

Solar energy is a renewable energy source that can be utilized for different applications in today's world. The effective use of solar energy requires a storage medium that can facilitate the storage of excess energy, and then supply this stored energy when it is needed. An effective method of storing thermal energy from solar is through the use of phase change ...

Intelligent phase change materials for long-duration thermal energy storage Peng Wang,<sup>1</sup> Xuemei Diao,<sup>2</sup> and Xiao Chen<sup>2,\*</sup> Conventional phase change materials struggle with long-duration thermal energy storage and controllable latent heat release. In a recent issue of *Angewandte Chemie*, Chen et al. proposed a new

Phase change material-based thermal energy storage Tianyu Yang, <sup>1</sup>William P. King,<sup>2</sup> 34 5 \*and Nenad Miljkovic 6 SUMMARY Phase change materials (PCMs) having a large latent heat during solid-liquid phase transition are promising for thermal energy storage applications. However, the relatively low thermal conductivity

The optimal composites system has an impressive solar thermal energy storage efficiency of up to 94.5%, with an improved energy storage capacity of 149.5 J g<sup>-1</sup>, even at a ...

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Benefiting from high fusion enthalpy, narrow storage temperature ranges, and relatively low expansion coefficients, solid-liquid phase change materials (PCMs) have been ...

PCMs [9, 10] are a novel type of materials capable of utilizing their own phase transitions to exhibit heat storage/release cycle characteristics. Solid-liquid phase PCMs are predominantly utilized [11, 12]. They have been applied in various fields, including construction [13], air conditioning [14], and food transportation [15] to reduce energy consumption for ...

Phase-change materials (PCMs) offer tremendous potential to store thermal energy during reversible phase transitions for state-of-the-art applications. The practicality of ...

This enhances energy utilization efficiency, making PCMs an energy-saving and environmentally friendly latent heat storage material. There are various types of PCMs, among which the phase change process of PCMs can be divided into solid-solid phase change and solid-liquid phase change. Compared to solid-solid PCMs, solid-liquid PCMs ...

Solid-liquid phase change materials (SL-PCMs) change their internal molecular arrangement from an ordered crystalline structure to a disordered amorphous one when temperature exceeds a critical threshold (i.e., the phase transition temperature). An increase in vibrational energy breaks the supramolecular bonds between individual molecules, causing ...

Thermal energy harvesting and its applications significantly rely on thermal energy storage (TES) materials. Critical factors include the material's ability to store and release heat with minimal temperature differences, the range of temperatures covered, and repetitive sensitivity. The short duration of heat storage limits the effectiveness of TES. Phase change ...

This implies that when a phase change occurs from a solid to a liquid or vice versa in an organic PCM, a sizable quantity of heat can be retained or released. ... Recent developments in phase change materials for energy storage applications: a review. Int J Heat Mass Transf (Pergamon) 129:491-523. ... Muhammad T (2022) Solar district heating ...

The global energy transition requires new technologies for efficiently managing and storing renewable energy. In the early 20th century, Stanford Olshansky discovered the phase change storage properties of paraffin, advancing phase change materials (PCMs) technology [].Photothermal phase change energy storage materials (PTCPCEsMs), as a ...

Solid-solid phase change materials (SSPCMs) with small volume change and leak-proof characteristic during the whole process of phase change play a vital role in development of PCM for thermal energy storage (TES). However, the non-recyclability of the materials due to their permanent cross-linking networks limited their practical application.

The performance of thermal energy storage based on phase change materials decreases as the location of the melt front moves away from the heat source. Fu et al. implement pressure-enhanced close ...

Review on solid-solid phase change materials for thermal energy storage: Molecular structure and thermal properties Ali Fallahia,d, Gert Guldentopsa, Mingjiang Taoa, Sergio Granados-Focilb, Steven Van Desselc,? a Civil and Environmental Engineering Department, Worcester Polytechnic Institute, Worcester, MA, United States bDepartment of Chemistry, Clark University, ...

The thermal characterization of two binary systems of n-alkanes that can be used as Phase Change Materials (PCMs) for thermal energy storage at low temperatures is reported in this work. The construction of the solid-liquid binary phase diagrams was achieved using differential scanning calorimetry (DSC) and Raman spectroscopy. The solidus and liquidus ...

This can be achieved by thermal storage for space heating and cooling purposes. ... Think how water requires significant amount of energy when it changes from solid phase to liquid phase at 0&#176;C (32&#176;F) or

how wax extends the burning time of a candle. Moreover, the cycle of the melting and solidification can be repeated many times. ...

ND undergoes a phase change during heating and cooling, resulting in a heat absorption and release platform. The thermal energy storage and waste heat recovery performance of CP-based composites correspond to the enthalpy and the encapsulation ratio, with ND/CP80 and ND/CP160 having optimal energy storage.

for heating, with greater energy transfer rates ... which reduces heat transfer during the solid-liquid change of phase ... performance of phase change energy storage .

Phase change materials (PCMs) having a large latent heat during solid-liquid phase transition are promising for thermal energy storage applications. However, the relatively low thermal ...

Thermal energy storage can be categorized into different forms, including sensible heat energy storage, latent heat energy storage, thermochemical energy storage, and combinations thereof [[5], [6], [7]]. Among them, latent heat storage utilizing phase change materials (PCMs) offers advantages such as high energy storage density, a wide range of ...

Phase change materials (PCM) have a potential role in thermal energy storage applications. Recent progress has shown notable work on solid solid phase change materials (SS-PCM) which possess unique advantages of low subcooling, limited volume expansion due to a solid solid phase transition, high thermal stability and also had significant latent heat and ...

The fabrication of shape-stabilized PCMs was used to prevent leakage during the solid-liquid phase change process. Generally, there are four main techniques for enclosing solid-liquid PCMs, which mainly included core-shell confinement, porous confinement, longitudinal confinement, and confinement in the interface of nanomaterials [17]. Among them, ...

Currently, the literature concerning the utilization of polymer-based solid-solid PCMs as phase change heat storage asphalt pavement materials is less abundant. Wei et al. [36] and Liu et al. [37] synthesized polyurethane-based solid-solid phase change materials (PUSSPCMs) as asphalt modifiers that could delay the temperature rise of ...

Usage of PCMs had lately sparked increased scientific curiosity and significance in the effective energy utilization. Ideas, engineering, as well as evaluation of PCMs for storing latent heat were comprehensively investigated [17,18,19,20]. Whenever the surrounding temperature exceeds PCM melting point, PCM changes phase from solid state into liquid and ...

Phase change materials with stable shape and superb thermal properties play a significant role in efficient

utilization of solar energy. Herein, a novel industrial waste-based shape-stabilized phase change material (SSPCM) with a high paraffin load (61.32%) and environment-friendly was designed and prepared via a vacuum impregnation method, in which calcium ...

Latent heat thermal energy storage based on phase change materials (PCM) is considered to be an effective method to solve the contradiction between solar energy supply and demand in time and space. ... In the solid-liquid heating stage, the temperature rise rate of HPC is lower than that of all porous shaped composite PCMs. It can be also found ...

The heating method for reducing the viscosity of crude oil is mainly electric heating currently. In order to meet the needs of environmental protection and industrial production, a new electric heating device with phase change thermal storage is designed by combining the crude oil viscosity reduction heating method, off-peak electricity, and phase ...

The current energy crisis has prompted the development and utilization of renewable energy and energy storage material. In this study, levulinic acid (LA) and 1,4-butanediol (BDO) were used to synthesize a novel levulinic acid 1,4-butanediol ester (LBE) by both enzymatic and chemical methods. The enzymatic method exhibited excellent ...

ConspectusSolar-thermal energy storage (STES) is an effective and attractive avenue to overcome the intermittency of solar radiation and boost the power density for a variety of thermal related applications. Benefiting from high fusion enthalpy, narrow storage temperature ranges, and relatively low expansion coefficients, solid-liquid phase change materials (PCMs) ...

1.2 Types of Thermal Energy Storage. The storage materials or systems are classified into three categories based on their heat absorbing and releasing behavior, which are- sensible heat storage (SHS), latent heat storage (LHS), and thermochemical storage (TC-TES) [].1.2.1 Sensible Heat Storage Systems. In SHS, thermal energy is stored and released by ...

Thermal energy storage material has become a focus of study because of the environment deterioration and fossil energy depletion. Phase change material (PCM) is considered as one of the most promising thermal energy storage materials and has been widely used in aerospace [], energy-saving buildings [], solar energy storage [3,4,5,6], biomedical ...

Solid-solid PCMs, as promising alternatives to solid-liquid PCMs, are gaining much attention toward practical thermal-energy storage (TES) owing to their inimitable advantages such as solid-state processing, negligible volume change during phase transition, no contamination, and long cyclic life.

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