

Photothermal energy storage system



Overview

The conventional photothermal-assisted scheme adopted by advanced adiabatic compressed air energy storage (AA-CAES) has equal stages of expanders and high-temperature reheaters, and is equipped with a regenerator to waste heat recovery, which is relatively complex and requires high solar heat supply and solar irradiance. In this paper, a novel photothermal-assisted AA-CAES (PT-AA-CAES) with a simpler structure and suitable for low sol. The conventional photothermal-assisted scheme adopted by advanced adiabatic compressed air energy storage (AA-CAES) has equal stages of expanders and high-temperature reheaters, and is equipped with a regenerator to waste heat recovery, which is relatively complex and requires high solar heat supply and solar irradiance. In this paper, a novel photothermal-assisted AA-CAES (PT-AA-CAES) with a simpler structure and suitable for low solar irradiance is designed, which adopts 3-stage expansion and 2-stage high-temperature reheat. The thermodynamic model of PT-AA-CAES system is established, and a comprehensive evaluation coefficient combining exergy efficiency and energy storage density is proposed. The numerical results demonstrate that the compressor unit outlet pressure and expansion unit inlet pressure with the optimal comprehensive performance are 10 MPa and 4 MPa. Furthermore, when the solar irradiance is below 690 W/m², 660 W/m², and 600 W/m², the output work, exergy efficiency, and energy storage density of the novel PT-AA-CAES system will surpass those of the conventional PT-AA-CAES system with the same solar heat consumption, and at a solar irradiance of 580 W/m², the exceeded values are 44.3 kW h, 2.03%, and 0.15 kW h/m³, respectively. These conclusions can assist the AA-CAES system in the selection of unit pressures and photothermal-assisted scheme.

••Advanced adiabatic compressed air energy storage
Photothermal-assisted scheme
Thermodynamic analysis
Comprehensive evaluation coefficient
A solar collector area, m²
C heat capacity, kJ/(K·h)
c_p specific heat at constant pressure, kJ/(kg·K)
c_v specific heat at c...

Article Content

Journal of Energy Storage

Phase change materials (PCMs) are able to harvest excess heat from the ambient environment by means of latent heat, which is considered to be an effective strategy for convenient energy storage and sustainable utilisation. Among many PCMs, polyethylene glycol (PEG) has become a research hot spot owing to the advantages of high energy density, easy accessibility and ...

Flexibility, malleability, and high mechanical strength phase ...

Heat energy is one of the most crucial energy sources for the development of human civilization. However, the difficult storage of vast amounts of thermal energy, such as that found in solar energy, geothermal energy, and industrial waste heat, significantly lowers the efficiency of energy utilization. Phase change materials (PCMs) can maintain a ...

A review of the photothermal-photovoltaic energy supply system ...

Therefore, developing the integration of electric energy storage, thermal energy storage and solar energy utilization system has become an important approach to match the unstable characteristic of building demand, and provide reliable, stable and sustainable energy supply for building, which was of great practical significance [19, 20].

Photothermal energy storage system technology

Photothermal energy storage system technology. 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, ...

High-directional thermally conductive stearic acid/expanded ...

Particularly, photothermal energy storage systems that store excess solar energy generated during the day for nighttime utilization are widely adopted. Stearic acid (SA) has garnered significant attention as a recommended PCM due to its favorable properties, such as cost-effectiveness, high thermal storage density, non-toxicity, and ...

Thermodynamic analysis of photothermal-assisted liquid ...

Compressed air energy storage (CAES) is widely concerned among the existing large-scale physical energy storage technologies. Given that carbon dioxide (CO₂) has superior physical qualities than air, as well as excellent thermodynamic performance, low critical parameters, and high heat transfer performance, CO₂ may be employed as a working medium ...

Photothermal energy storage system technology

An azobenzene-based photothermal energy storage system for co-harvesting photon energy and low-grade ambient heat via a photoinduced crystal-to- were purchased from Shanghai Aladdin Biochemical Technology Co., Ltd. Dichloromethane (DCM, AR and SP), ethyl acetate (AR) and petroleum ether (AR) were purchased from Tianjin Kemiou Chemical ...

An azobenzene-based photothermal energy storage system for ...

Recent evidence suggests that a class of azobenzene (Azo) photoswitches featuring a reversible photoinduced crystal-to-liquid transition could co-harvest photon energy ...

Bioinspired wood-based composite phase change materials for ...

Download Citation | On Feb 1, 2025, Rongjun Wei and others published Bioinspired wood-based composite phase change materials for efficient photothermal conversion and energy storage | Find, read ...

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 ...

A study on novel dual-functional photothermal material for high ...

Therefore, a novel controllable strategy was proposed in this study to fabricate dual-functional photothermal storage three-dimensional (3D) phase change blocks (PCBs) with ...

Photothermally enhanced ion-transport in solid-state, non-Faradic ...

The universal direct dependence of ionic mobility on temperature severely restricts the low-temperature operation of energy storage devices. We overcome this limitation by synergizing photothermal conversion with electrochemical energy storage, using non-graphitizable nanocarbon florets (NCF) as multi-functional electrodes.

High Dimensional Model Representation Approach for Prediction ...

The thermal energy required for the reaction and to preheat biomass and supercritical water comes from the photothermal energy storage system. The biomass gasification process involves complex physical and chemical processes . Prediction and optimization of the gasification can be performed using process simulation and surrogate models.

Molecular solar thermal energy storage in photoswitch oligomers ...

Molecular photoswitches can be used for solar thermal energy storage by photoisomerization into high-energy, meta-stable isomers; we present a molecular design ...

Photothermal Nanomaterials: A Powerful Light-to-Heat ...

We present an extensive catalogue of nanostructured photothermal materials, including metallic/semiconductor structures, carbon materials, organic polymers, and two-dimensional materials. The proper ...

An azobenzene-based photothermal energy storage system for ...

From: An azobenzene-based photothermal energy storage system for co-harvesting photon energy and low-grade ambient heat via a photoinduced crystal-to-liquid transition. Figure 6. Schematic illustration of photoinduced ambient heat conversion model. Back. Energy Materials. ISSN 2770-5900 (Online) editorial@energymaterj .

Photothermal Phase Change Energy Storage Materials: A

Photothermal phase change energy storage materials (PTPCESMs), as a special type of PCM, can store energy and respond to changes in illumination, enhancing the efficiency of energy ...

Photothermal-assisted scheme design and thermodynamic ...

The conventional photothermal-assisted scheme adopted by advanced adiabatic compressed air energy storage (AA-CAES) has equal stages of expanders and high-temperature reheaters, and is equipped with a regenerator to waste heat recovery, which is relatively complex and requires high solar heat supply and solar irradiance. In this paper, a novel photothermal ...

Superhydrophobic multi-shell hollow microsphere confined phase ...

This solar photothermal/storage system [, ... Investigation of a packed bed energy storage system with different PCM configurations and heat transfer enhancement with fins using CFD modeling. Chem Pap, 78 (2024), pp. 2453-2467. Crossref View in ...

Improvement of azobenzene photothermal energy storage ...

Cao Ruifeng and others proposed a hybrid energy system based on the combination of hydrogen fuel compressed air energy storage system and water electrolysis hydrogen generator . As an eco-friendly ... This paper aims to improve the photothermal energy storage performance of the composite material by preparing AZO-g-C 3 N 4 material ...

Photothermal Phase Change Energy Storage Materials: A ...

To meet the demands of the global energy transition, photothermal phase change energy storage materials have emerged as an innovative solution. These materials, utilizing ...

Azopyridine Polymers in Organic Phase Change Materials for High Energy ...

Azo-compounds molecules and phase change materials offer potential applications for sustainable energy systems through the storage and controllable release photochemical and phase change energy. ... for photothermal energy storage and synergistic cooperation with organic phase change materials present significant challenges. Herein, three ...

Hydrogel-Based Photothermal-Catalytic Membrane for Efficient ...

Moreover, the robust system performance, validated through long-term and outdoor testing, demonstrates practical viability for real-world implementation and scalable applications. These findings provide novel insights into developing high-performance PTC systems for addressing the water-energy nexus. 4 Experimental Section

MXene-based phase change materials for multi-source driven energy ...

PCMs composited with MXene enable energy storage through a photothermal-driven phase transition conversion process [149, 150]. ... With a conversion system plotted in Fig. 5 (g), the open circuit voltage (OCV) of this system and the relative temperature are summarized in Fig. 5 (h). The OCV rises rapidly during the initial irradiation and ...

Photoswitchable phase change materials for unconventional thermal ...

For the photochemical conversion, the incident photon energy (E_{total}) can be transformed into three parts: the resulting chemical energy stored inside the material system (E_{in}), thermal energy due to the parasitic photothermal effect (Q_{pt}), and energy loss (E_{loss}) as shown in Figure 4.

Biomass-based shape-stabilized phase change materials for ...

The resulting CPCMs have excellent photothermal conversion and energy storage/release capabilities. ... $W/m \cdot K$, remains a persistent obstacle, significantly limiting their potential use, especially in high-power-density energy storage systems. To enhance the thermal conductivity of PCMs, incorporating additives with high thermal conductivity is ...

An azobenzene-based photothermal energy storage system ...

An azobenzene-based photothermal energy storage system for co-harvesting photon energy and low-grade ambient heat via a photoinduced crystal-to-liquid transition Liqi Dong^{1,2}, Fei Zhai¹, Hui Wang^{1,2}, Cong Peng¹, Yiyu Feng¹, Wei Feng^{1,3,*} ¹School of Materials Science and Engineering, Tianjin University, Tianjin 300072, China.

Polypyrrole-boosted photothermal energy storage in MOF-based ...

1 INTRODUCTION. Renewable, abundant, and clean solar energy is expected to replace fossil fuels and alleviate the energy crisis. However, intermittency and instability are the deficiencies of solar energy due to its weather and space dependence. [] Emerging phase change material (PCM)-based photothermal conversion and storage technology is an effective ...

Improved absorption of phosphates through interface junctions ...

The light absorption and photothermal energy storage of $Mg(OH)_2$ and Ca ... Review of carbonate-based systems for thermochemical energy storage for concentrating solar power applications: state-of-the-art and outlook. Energy Fuels (2023), pp. 1777-1808. Crossref View in Scopus Google Scholar.

Photothermal Nanomaterials: A Powerful Light-to-Heat Converter

Even conventional fossil fuels are the long-term storage of solar energy. ... (1) When the solar absorbers are dispersed in water, the photothermal energy collected by the absorbers will transfer to water through classical (global heating) and nonclassical (nanobubble generation) mechanisms. Such volumetric systems, also known as nanofluids ...

Contact Us

For more information, pricing, or custom solutions, please contact us:

Website: <https://www.pamacamper.it>

Email: info@pamacamper.it

Phone: +39 331 478 9250

Address: Via Roma 12, 20121 Milano, Italy

This document is for informational purposes only. Specifications subject to change without notice.

