Jian Huang et al., Madridge J Nanotechnol Nanosci. 2018
http://dx.doi.org/10.18689/2638-2075.a3.002

3rd International
Nanotechnology Conference & Expo
May 7-9, 2018 Rome, Italy

Heat Concentration for Solar Steam Generation using Micro-Nano Structure Membrane

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Solar steam generation, as a traditional way to utilize solar energy with photo-thermal conversion, has great potential applications, including wastewater treatment, desalination, chemical concentration and recovery. For traditional solar steam generation with a black coating in the bottom of the solar pond, the steam generation efficiency was relatively low due to the weak light capture capacity and large thermal loss. Therefore, many nano materials have been used to improve the steam generation process, such as noble metal, semiconductor, carbon and other composite materials. Except for the application of some nano materials to enhance solar absorbance, different evaporation processes were designed to reduce the heat loss to the bulk water and the environment. For example, volumetric evaporation using nanofluid could enhance photo-thermal conversion and improve solar steam generation efficiency. Membrane evaporation using micro-nano structure membrane could further reduce the thermal loss with heat concentration effect due to the localized surface plasmon resonance. In brief, the key to improving solar steam generation is to enhance light capture and heat concentration.

In this work, several different membranes with Au, TiO_2 nanoparticles and different substrates were prepared and their photo-thermal conversion capacities were investigated. Through the solar water evaporation, the enhancement to solar steam generation rate and efficiency were also studied. It was found that compared with volumetric evaporation, a hot area could be formed using the membrane structure, which is conducive to the heat concentration. Besides, the heat loss could be reduced through reducing the contact area between the membrane and water.

Acknowledgement: This work is financially supported by the National Natural Science Foundation of China (Grant No. 51421063, No. 51676060), the Natural Science Founds of Heilongjiang Province for Distinguished Young Scholars (Grant No. JC2016009).

Biography:

Mr. Jian Huang obtained his B.S. Degree at Harbin Institute of Technology in China in 2016, and is a postgraduate student of Harbin Institute of Technology at present. Until now, he has published 2 patent applications and 4 papers. His current research focuses on solar energy utilization, heat and mass transfer, and solar seawater distillation.