Research on Temperature Control System Mechanism of New Energy Lithium Battery for Automobile

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Abstract. At present, energy is in short supply all over the world, and the environmental pollution problem is becoming more and more serious. Therefore, in order to alleviate the double pressure of environmental pollution and energy, new energy vehicles have been invented, among which electric vehicles have been widely developed. Clean energy utilization is urgent and important, and it is becoming a trend to replace fuel vehicles with electric vehicles. Battery is an important component of electric vehicle, and its correlation with vehicle performance is rather high. Lithium-ion battery has the advantages of high energy density and low self-discharge rate, and has gradually become the preferred battery for electric vehicles. Sensors used in electric vehicles mainly include sensors for detecting battery temperature, sensors for monitoring motor temperature and temperature sensors for battery cooling system. The performance and service life of lithium-ion batteries are greatly affected by temperature. In order to control the temperature of lithium battery, this paper studies its thermal management system. This paper discusses the significance of temperature control of lithium battery in electric vehicle, and puts forward the optimization measures of operation mechanism of lithium battery thermal management system.

Keywords: New Energy; Lithium Battery; Temperature Control.

1. Introduction

With the progress and development of the times, pure electric vehicles gradually come into people's lives, and the application of sensors in electric vehicles makes them more intelligent. At present, the main power battery used in new energy vehicles in the world is lithium battery, so the performance of lithium battery determines the development of new energy vehicles. Lithium battery belongs to both new material industry and new energy industry, so the development of lithium battery is attributed to the development of these two industries [1]. Lithium battery has the advantages of extremely high heat release and transmission performance, good stability, stable voltage, and no great influence on the material itself when it is idle for a period of time. Among lithium battery materials, lithium phosphate battery is the main development object [2]. At present, there are nearly a hundred sensors installed in an ordinary family car, while there are more sensors in luxury cars. Sensors used in electric vehicles mainly include sensors for detecting battery temperature, sensors for monitoring motor temperature and temperature sensors for battery cooling system [3]. The performance and service life of lithium ion batteries are greatly affected by temperature. The safe operating temperature of lithium battery is 16-36℃. If the electric vehicle is in a high temperature environment, a large amount of heat will be generated in a short time when the battery is discharged, and it is difficult to dissipate heat, which will accumulate in the battery, and the lithium battery may be out of control or explode [4].

With the continuous growth of car ownership, the problems of environmental pollution and energy shortage have become increasingly prominent. As the "heart" of electric vehicles, batteries are responsible for providing kinetic energy for vehicles [5]. Lithium battery has the characteristics of no pollution and low cost, and is often used as the main energy source of electric vehicles [6]. As one of the three cores of electric vehicles, lithium battery's temperature changes directly affect the safety and performance of vehicles. The lithium battery thermal management system can be used for regulation, which can keep the stability of the lithium battery, thus enhancing the performance of the electric vehicle [7]. The temperature control of lithium battery in electric soft package for automobile has

become a key concern of technicians. This paper discusses the significance of temperature control of lithium battery in electric vehicle, and puts forward the optimization measures of operation mechanism of lithium battery thermal management system.

2. Significance of Temperature Control of Lithium Battery in Electric Vehicle

Lithium batteries were first used only in cardiac pacemakers, but with the development of science and technology, lithium batteries have become the mainstream. Lithium-ion battery has many advantages, such as high energy density, no memory effect, wide working temperature and fast charging. At present, most mobile electronic products use lithium batteries as power supply. The reason why lithium battery is used as the driving device of new energy vehicle is that it is a secondary battery formed by using two mutually embedded lithium ion compounds as the positive and negative electrodes of the power supply. When lithium ions are under the action of electric field, they will move according to certain rules, with positive charge moving to one side and negative charge moving to the other side, forming a potential difference, thus realizing the charging and discharging process. Compared with other battery types, lithium battery has great advantages in comprehensive performance such as cost and safety, but the problem of temperature control has not been well solved [8]. Due to the existence of battery impedance, the lithium battery will generate heat in the process of charging and discharging, and the electrochemical reaction will also generate heat, which makes it difficult for the lithium battery to always be at an appropriate temperature when working. Long-term high temperature of lithium battery will affect its performance, accelerate the aging process and shorten its service life. The basic structure of the power system of new energy vehicles is shown in Figure 1.



Figure 1. Power system of new energy vehicle

At present, most lithium batteries use lithium dioxide as a reactor. During the charging process, lithium dioxide will undergo a chemical reaction under the action of high voltage, releasing lithium ions. Under the action of electric field, lithium ions will be embedded into the negative charge side after a certain rule of movement, forming a carbon-lithium compound again. When discharging, the principle is roughly the same. Under high voltage, the compound at the negative electrode will undergo chemical reaction to produce lithium ions. Under the action of electric field, lithium ions move according to certain rules, and some of them move to the positive electrode to form new carbon-lithium compounds. The role of lithium battery thermal management system is to help the lithium battery dissipate heat and heat, and to keep the temperature consistency of the battery pack. At the same time, the temperature difference of individual batteries in battery packs of electric vehicles has a great influence. Inconsistent temperatures will lead to overcharge or overdischarge of individual

batteries, and the aging process among battery packs will be inconsistent, which will shorten the life span and reduce the safety and performance of lithium batteries.

3. Application of Power Battery in Electric Vehicle

The emergence of new energy vehicles is the combination of zero pollution emission and renewable energy. Through the electronic control system of new energy vehicles, the motor and battery can be well matched. As the core part of the new energy vehicle, the power lithium battery should be considered comprehensively in terms of safety, cost, performance, life and so on in order to build an excellent new energy vehicle. The focus of new energy vehicle development is the government. As an advocate, it is essential for the government to build a platform for the development of new energy vehicles. However, the new energy vehicle enterprises determine the innovation of new energy vehicles, and they are the protagonists of the development of new energy vehicles. No matter whether they are manufacturers, operators or financial enterprises of new energy vehicles, they can obtain long-term or short-term benefits in the development of new energy vehicles. Figure 2 shows the testing process of power lithium battery of new energy vehicle.

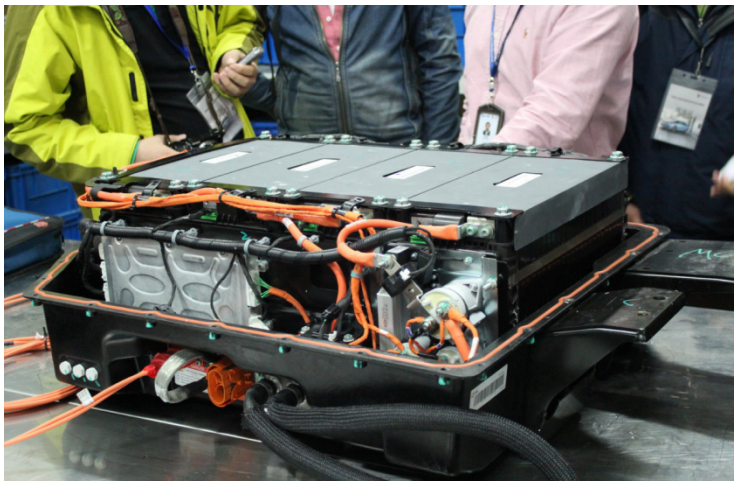


Figure 2. Test process of power lithium battery of new energy vehicle

Nowadays, power lithium batteries are most widely used in mobile communication and portable electrical appliances. By considering the advantages of lithium batteries, the new energy automobile industry continues to develop power lithium batteries that can achieve larger capacity. This will have an important impact on the development of new energy vehicles in the future. In the future, lithium batteries will not only be used in automobiles and household appliances, but also in aerospace, military and artificial satellites. As for power lithium batteries, higher technical content will be required in the future, and it is likely that lead-carbon and lead-acid batteries will be combined to further improve the performance-price ratio of power lithium batteries, so as to truly meet the requirement of long-term power supply [9]. China will also help the development of new energy and environmental protection by developing new energy vehicles and power lithium batteries. Battery balance management is conducive to maintaining the consistency level of the battery cells in the power battery pack, reducing or avoiding the overcharge or overdischarge caused by the inconsistency between the cells in the charging and discharging process, improving the cruising range and operation safety of electric vehicles, prolonging the cycle life of battery packs, and reducing the operation and maintenance costs of electric vehicles.

4. Temperature Control Strategy of Electric Vehicle Battery

Battery management system is an important part of electric vehicle, and the optimal management of electric vehicle battery is the guarantee to ensure the good operation of electric vehicle power

system. Lithium battery thermal management system refers to the electronic management system that can control and adjust the internal temperature of power lithium battery in electric vehicle. According to the difference of heat conducting medium and structure, it can be divided into air cooling, liquid cooling, direct cooling and phase change material cooling. In the process of using lithium battery as the driving force of new energy vehicles, heat generation is the basic, and heat conduction is the core. Everyone knows that when conducting heat, it is necessary not only to have high requirements for heat transfer equipment, but also to protect it well, because energy will not be produced or disappear for nothing, it will be shown in another form, and it will not transmit 100% heat to the required equipment. The performance of lithium battery can only play its maximum role in a suitable working temperature range. In order to improve the power, economy and safety of electric vehicles, a thermal management system is installed to regulate the temperature of lithium batteries.

The selected temperature sensor of the system requires high integration, strong anti-interference ability, and can directly read the measured temperature. The circuit is simple and easy to realize, and it can display the ambient temperature of the battery in real time. It can set the alarm limit value and temperature threshold value of the electric vehicle respectively, and start the cooling system when the temperature exceeds the threshold value. The MCU and the temperature sensor together form an analog acquisition system to complete data acquisition and conversion. Digital display of temperature with liquid crystal display. The battery temperature control system is shown in Figure 3.

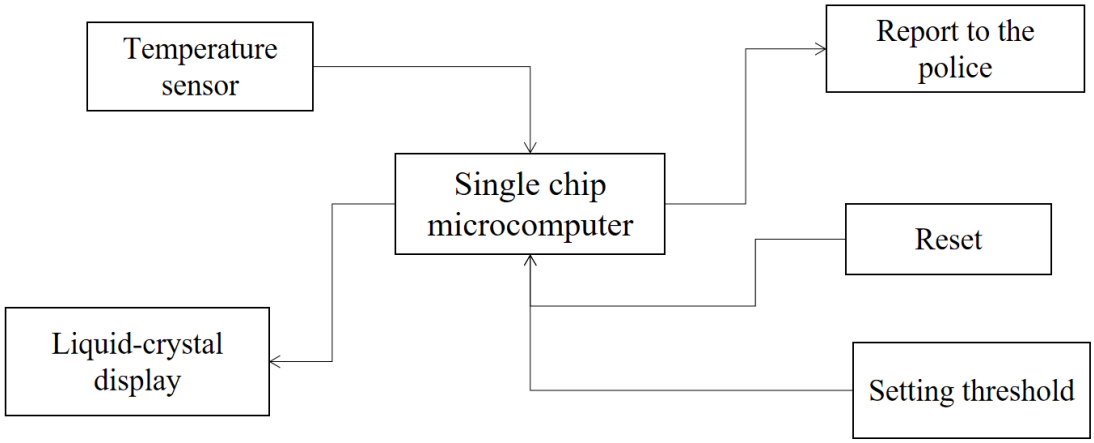


Figure 3. Battery temperature control system

Because of the difference in thermal conductivity of different parts, the surface temperature can't accurately indicate the true temperature of the battery, and only the core temperature can correctly indicate the state of the battery. In the electrical system, once the insulation protection between the high-voltage circuit and the chassis is damaged, the heat accumulation effect will occur, causing fire and affecting the safety of electrical equipment and vehicle operation. Therefore, it is necessary to test the insulation between the high-voltage circuit and the chassis irregularly. Due to the coupling characteristics of electrochemical reaction and heat in the battery, the factors that affect the temperature of the battery increase significantly, and the thermal conductivity, specific heat capacity and internal resistance are interrelated. When considering controlling the temperature of the battery, it is necessary to consider all aspects. In the process of studying the temperature control of a single battery, it is found that there are temperature gradients and local thermal effects in the battery, which greatly affect the temperature of the battery and need to be paid attention by relevant personnel.

5. Conclusion

With the progress and development of the times, pure electric vehicles gradually come into people's lives, and the application of sensors in electric vehicles makes them more intelligent. This paper discusses the significance of temperature control of lithium battery in electric vehicle, and puts forward the optimization measures of operation mechanism of lithium battery thermal management

system. Sensors used in electric vehicles mainly include sensors for detecting battery temperature, sensors for monitoring motor temperature and temperature sensors for battery cooling system. The performance and service life of lithium ion batteries are greatly affected by temperature. Lithium battery has the characteristics of no pollution and low cost, and is often used as the main energy source of electric vehicles. In order to prolong the life of lithium batteries, enhance the performance of electric vehicles and protect people's safety, this paper discusses how to control the temperature of lithium batteries. The thermal management system can control the temperature of the battery according to the ambient temperature of the battery, so that the battery can be kept in the best state and the overall temperature difference can be controlled. The lithium battery management system realizes the real-time monitoring of the state of the lithium battery pack, the communication and transmission of data information between the main controller and the sub-controllers, and the effective control of the execution actions, etc., which improves the safety of the battery pack and prolongs its service life.

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