Phase change energy storage battery modeling

Can phase change material be used in active battery thermal management systems?
The incorporation of phase change material (PCM) within active battery thermal management systems (BTMS) is viewed as a promising direction for future advancements,yet an ideal structure for PCM implementation in BTMS to facilitate industrialization remains elusive.

What is the phase transition of a PCM battery?
In the initial phase of the discharge process,the PCM is in its solid state,and heat dissipation primarily depends on conduction and the sensible heat capacity of the material. As the battery temperature rises and approaches the melting pointof PCM,approximately between 36 °C and 38 °C; the phase transition begins.

How does phase change affect battery temperature?
This phase change process stores energy in the form of latent heat,which results in a mitigation of the battery temperature rise rate. In addition,the maximum battery temperature exceeds the optimum range of battery cell (40 °C),which shows that more efficient passive techniques are required to cool down the LIB cell.

What is the phase transition of a battery?
As the battery temperature rises and approaches the melting point of PCM,approximately between 36 °C and 38 °C; the phase transition begins. The phase transition becomes noticeable after 200 s in Fig. 12. During this stage,the PCM near the battery surface starts to melt,absorbing a significant portion of the heat generated by the battery.

What is a phase change material (PCM)?
Phase change materials (PCM) can absorb or release a large amount of latent heat during the phase change process while maintaining a constant temperature (phase change temperature).

How can battery thermal management improve the cycle life?
This matter of enhancing the cycle life of batteries has become an important subject in many studies [4,5]. Due to the safety and high-energy density requirements of LIBs ,a battery thermal management system (BTMS) is needed to assist in controlling the LIB temperaturewithin the ideal operating range of 15 °C to 40 °C [7,8].

In this paper, STAR-CCM+ software is used to carry out three-dimensional simulation of single cell and battery packs with PCM to investigate changing characteristics of ...

Abstract mine the effective thermal properties of composite phase change materials (CPCMs) consisting of paraffin and copper foam. In this approach, first t e CPCM microstructures are ...

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Abstract Phase change materials (PCMs) bring great hope for various applications, especially in Lithium-ion battery systems. In this paper, the modification methods ...

Lithium-ion batteries are increasingly employed for energy storage systems, yet their applications still face thermal instability and safety issues. This study aims to develop an ...

Battery energy storage systems become increasingly important to address the intermittency of renewable energies, but their widespread adoption is still hindered by thermal ...

This review comprehensively examines modeling and simulation approaches for phase change material-based passive and hybrid battery thermal management systems (BTMS).

This study synthesizes seven ester-based phase change materials (PCMs), significantly broadening their phase change temperature range while exhibiting excellent ...

One of the most effective methods for thermal energy storage relies on the latent heat property of phase change materials (PCMs). Fins are widely employed as an efficient ...

We evaluated the effectiveness of the phase-change energy storage multi-tube heat exchanger through transient simulations using ANSYS finite element software. We also con-ducted ...

The experimental results demonstrated that the pro-posed thermal management system effectively controlled the heat generation of the battery pack and maintained the battery pack ...

Request PDF | On Apr 9, 2025, Houssam Eddine Abdellatif and others published Modeling and performance analysis of phase change materials in advanced thermal energy storage systems: ...

Phase change materials (PCMs) have emerged as a viable technology for thermal energy storage, particularly in solar energy applications, due to their ability to efficiently ...

The incorporation of phase change material (PCM) within active battery thermal management systems (BTMS) is viewed as a promising direction for future advancements, yet ...

INTRODUCTION Solid-liquid phase change materials (PCMs) have been studied for decades, with application to thermal management and energy storage due to the large latent heat with a ...

JIN Lu,XIE Peng,ZHAO Yanqi, et al. Research Progress on Phase Change Material Based Thermal Management System of EV Batteries [J]. Materials Reports, 2021, 35 (21): 21113-21126.

Abstract Phase change materials (PCMs) are crucial for efficient energy storage, yet their inherent challenges

include low thermal conductivity, limited latent heat capacity, and ...

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