation efficiency by localizing the heat at the water-air interface using a black absorber. It is worth mentioning at this stage that the two functions of localized heating and water imbibition are different functions that can be separated in their implementation. However, one can note that a vast majority of state-of-the-art implementations show that both functions are integrated together, which is typically a black and porous medium, hence providing simultaneous light absorption and water absorption capabilities. In addition, there is a concern about thermal conductivity so as to minimize loss of the surface-localized generated heat into the surrounding water bulk. As of late, bilayer structure black absorbers (Fig.1) have been developed in different combinations of photothermal materials and porous media aiming to achieve efficient steam generation[1], [2, 页 2].



(Fig.1: Heat and mass transfer in the double-layer structure during steam generation process)

Here we report the modelling of a bilayer structure and obtain the structural optimization design of black absorber through theoretical analysis[3]. Simultaneously, we launch the simulation model in COMSOL and our simulation results are in good agreement with the water imbibition rate in the literature[4]. The results show several key parameter trends for determining the geometry of bilayer structure, especially the water imbibition rate caused by capillary fluid flow. According to the establishment of this theoretical and numerical model, the optimization geometry structure can be designed for enhanced steam generation.

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### Reference

- [1] H. Ghasemi 等, 《Solar steam generation by heat localization》, *Nat. Commun.*, 卷 5, 页 4449, 7 月 2014.
- [2] M. Ye 等, 《Synthesis of Black TiO<sub>x</sub> Nanoparticles by Mg Reduction of TiO<sub>2</sub> Nanocrystals and their Application for Solar Water Evaporation》, *Adv. Energy Mater.*, 卷 7, 期 4, 页 1601811, 2017.
- [3] X.-H. Tan, L. Jiang, X.-P. Li, Y.-Y. Li 和 K. Zhang, 《A complex model for the permeability and porosity of porous media》, *Chem. Eng. Sci.*, 卷 172, 页 230–238, 11 月 2017.
- [4] A. A. Jeje, 《Rates of Spontaneous Movement of Water in Capillary Tubes》, 2004.