International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 5 Issue 6 ǁ June. 2017 ǁ PP. 37-41

Research on Structural Design of New Type Buttoned Lithium Battery

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ABSTRACT : The new button lithium battery with two sealed structure and elastic compression device, can achieve a good battery test; manual battery seal can be achieved without the use of button battery sealing machine, simplify the assembly process, to avoid the sealing machine on the glove box Impact; made the battery easy to dismantle, you can repeatedly use more than a hundred times to improve the utilization of resources.

Keywords: Button type lithium battery, Battery package, Shell material, sealing machine

I. INTRODUCTION

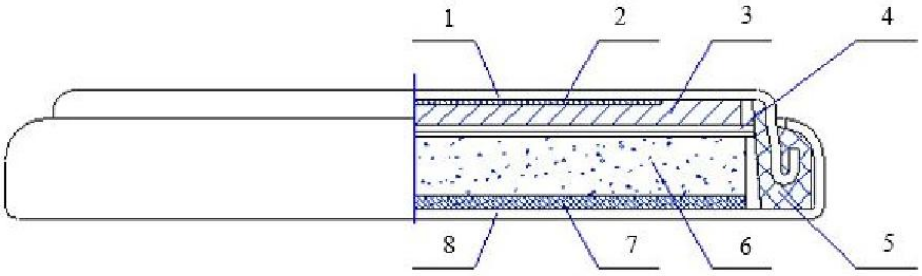
Lithium-ion battery is one of the most important energy storage and conversion devices, with high energy and high power density and long cycle life advantages, in portable electronic devices, communications tools, fixed energy storage systems and electric vehicles and other fields are large Scale application. [1] But the main research, whether it is lithium cathode, anode active material synthesis and modification of the electrolyte or the optimization of the test are required to first assembled into a button cell, and then a variety of tests.

These button cells used in the laboratory share a common drawback: preparation time-consuming; poor experimental repeatability; not easy to dismantle the test after the electrode; materials are not easy to recover, easily lead to environmental pollution and waste of resources. In order to solve this problem, we designed a lithium-ion battery materials for research and testing of a new structure of the button cell. This button battery, easy to install and dismantling, easy to recover and study the test after the material can be repeated several times to use, reduce pollution and improve resource utilization.

1. Design and Analysis of a Novel Button Lithium Battery

With the rapid development of lithium-ion battery, people on the battery performance and quality of a higher demand for lithium-ion battery research has also been widespread concern, which reminds people to more quickly verify their own ideas. To achieve the purpose of the study, which requires the design of the button lithium battery must be easy to install and dismantling.

Taking into account the lithium-ion battery research needs to consume a large number of button-type battery shell for the assembly of batteries for testing, but also faced with how to deal with a large number of waste battery recycling problems, and even some people directly into the garbage bin, Lithium-ion battery research itself will cause some harm to the social environment. This requires the design of the button lithium battery can be used repeatedly to improve resource utilization and reduce pollution.Common button lithium battery mainly by the anode, cathode, diaphragm, electrolyte, cathode shell, negative cover, sealed apron and other components, [2] the structure as shown below:



1, negative cover; 2, gasket; 3, negative lithium; 4, diaphragm
5, sealed apron; 6, cathode material; 7, aluminum foil; 8, positive shell
Fig.1. common button cell structure shown in the diagram

The positive and negative electrodes of the lithium battery are composed of active substances with high electrochemical activity and the current collector. The positive and negative electrodes of the rechargeable lithium battery directly determine the performance and service life of the battery and the service life. Specific

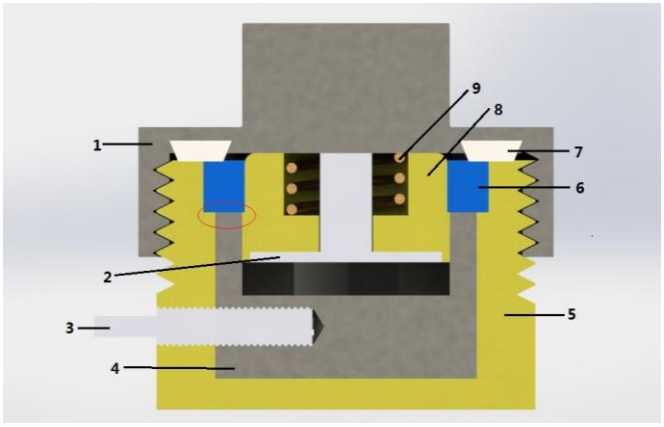
capacity. Electrolyte is divided into liquid electrolyte and solid electrolyte, button lithium battery is commonly used in liquid electrolyte, the battery charge is through the transmission of electrolyte in the battery can be transferred between the positive and negative, thus forming the battery charge and discharge. Diaphragm in the button lithium battery has two main roles: (1) as an insulating layer, to prevent the battery inside and outside the positive and negative contact caused by internal short-circuit; (2) as a selective permeability membrane, to prevent the larger molecules through , Allowing only charged ions in smaller electrolytes to pass through. This is conducive to improving the positive and negative electrode near the concentration difference, enhance the ability of diffusion of ions, thereby enhancing the battery charge and discharge efficiency. In addition the quality of the battery separator will also affect the battery resistance, capacity, life and safety performance. Generally, high strength thinned polyolefin porous membranes are used. [3] Lithium-ion battery failure modes are: capacity attenuation, discouraging or leakage, fluid loss, thermal runaway and so on. Where the capacity attenuation is the most common failure mode, resulting in this failure a lot of factors: in the electrode, repeated charge and discharge to reduce the active surface area of the electrode, the current density increases, the polarization increases; in the electrolyte solution, the electrolyte or conductive Salt decomposition leads to a decrease in its conductivity, resulting in interfacial passivation. In addition, the diaphragm block or damage, the battery short-circuit, etc. will shorten the battery life. [4] In order to facilitate the study of the reasons for the failure of lithium batteries, the need to destroy the internal structure of the battery without breaking the battery shell, remove the required research materials. And to prevent the impact of external moisture, button cell sealing machine to be installed in the glove box, long use, severe impact may damage the glove box. Therefore, it is necessary to abandon the common button cell by mechanical compression sealing way, need to find a simple, good sealing, easy to dismantle and high efficiency detection button battery assembly. In the button cell production process, the seal is an important factor in determining the quality of the battery, button cell sealing will directly affect the battery discharge performance, derogatory performance and battery consistency. Be sure to ensure that the battery is good sealing, while controlling the button cell sealing contact in the process of the size of the amount of rebound to ensure that the same compression force. [5]

II. BUTTON LITHIUM BATTERY MATERIAL SELECTION

Lithium battery shell (cathode shell, negative cover) divided into three types: plastic shell, aluminum shell, steel shell. Button type lithium battery shell generally use steel shell. The buckle battery case is not absolutely stable during the charge and discharge test. The stability of the shell will affect the actual test material charging curve and the first efficiency, should be evaluated on the shell material. Some manufacturers of battery shell (especially the positive) in the charging process of oxidation occurs, will produce a certain capacity, resulting in the material charge capacity is too high (even more than the theoretical value) and charge and discharge efficiency is low; in the discharge process , The impact of the battery shell on the capacity is not significant, but when the quality of the active material is small, the effect can not be ignored. Material performance test abnormalities, may be the problem of the material itself, or pole piece preparation problems, and the battery shell instability may also be the problem. According to other people's research experience that the shell is generally not for the steel. Compared to the survey found that the commonly used materials in the 430 non-induced steel compared to 304 stainless steel is not only low prices, and higher conductivity. So the final positive and negative shell are selected 430 non-induced steel. [6] In order to improve the accuracy of the electrode material performance test and reduce the impact of the battery shell on the performance test, in the assembly of button batteries should not use the spring, the gasket should be made of aluminum material. So choose to abandon the structure of the spring, the use of non-contact with the battery inside the spring instead of the function of the spring, while the gasket selected as aluminum material to reduce the material on the battery performance. Common button cell sealed aprons generally use nylon material, sealed apron not only to seal well to prevent electrolyte leakage, and was placed in the cathode shell and the negative shell between the insulation. Taking into account the electrolyte bottles are mostly polytetrafluoroethylene materials, nylon and PTFE in contrast and found that nylon heat resistance, corrosion resistance, wear resistance are not as good as PTFE but tensile strength far Much larger than polytetrafluoroethylene. Taking into account the advantages of the two materials, the final choice of polytetrafluoroethylene placed in the positive and negative between the insulation play a role, while the use of nylon greater tensile strength of this feature as a seal apron.

III. STRUCTURAL DESIGN OF BUTTON LITHIUM BATTERY

The figure of the button lithium battery is in accordance with the structural parameters of LIR2O16 design, the internal diameter of 20mm, thickness of 1.6mm. The central rod is made of aluminum material, the base under the cover and the sealing sleeve of the material using polytetrafluoroethylene, sealed apron with nylon material. According to the foregoing analysis, it can be seen that the material in contact with the inside of the battery can effectively prevent the electrochemical performance of the battery material.



1, upper cover 2, center rod 3, conductive rod 4, lower base
5, the base under the sleeve 6, the jacket 7, sealed apron 8, the central rod 9, spring
Fig.2. Schematic diagram of the structure of a new type of lithium battery

This new type of button lithium battery, the outermost thread in the form of fastening, assembly can use torque wrench, when the torque reaches 5 N • m to meet the requirements. The interior design has two layers of sealing structure. The first layer is by the cover and the lower base of the pressure between the sleeve will be sealed plastic ring deformation, so as to achieve the sealing effect, its main role is to avoid the outside air into. The second layer is the sealing sleeve, respectively, with the base under the base and the center of the sleeve in close contact to form a sealed structure, which is completely sealed inside the battery.

The cavity is also designed by means of a rounded corner at the contact of the gland and the center rod, as shown in Fig.3, which prevents the internal pressure of the battery due to the excess of the electrolyte and the gas generated by the reaction The consistency of the battery is reduced. And the new button-type lithium battery assembly is simple, do not need special tools and equipment, the basic operation can be free. Each part is independent of each other and can be replaced individually.

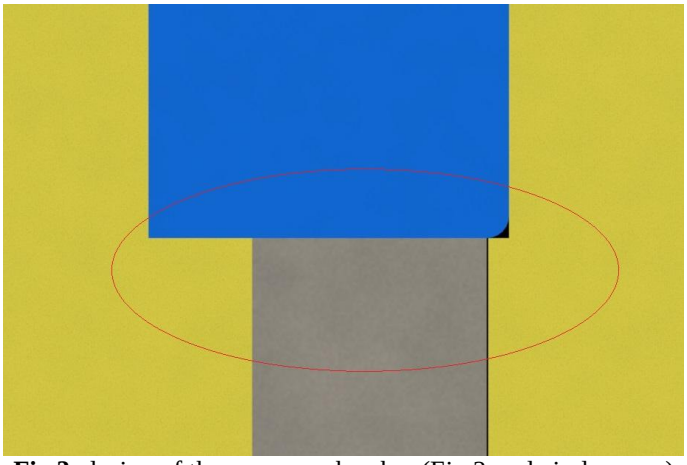


Fig.3. design of the pressure chamber (Fig.2. red circle zoom)

IV. EXPERIMENT AND CONCLUSION OF BUTTON LITHIUM BATTERY

In the glove box filled with high purity nitrogen, the pole piece made of NCM as the active material was used as the positive electrode, and the lithium plate was used as the negative electrode, and the Celgard 2400 film (manufactured by USA) was used as the separator. Of the button-type battery device assembled into a battery, the common button battery pack assembly battery number A_1, A_2, their own design device to prepare the battery number B_1, B_2. Will be prepared by the battery, with a blue battery test system to 0.1C magnification charge and discharge, the first charge and discharge curve shown in Fig.4. Which is red for the common button cell shell assembly battery charge and discharge curve, blue for the design of the device prepared by the battery charge and discharge curve. The specific capacity of the two groups is 193.93 mAh / g, 193.96 mAh / g, 194.52 mAh / g and 194.57 mAh / g, respectively. The error is very small, which satisfies the requirement and the error may be less.

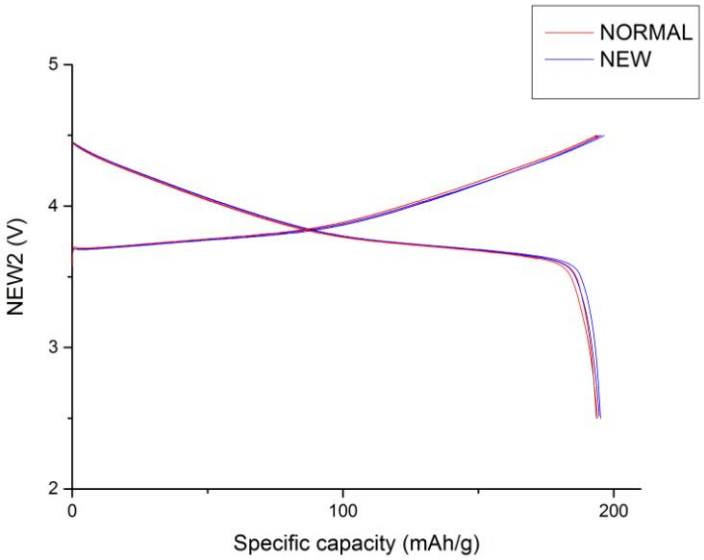


Fig.4. prepared by the battery 0.1 C first charge and discharge curve

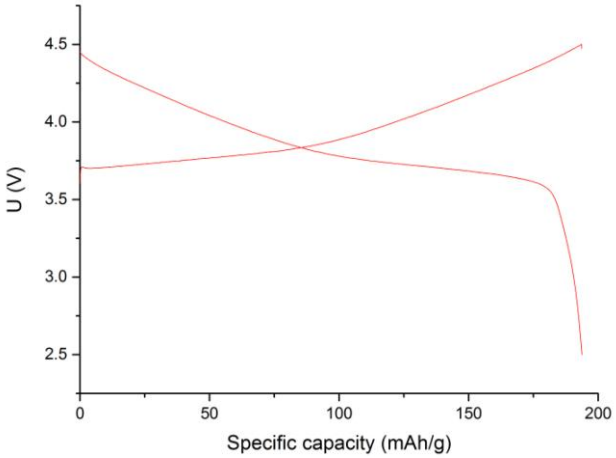


Fig.5. 100 times the preparation of the battery 0.1 C first charge and discharge curve

The laboratory usually has a lot of testing of the material, the need to re-use the design of the button-type battery equipment. When the device is used for the first 100 times, the same charge and discharge curve is tested for 0.1 C in the same condition as the first assembled battery. The results are shown in Fig. Material specific capacity of 193.74mAh / g, with a small difference before, you can continue to use, while the device can prove that at least 100 times.

V. CONCLUSION

A new type of button lithium battery is designed by using two layers of sealing and elastic compression structure. With the traditional preparation methods can use this new type of button type lithium battery prepared by the battery to achieve the same effect, and it is easy to disassemble and install in the laboratory on the electrode and the electrolyte of more use. After disassembly, the utility model can be reused more than one hundred times, and the utilization ratio of the resource is improved, and the environmental pollution of the button battery directly discarded is reduced.

ACKNOWLEDGEMENT

This project is sponsored by Shanghai University of Engineering Science Innovation Fund for Graduate Students (No.E3-0903-17-01267)

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