Multifunctional battery temperature control system design

How to control multilayer temperature uniformity and energy consumption in battery thermal management?
To achieve fine control of multilayer temperature uniformity and energy consumption in a battery thermal management system (BTMS),a model predictive control(MPC) based on the reduced-order model and the heat generation previewer is proposed in this work. A direct contact liquid cooling battery pack is adopted to verify the control strategy.

What is a conventional battery thermal management system?
Conventional battery thermal management systems have basic temperature control capabilitiesfor most conventional application scenarios.

How a PCM can improve battery thermal management?
The efficient control and regulation of cooling mechanisms and temperature are of utmost importance to uphold battery performance, prolong battery lifespan, and guarantee the safe operation of EVs. One innovative solution employed in the automotive industry is the use of PCMs for battery thermal management .

How does a battery thermal management system work?
In terms of battery thermal management systems,PCMs are incorporated into battery packs to absorb and dissipate surplus heat produced during use. When there is a rise in battery temperature,PCM absorbs this generated heat and undergoes a phase transition from solid state to liquid through which the thermal (heat) energy is stored.

What is the maximum temperature difference of a battery module?
The result showed that the maximum temperature and maximum single-cell temperature difference of the battery module could be controlled at 39.75 °C and 4.91 °C,while the flow energy consumption was reduced by 80.80 % compared to the continuous liquid cooling mode under 3C discharge with an ambient temperature of 30 °C.

What is a battery thermal management system (BTMS) controller?
A Battery Thermal Management System (BTMS) controller with smart featuresis designed,validated through simulations,and implemented at lab level. The bedrock of the developed controller consists of four Proportional-Integral-Derivative (PID) controllers that manage independently the four actuators of the evaluated thermal system.

PCM cooling is an effective passive thermal management method with no energy consumption. Numerous studies have demonstrated the feasibility of PCM-based BTMS in reducing battery temperature and improving temperature uniformity.

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Many studies, both numerical and experimental, have focused on improving BTMS efficiency. This paper presents a comprehensive review of the latest BTMS designs developed in 2023 and 2024, with a focus on recent advancements and innovations. The primary objective is to evaluate these new designs to identify key improvements and trends.

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