

Solar heating of seawater to generate steam

What is solar steam generation?

Fundamentally, solar steam generation is a process by which solar energy is used to drive the endothermic phase transition from liquid water to vapour. A necessary step for this process is the energy transfer from solar photons to the water molecules. Unfortunately, water is a poor absorber of photons at solar wavelengths.

Can solar energy be used to generate steam?

Steam generation using solar energy provides the basis for many sustainable desalination, sanitization, and process heating technologies. Recently, interest has arisen for low-cost floating structures that absorb solar radiation and transfer energy to water via thermal conduction, driving evaporation.

Can solar energy evaporate water and generate steam?

Solar energy can be used to evaporate water and generate steam, however this usually requires expensive optical concentrators. Ni et al. demonstrate a low-cost solar receiver based on thermal concentration that generates steam at 100 °C without the need for optical concentration.

Does interfacial solar steam generation improve freshwater production?

Nature Water 1,391-398 (2023) Cite this article In recent years, interfacial solar steam generation has shown great potential for desalination with high solar-to-steam conversion efficiency. However, the freshwater production rate is still limited by the substantial latent heat of water evaporation and condensation efficiency.

How does solar steam work?

2.1. Working Principles of Solar Steam Technology According to the energy transfer process, the operation of a solar steam device consists of three steps: light-to-heat conversion, heat-to-steam conversion, and steam condensation. Photothermal materials interact with sunlight in the presence of the sun [29,30].

How a multilayered solar steam generation system is fabricated?

In this work, high-performance, low-cost, environmentally friendly multilayered solar steam generation systems are fabricated by engineering the structure and using a biomass photothermal material....

SUNCNIM guarantees the annual energy production of the solar steam generator through simple indicators in order to monitor the level of performance. This performance guarantee is valid throughout the entire duration of the project: development phase, provisional and final acceptance of the system and normal operation by the customer.

In the past years, solar-driven interfacial vapor generation (SIVG) systems based on photothermal effect have been developed to generate steam and collect freshwater from seawater or wastewater, offering a prospective solution to global issue of water scarcity [9,10,11,12,13,14,15]. Since its seminal propose, the SIVG has gained

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more and more ...

For more detail information refer to the article "Desalination of seawater by successive heating of thin layers of water using solar radiations from a Fresnel concentrator"[1], the preprint "Detail Design - Linear Fresnel concentrator Steam Generator"[2], the preprint Steam Flow formulation of the Linear Fresnel concentrator Steam Generator[3] and the preprint "Solar Heat Transfer ...

Carbonized wood-based solar steam generator (CW-SSGD) has great potential for seawater desalination, wastewater treatment and solar steam power generation due to its sustainability and easy preparation [71], [106], [149], [150]. CW-SSGD has good salt accumulation resistance due to the inherent advantages of natural structure, which makes it ...

Water purification via interfacial solar steam generation exhibits promising potential. However, salt crystallization on evaporators reduces solar absorption and obstructs water supply. To address it, a waffle-shaped solar ...

In summary, we reported an MSTE with efficient multi-stage steam heat transfer and long-life MEG, which achieves a solar-to-vapor conversion efficiency of 187% and a water production rate of 2.79 kg^{m⁻²h⁻¹}, while achieving a continuous power output of more than 55.3 mW^{m⁻²}. Through structural innovation and the bionic honeycomb ...

The brighter the light, the more steam is generated. The new material is able to convert 85 percent of incoming solar energy into steam -- a significant improvement over recent approaches to solar-powered steam generation. What's more, the setup loses very little heat in the process, and can produce steam at relatively low solar intensity.

In this study, we present a highly efficient and sustainable photoabsorber designed specifically for interfacial solar steam generation (ISSG) of seawater. To achieve this, we coated poplar wood with Ag-doped VO₂ (Ag@VO₂) and reduced graphene oxide (RGO) as single or double layers of photothermal materials. The evaporation flux of Ag@VO₂ coated on ...

Joule-heating assisted heliotropic solar steam generator for all-day, all-weather solar desalination ... and then combined with melamine sponge to obtain t-CF-melamine solar steam generator (SSG). The heating properties of t-CF-melamine are examined, and the surface temperature reaches as high as 155°C in 5 min at an input voltage of 3 V ...

The desalination of seawater implemented in the desalination system under development includes the following processes: The process of heating seawater in a solar collector, the process of boiling seawater and its vaporization, steam removal from the solar collector housing, salt brine removal from the solar collector, steam condensation process in a condenser, heat exchange ...

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Water evaporation, one of the key steps in the natural water cycle, plays a ubiquitous role in a myriad of applications, such as evaporative cooling, 1, 2 paper industry, 3 power generation, 4 and seawater desalination. 5 Attributing to the shortage of freshwater resources and the crisis of traditional energy, sustainable and clean energy has become ...

Request PDF | Solar-driven simultaneous steam production and electricity generation from salinity | Solar-driven interfacial water evaporation, which concentrates the solar heating at water ...

Intensifying Heat Using MOF-Isolated Graphene for Solar-Driven Seawater Desalination at 98% Solar-to-Thermal Efficiency ... the G@ZIF-based steam generator realizes 96% energy conversion ...

Solar-to-steam efficiency (?), a key indicator of system energy efficiency, is defined as the ratio between the latent heat of the produced steam and the input solar energy in equation 13,27

design of solar desalination plant inclusive of solar parabolic collectors, steam generator, and MED unit has been proposed to commute the conventional plant. Further, an implementing was carried

The purpose of this paper is to formulate the heat transfer needed to generate continuously the steam from the "Linear Fresnel concentrator Steam Generator" according to its dimensions.

This approach uses abundant solar energy as a heat source to purify seawater, resulting in a high energy conversion efficiency. ... We aim to emphasize the unique value of biomass-based materials in solar steam generation and inspire researchers looking for greener, lower cost approaches to synthesize efficient photothermal materials, which can ...

Among various freshwater extraction technologies, solar steam generation (SSG) is particularly attractive as it utilizes solar energy to heat water and generate steam, which is then condensed into fresh and clean water [6, 7]. SSG has gained significant attention in recent years due to its eco-friendliness, low-cost, and environmental benefits.

Furthermore, to evaluate the performance of harvesting solar energy to generate steam, thermal conversion efficiency was calculated according to the expression as follows (Miao et al., 2019): $\eta = \frac{R_e \cdot h_{LV}}{3600 q}$ where η represents the thermal conversion efficiency, q the illumination intensity (kW m^{-2}), and h_{LV} was defined by the following equation: $h_{LV} \dots$

The present study reports the synthesis of a 3D solar steam generator comprised of BiVO_4 and carbon nanotubes (CNT) nanocomposite decorated over a cigarette filter as the light-to-heat conversion ...

Using solar energy to drive seawater desalination is an ideal strategy to simultaneously address clean water

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shortages and environmental issues. ... to heat up the above water source to generate steam, the early stage of solar-driven photothermal evaporation introduces the system called solar heating of a nanofluid, ...

The conventional thermal distillation method requires heat energy generated from fossil fuel combustion to treat seawater, which is desalinated by heating to produce steam for condensation. ... have developed ...

For the first time, we report a deployable, three-dimensional (3D) origami-based solar steam generator capable of near full utilization of solar energy. This auxetic platform is designed based on Miura-ori tessellation and is able to efficiently recover radiative and convective heat loss as well as to trap solar energy via its periodic concavity pattern.

The solar steam generator fabricated with a unidirectional pathway design satisfactorily absorbed incoming solar illumination, provided localized heat at the air-water interface and produced steam at a rate of 1.386 ...

Solar thermal energy is a technology designed to capture the sun's radiant heat and convert it into thermal energy (heat), differentiating it from photovoltaics, which generate electricity. Systems like parabolic mirrors or flat plate collectors concentrate sunlight onto a specific area, heating a fluid that transfers the energy to a storage unit.

Recently, there has been an initial interest in an attempt to design a solar-driven integrated system that can simultaneously and efficiently generate freshwater and electricity [21], [22]. Wang et al. devised a hybrid device of the PV and the membrane distillation system, which could produce freshwater of 1.64 kg·m⁻²·h⁻¹ and electricity with efficiency of 11 % ...

The global increase in population, the phenomenon of climate change, the issue of water pollution and contamination, and the inadequate management of water resources all exert heightened strain on freshwater reserves. The potential utilization of the interfacial solar steam generation (ISSG) system, which utilizes photothermal conversion to generate heat on ...

Here, a facile, cost-efficient, and scalable method was proposed to prepare porous silicon loaded wood (porous silicon/wood) as solar steam generation device for seawater desalination. The porous silicon, which was obtained from in situ acid etching of Al-Si alloy powder, could be firmly deposited on the wood surface via capillary infiltration method.

The heating realization is through solar energy to heat the absorber to generate high-temperature steam/vapor, which quickly diffuses to the heated area to release the latent heat of condensation. Typically, the ...

Request PDF | On Nov 1, 2023, Tushar Prashant Pandit and others published Joule-heating assisted heliotropic solar steam generator for all-day, all-weather solar desalination | Find, read and cite ...

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Solar steam generator. Similarly to the strategy suggested by Ghasemi et al. 18 and other authors thereafter 19,27,28,38,41,43,44,45,46,47, solar steam generation is here enhanced by the ...

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