Heat pipe water cooling battery system

Furthermore, heat pipe-based cooling systems offer the additional advantage of isolating the battery from the cooling fluid channel, thereby augmenting the overall reliability of the cooling system [12]. To further enhance the cooling performance of heat pipes, they are typically synergistically coupled with air cooling, which facilitates the dissipation of heat from ...

The lithium-ion battery is widely used in the power system of pure electric vehicles and hybrid electric vehicles due to its high energy density. However, the chemical and electrochemical reactions generate a lot of heat. If the heat is not transferred through some refrigeration methods in time, it will lead to a rapid rise in the temperature of the battery. In this ...

For example, Li et al. [11] designed a liquid-based battery thermal management system by employing copper tubes attached to silicon cooling plates which were placed between several battery cells. Water, pumped at 0.48 l/min flow rate through the tubes, was used as a coolant, absorbing and transferring heat away from the cells.

There are a number of different applications that could use heat pipes or loop heat pipes (LHPs) in the intermediate temperature range of 180 to 430ºC (450 to 700 K), including space nuclear power system radiators, fuel cells, geothermal ...

A large-capacity prismatic lithium-ion battery thermal management system (BTMS) combining composite phase change material (CPCM), a flat heat pipe (FHP), and liquid cooling is proposed. The three conventional configurations analyzed in this study are the BTMSs using only CPCM, CPCM with aluminum thermal diffusion plates, and CPCM with FHPs. In ...

Battery thermal management is becoming more and more important with the rapid development of new energy vehicles. This paper presents a novel cooling structure for cylindrical power batteries, which cools the battery with heat pipes and uses liquid cooling to dissipate heat from the heat pipes. Firstly, the structure is parameterized and the numerical model of the battery ...

Heat pipe cooling technology reduces the temperature distribution inhomogeneity of a single cell, but it is still not possible to completely dissipate thermal heat out of the battery module if the cooling system of the battery pack only utilizes heat pipes [121]. Therefore, PCM cooling and heat pipe cooling require a combination of air or ...

2.1. Geometric model description. Figure 1 shows a schematic diagram of the battery pack with HCLC, comprising 15 18650 LIB (connected in 5 series and 3 parallel (5S3P)), aluminum thermal conductive element, curved flat heat pipes, and liquid-cooled plate. The main physical parameters of these elements are shown in Table 1.An aluminum block with curved grooves ...

Passive in-core cooling system using Hybrid Heat Pipes [208]. Tests on hybrid heat pipes have been carried out by Jeong et al. [138] for advanced nuclear power plants. The results have demonstrated that the system is able to shut down the reactor and, at the same time, remove the heat decay from the nuclear pressure vessels. To validate the heat pipe ...

This paper presents a novel cooling structure for cylindrical power batteries, which cools the battery with heat pipes and uses liquid cooling to dissipate heat from the heat pipes. Firstly, ...

The following will take Tesla as an example and give a brief insight into how Tesla carries out heat pipe cooling of its battery packs. Tesla uses liquid cooling solution for battery thermal management, each Tesla is equipped with a special liquid cycle temperature management system, and around each single battery. The coolant used is a mixture of 50% water and ...

However, heat pipe based battery thermal management systems (HP-BTMS) are yet to be commercialized due to lack of understanding their limitations during rapid heat fluctuations and adverse ...

This comprehensive review highlights the different heat generation mechanisms of Li-ion batteries and their resulting consequences, followed by the operating principles of ...

The thermal management system of batteries plays a significant role in the operation of electric vehicles (EVs). The purpose of this study is to survey various parameters enhancing the performance of a heat pipe-based battery thermal management system (HP-BTMS) for cooling the lithium-ion batteries (LIBs), including the ambient temperature, coolant ...

Combining a cooling channel and round heat pipes (RHP) at system level, this study examines the vertical position of the RHP under various heat load conditions and liquid temperatures. Moreover, the study also goes through thermal resistance network of the entire system and determines the part with high temperature gap. Experimental results ...

Alternatively, passive cooling systems such as heat pipes can be used to control the battery temperature which has been discussed by Putra et al. [24]. In their research, batteries of the electric vehicle have been cooled using heat pipes as heat exchangers. The flat plate loop heat pipe (FPLHP) in the thermal management for lithium-ion ...

MHPA shows excellent performance in controlling the battery temperature within 40 °C. The effective thermal management can be done by incorporating heat pipe alone or by ...

This study presents experimental investigations on the optimal design and operating conditions of pulsating heat pipe (PHP) cooling systems for cylindrical 18650 cells in electric vehicles with a special top heating mode. The research explores the effects of various parameters, including the number of turns, working fluid, filling ratio, coolant temperature, and ...

Battery thermal management systems based on heat pipes can be classified into heat pipe only, heat pipe-air cooling, heat pipe-liquid cooling, and heat pipe-PCM. In the last few years, researchers developed a more complex solution by combining three cooling methods such as heap pipe-PCM-liquid cooling to get better thermal performance. Hybrid ...

Heating and cooling all a battery EV"s systems must be managed efficiently, as engine waste heat is no longer available (Courtesy of Webasto Group) As liquid-based cooling for EV batteries becomes the technology of choice, Peter ...

Flat heat pipe (FHP) is a relatively new type of battery thermal management technology, which can effectively maintain the temperature uniformity of the battery pack. We have constructed a resistance-based thermal model of the batteries considering the impact of the state of charge (SOC), battery temperature, and current on the battery heat generation. The ...

In this research, a multi-physics model considering the battery aging effect is developed for micro heat pipe battery thermal management system (MHP-BTMS). A novel multi-variables global optimization framework combining multi-physics modeling, deep learning and multi-objective optimization algorithms is established for optimizing the structural parameters of ...

Jouhara et al. (2020) placed a flat heat pipe under a battery module, and the system was cooled by water flow. The maximum cell temperature was maintained below 35°C and the temperature uniformity was ...

In general, the cooling systems for batteries can be classified into active and passive ways, which include forced air cooling (FAC) [6, 7], heat-pipe cooling [8], phase change material (PCM) cooling [[9], [10], [11]], liquid cooling [12, 13], and hybrid technologies [14, 15].Liquid cooling-based battery thermal management systems (BTMs) have emerged as the ...

Furthermore, due to the high viscosity of water, the water cooling system requires extra energy to circulate liquid. The importance of the heat pipe as a thermal superconductor for thermal management is gradually being realized. Liu carried out research on battery cooling with an ultra-thin micro heat pipe (168 mm × 10 mm × 1 mm). In their system, ...

Air cooling, Water cooling, Thermoelectric cooling, Heat Pipe cooling, Phase Change Materials (PCM) cooling, and hybrid cooling are methods of a thermal management system. A heat pipe-assisted Battery Thermal Management System (HP-BTMS) is a passive method to enhance the thermal performance of EVs by ensuring temperature uniformity for the ...

There are two cooling tube arrangements were designed, and it was found that the double-tube sandwich structure had better cooling effect than the single-tube structure. In order to analyze the effects of three parameters on the cooling efficiency of a liquid-cooled battery thermal management system, 16 models were

designed using L16 (43) orthogonal ...

Among the mentioned cooling systems, heat pipes are highly under the attention because of high heat transfer efficiency, low cost and maintenance, lightweight, and high lifetime. The heat pipe is a passive cooling system with a ...

Thermal management systems based on heat pipes can achieve excellent cooling performance in limited space and thus have been widely used for the temperature control of Li-ion batteries. In this paper, the thermal management ...

Research studies on phase change material cooling and direct liquid cooling for battery thermal management are comprehensively reviewed over the time period of 2018-2023. This review discusses ...

It is concluded that for all types of thermal management systems based on heat pipes, water spray cooling could achieve better cooling performance than forced air cooling and water bath cooling, while its energy consumption is obviously smaller than forced air cooling. For thermal management systems based on oscillating heat pipes, improved ...

Fig. 1 shows a picture of the sandwiched heat pipes cooling system (SHCS) for a prismatic LTO battery cell with their dimensions. In this design, the cell is sandwiched by six flat heat pipes. The detailed parameters of the battery cell and heat pipes are presented in Table. 1. The SHCS quickly absorb and transfer the heat to the cooling medium ...

A BTM using heat pipe and water spray is studied for Li-ion battery operating at 40 ... liquid cooling achieves more efficient heat dissipation and delivers an improved thermal control for Li-ion battery. Nonetheless, liquid-cooling system has to include more accessories (such as heat exchangers). This inevitably increases its weight and adds its level of complexity ...

Results indicate that the liquid-coupled heat pipe PCM cooling system takes a longer time to reach 44 °C compared to the air-coupled PCM cooling system. The heat pipe-assisted PCM effectively diminishes heat accumulation within the PCM by timely exporting the heat generated by the battery through the heat pipe.

In conclusion, the cooling method of heat pipe plus liquid cooling can effectively control the battery temperature, and the temperature homogeneity of the system can be well improved by adjusting ...

In this paper, a heat pipe and wet cooling combined BTM system is developed to handle the thermal surge of lithium-ion batteries during high rate operations. The proposed ...

Download Citation | On Sep 26, 2023, Zhuo Liu and others published Numerical Study of Combined Heat Pipe and Water Cooling for Battery Pack Cooling | Find, read and cite all the research you need ...

Heat pipe water cooling battery system

The heat pipe with a water cooling system recorded a maximum temperature of 21.5 °C with a 3C discharge rate, which was the highest among all the five cooling systems. In battery packs with heat pipes, the maximum temperature gradient was under 3 °C, and the temperature gradient at the end of the discharge was even less than 1.5 °C in liquid cooling ...

Zhao 21 developed a BTMS that combines heat pipes and wet cooling. The proposed BTMS relies on ultrathin heat pipes, which can effectively transfer heat from the battery side to the cooling end. The heat pipe BTMS also introduces a combination of natural convection, fan cooling, and wet cooling methods. The system can control the temperature ...