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Solar Water Evaporation for the Purpose of Purifying Water

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Editorial

The most prevalent and promising renewable energy source, solar energy, holds enormous promise for the long-term sustainability of human civilisation. The development of effective solar energy conversion and harvesting techniques, such as photovoltaic photosynthesis and solar thermal technology, is accelerated by rising energy needs. Solar water evaporation, also known as using solar radiation to power water evaporation, provides environmentally beneficial approaches to an energy-water nexus and connects basic research and engineering discoveries in this multidisciplinary field of science and technology. As SWE technologies have advanced, there has been a progressive shift in the research paradigm away from increasing overall energy input and toward materials engineering and property tuning for effective energy consumption.

Over the past ten years, the development of new materials has been crucial in improving heat transmission during water evaporation and modifying the way water changes phases in functioning systems. From the molecular to the macroscale, the development of materials has produced functions that address every facet of managing energy and water, including photothermal conversion, heat localization, energy harvesting, and water confinement and activation. Based on positive principles, such as efficiency, photothermal materials, such as plasmonic nanoparticles, semiconductors, carbon-based materials, and conjugated polymers have been created for high solar-to-heat conversion efficiency.

Instead of heating the majority of the water, concentrating the heat along the evaporation front can efficiently transfer the energy to the water that can evaporate. This reduces the amount of energy required to evaporate the water. Interfacial evaporation is made possible by thermal insulation configurations with planned water transport paths, which might significantly minimise heat losses. By using SWE to design three-dimensional buildings, heat losses for water evaporation might be recycled. New architectural designs that are motivated by plant transpiration have been created to harness environmental energy to power water vaporisation. In addition to the advancement in controlling heat transport, recent years have seen a breakthrough in materials-enabled water activation.

SWE technologies provide fresh possibilities for many functional systems. The most popular method of producing clean water using the SWE process is solar water purification. Saltwater or wastewater-derived freshwater gaining from the solar water evaporators with a high rate of SWE have been created with desired sturdiness and longevity in various water sources, enhancing the production of clean water of solar stills illuminated by the sun. Furthermore, the development of additional features like sterilising, power production, and evaporative cooling is facilitated by the improved understanding of the underlying SWE process. For SWE-based practical applications to be greatly advanced, novel material and structural designs are essential.

Here, we examine recent developments in SWE technology, as well as allied fields including water purification and increased multipurpose uses. The fundamentals of solar water evaporator design are first examined from a materials and construction perspective. Then, several methods for achieving high SWE rates are discussed with examples. The designs of sun still systems for water collecting and the development of SWE technologies for solar water purification from various water sources are displayed. By combining SWE technology with other cutting-edge sectors, we then shift to a variety of multifunctional applications outside water purification. The difficulties and opportunities for developing new SWE-based water purification technologies as well as a wide variety of other applications are also covered [1-5].

Conflict of Interest

None.

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