Analysis of the difficulties of photothermal energy storage



Overview

Abstract Infiltrating phase change materials (PCMs) into nanoporous metal–organic frameworks (MOFs) is accepted as a cutting-edge thermal energy storage concept. However, weak photon capture capability of pristine MOF-based composite PCMs is a stumbling block in solar energy utilization.

Abstract Infiltrating phase change materials (PCMs) into nanoporous metal–organic frameworks (MOFs) is accepted as a cutting-edge thermal energy storage concept. However, weak photon capture capability of pristine MOF-based composite PCMs is a stumbling block in solar energy utilization.

In this study, we prepared CNT-BN-SA-1, a photothermal phase change energy storage material with excellent stability, long life, and high enthalpy value. The Hm of CNT-BN-SA-1 is 143.5 ± 5.0 J g −1, which has the desired high enthalpy value.

By developing the thermodynamic models of the systems, numerical results indicate that the photothermal assistance significantly enhances the thermal performance of LCES system, with the exergy efficiency increased by 16.00 % to 62.23 % and the energy storage density increasing from 8.06 kWh/m3 to 18.59 kWh/m 3, respectively.

However, current thermal energy storage technologies have problems with insufficient energy storage material performance, especially low energy storage density, complex energy storage process and large heat loss.

Herein, a photothermal energy-storage capsule (PESC) by leveraging both the solar-to-thermal conversion and energy-storage capability is proposed for efficient anti-/deicing. What is solar energy photothermal conversion & storage?

For solar energy photothermal conversion and storage systems, materials not only have efficient photothermal conversion capabilities, but also provide a place for storage and energy exchange for phase change media, while avoiding problems such as leakage and poor thermal conductivity during the phase change process.

What are the environmental disadvantages of photothermal catalysis?

Despite their remarkable efficiency in harnessing solar energy and converting it chemically, these technologies have environmental disadvantages. One factor to assess is the energy consumption while preparing materials for photothermal catalysis. For instance, creating and activating photothermal catalysts requires significant energy.

What is photothermal phase change energy storage?

To meet the demands of the global energy transition, photothermal phase change energy storage materials have emerged as an innovative solution. These materials, utilizing various photothermal conversion carriers, can passively store energy and respond to changes in light exposure, thereby enhancing the efficiency of energy systems.

How can photothermal conversion materials solve the solar energy imbalance?

Using photothermal conversion materials to capture solar energy, energy conversion, and then through phase change materials to store solar energy can effectively solve the imbalance between the use of solar energy in time and space supply and demand.

Is photothermal catalysis sustainable?

When examining the environmental consequences of synthesizing and utilizing advanced photothermal catalysis for sustainable energy and materials, it is essential to consider the potential hazards associated with by-products and energy consumption during material processing.

How will PCMS affect solar photothermal conversion and energy storage materials?

Due to the introduction of PCMs, the light absorption capacity of composite solar photothermal conversion and energy storage materials will be reduced, and the development of composite phase change materials with a broad light absorption range and high photothermal conversion capacity is the focus at present.

Analysis of the difficulties of photothermal energy storage



Composite phase-change materials for photo-thermal conversion ...

PTCPCESMs can facilitate the conversion and storage of solar energy and can overcome the limitations of structural stability, thermal conductivity, light absorption capacity, ...

Long-term energy management analysis of a novel solar ...

Photothermal conversion phase change materials that integrate solar-thermal conversion with thermal management have emerged as a promising solution for energy ...





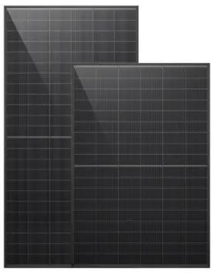
Thermodynamic analysis of photothermal-assisted liquid ...

Abstract Liquid compressed carbon dioxide (CO2) energy storage (LCES) is promising by mechanically storing the electricity into the high-pressure liquid CO 2. However, ...

A study on novel dual-functional photothermal material for high

The solar-heat storage efficiency of devices based on phase change materials (PCMs) is limited due to the light absorption and internal heat transfer within the PCMs, unclear ...





Recent progress on photothermal nanomaterials: Design, ...

Photothermal energy conversion represents a cornerstone process in the renewable energy technologies domain, enabling the capture of solar irradiance ...

Thermodynamic analysis of photothermal-assisted liquid ...

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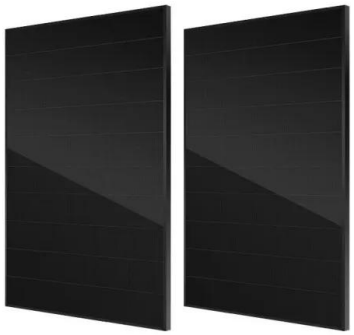


Photothermal storage and controllable release of a phase-change

Abstract Photochemical phase transition is an effective strategy to realize photothermal conversion and multi-source energy storage. Azobenzene molecule with photo ...

Advanced/hybrid thermal energy storage technology: material, ...

Thermal energy storage (TES) technology is playing an increasingly important role in addressing the energy crisis and environmental problems. Various TES technologies, ...



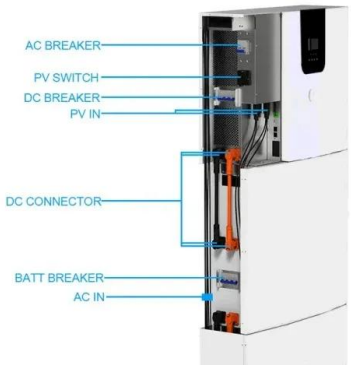


Analysis of the Operating Characteristics of a Photothermal Storage

The results of simulation tests on the solar collector system and the thermal storage subsystem show that the energy storage rate of the energy storage subsystem is affected by light intensity ...

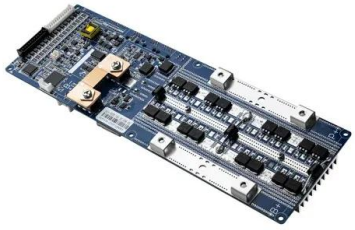
Thermodynamic analysis of photothermal-assisted liquid ...

Liquid compressed carbon dioxide (CO2) energy storage (LCES) is promising by mechanically storing the electricity into the high-pressure liquid CO2. However, the thermal efficiency of the ...



Efficient solar thermal storage of foamy bamboo charcoal-based

Thermal energy storage and photothermal conversion technology can effectively solve the shortcomings in the practical application of solar energy and improve the ...



Principles and applications of photothermal catalysis

In this review, Ding and colleagues summarize the functioning principles and categories of photothermal catalysis, catalyst design criteria and ...





Design and economic analysis of photothermal coupled ...

A 10 MW photothermal coupled compressed air energy storage system is established. The cycle efficiency of the system is increased greatly by adding a solar heat collector. The cycle ...

Thermodynamic analysis of an improved adiabatic compressed air energy

Energy storage technology is a cutting-edge research in the field of new and renewable energy application. In this paper we introduce the concept of an energy storage ...





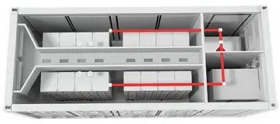
Recent advances and perspectives in solar photothermal ...

Developing high-efficiency solar photothermal conversion and storage (SPCS) technology is significant in solving the imbalance between the supply and demand of solar energy utilization ...

A photothermal energy storage phase change material with high ...

In this study, we prepared CNT-BN-SA-1, a photothermal phase change energy storage material with excellent stability, long life, and high enthalpy value. The Hm of CNT-BN ...







Photothermal-assisted solar hydrogen production: A review

Additionally, the paper reviews strategies for the integration of solar thermal energy into solar-coupled hydrogen production systems. Subsequently, evaluation metrics for ...

Recent advances and developments in solar-driven photothermal ...

The advancement of light-driven photothermal CO 2 reduction goes beyond environmental benefits, providing a sustainable route for chemical synthesis and energy storage.



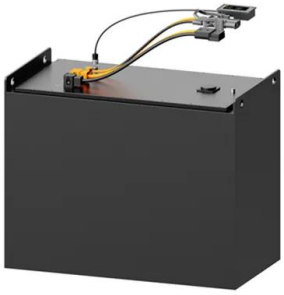


Polypyrrole-boosted photothermal energy storage in ...

Abstract Infiltrating phase change materials (PCMs) into nanoporous metal-organic frameworks (MOFs) is accepted as a cutting-edge ...

Improvement of azobenzene photothermal energy storage ...

The photothermal storage method that uses the chemical structure of photosensitive molecules to store energy has received a lot of attention in recent years [23].





Theoretical and experimental progress in photothermal catalysis ...

Abstract In the current energy crisis, converting solar-thermal energy into chemical forms has become paramount. Within the broad spectrum of light-mediated catalysis, ...

Analysis of Difficulties of Photothermal Energy Storage

Herein, a photothermal energy-storage capsule (PESC) by leveraging both the solar-to-thermal conversion and energy-storage capability is proposed for efficient anti-/deicing. ...





Recent advances and perspectives in solar photothermal ...

Environmental factors significantly influence solar energy, leading to intermittency and unpredictability. These factors hinder the continuous energy conversion of photothermal ...

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Design and economic analysis of photothermal coupled compressed air energy storage system To cite this article: Zhenhai Hu et al 2024 J. Phys.: Conf. Ser. 2823 012025 ...



Thermodynamic analysis of a novel concentrated solar power ...

This research provides a detailed thermodynamic analysis of a new Concentrated Solar Power (CSP) plant with integrated Thermal Energy Storage (TES). The ...



Thermodynamic analysis of photothermal-assisted liquid ...

Download Citation , On Aug 1, 2023, Hailun Fu and others published Thermodynamic analysis of photothermal-assisted liquid compressed CO2 energy storage system hybrid with closed-cycle ...





Photothermal-assisted scheme design and thermodynamic analysis ...

The conventional photothermal-assisted scheme adopted by advanced adiabatic compressed air energy storage (AA-CAES) has equal stages of expanders and high-temperature reheaters, ...

Development and system performance evaluation of new ...

In summary, the current problems of TCES are: a) Pure hydrated salts will form slag and affect their application; b) The traditional thermochemical energy storage process is ...





Analysis of structure-induced performance in photothermal methane ...

Structural design and optimization are important for improving the overall performance of solar reactors. In this study, a coupled optics-CFD model was established to ...

Comprehensive evaluation of the photothermal conversion ...

Their performance is evaluated at the material characterization, kinetics analysis, photothermal conversion and practical application perspectives. The thermochemical energy storage density ...



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