

CN110739487A Micro-buckle battery and preparation method thereof

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Micro button battery and preparation method thereof

Technical field

The invention belongs to the technical field of batteries, and particularly relates to a micro button battery and a preparation method thereof.

Background technique

Lithium-ion batteries are widely used in mobile electronic products because of their high energy density, high voltage, small size, and environmental protection. The safety of lithium-ion batteries has always been the focus of people's attention during use. The built-in micro button battery for Bluetooth and health and medical electronic equipment used for personal use generally has insufficient safety performance. Metal micro button batteries often swell when the internal pressure of the battery is too large, crack and leak, and in severe cases Burst.

At present, the safety structure design of the existing metal micro button battery is just a safety hole punched on the cover plate. When the internal pressure reaches a certain level, it is opened, but the moisture in the air also enters the battery at the same time, causing the battery to fail immediately. If the battery is not replaced in time, the leakage of the safety opening will corrode and damage the electrical equipment. At the same time, the metal micro button battery on the market, due to the metal case design, has a low weight energy density and increases the weight of electronic equipment. Meet the requirements of high energy density of micro button batteries for electronic equipment such as built-in headphones.

Existing soft-pack lithium-ion batteries are mostly packed with aluminum plastic film. The packaging material is stretched and deformed through pre-die molding. After the aluminum plastic film is stamped and formed, if the stamping mold is improperly designed, it will become thinner due to the stress on the corner. It is also the most serious. Excessive stretching of the aluminum layer at the corners will cause damage to the corners, making the battery a safety risk.

CN209266448U discloses a new type of aluminum-plastic film button battery, including an aluminum-plastic film casing and an electric core; the aluminum-plastic film casing is divided into an upper and lower hollow shell structure, and the upper and lower aluminum-plastic film casings are folded to form a cell cavity; The edges of the two layers of aluminum-plastic film attached to the aluminum-plastic film shell are sealed by hot-melt; there is a zigzag structure on the outer ring of the aluminum-plastic film packaging area. The core is formed by the positive electrode sheet, the separator and the negative electrode sheet in a laminated manner. The uncoated area at the end of the electrode sheet is connected to the electrode tabs; the electrode tabs are led out along the gap between the upper and lower layers of the aluminum plastic film casing, and the upper and lower surfaces of the electrode tabs are attached to Ear gel. However, the aluminum-plastic film button battery obtained by the method is easily stretched and cracked during use, causing the battery to leak or be damaged.

Therefore, there is a need in the art to develop a new type of micro button battery, which has excellent volume energy density and safety performance, has a simple preparation process, and can be industrially produced.

Summary of the invention

In view of the shortcomings of the prior art, an object of the present invention is to provide a micro button battery and a method for preparing the same. The micro button battery of the invention can not only make full use of the effective space in the battery case, improve the volume energy density of the battery, but also prevent the battery from stretching and cracking during the molding or using process, causing the battery to leak or break.

To achieve the above object, the present invention adopts the following technical solutions:

One of the objectives of the present invention is to provide a micro-button battery, which comprises a soft-film casing and a wound-type structured battery cell placed in the soft-film casing. Upper and lower shells of the pit;

An arc-shaped external chamfer is formed between the sidewalls of the pits in the upper and lower shells and the top of the pits, and the edges of the pit openings in the upper and lower shells form internal chamfers.

The present invention adopts a light-weight soft-encapsulated film package as the shell design. Because the capacity of the micro-button battery is small, even in the case of failure, the gas production is not large, and it can be digested by the expansion of the soft-encapsulated film, so as not to crack and leak. Or burst; even when the internal pressure is too high when it is abused, it just rushes through the sealed area without harming the human body.

The invention adopts a winding-type battery cell, and the flexible envelope is set as a concave structure, which can make full use of the effective space in the battery case, improve the volume energy density of the battery, and further improve the design of the lightweight flexible envelope. The energy density of the battery.

The battery core of the present invention adopts a winding structure, which has the advantages of tightly bonded interfaces between the positive and negative layers. After the battery is completed, the battery's positive and negative interfaces can be tightly combined without external pressure to ensure the electrochemical performance of the battery. . The winding cell structure is more conducive to automated production and enhances high production efficiency. However, in the prior art, a laminated structure using a battery cell has low production efficiency due to the requirements for the alignment of the positive and negative electrodes and the requirement that the negative electrode surrounds the positive electrode. In addition, the laminated cell requires external pressure to ensure tight bonding between the positive and negative electrodes, while the wound core is not required.

Preferably, a first outer chamfer having a radius $R1$ is formed between the sidewall of the pit and the top layer in the upper shell.

Preferably, a second outer chamfer having a radius $R3$ is formed between the side wall of the pit and the top layer in the lower shell.

Preferably, the edge of the recessed portion in the upper shell forms a first inner chamfer with a radius of $R2$.

Preferably, a second inner chamfer having a radius of $R4$ is formed at the edge of the recessed portion in the lower shell.

Preferably, an edge of the upper shell and the lower shell which are bonded together is provided with a circle of packaging area surrounding the battery cell.

Preferably, the soft film shell is an aluminum plastic film shell, which comprises a nylon layer, a metal layer and a PP layer in order from the outside to the inside.

The nylon layer, the metal layer, and the PP layer included in this order from the outside to the inside are: the side near the battery core is inside, that is, the PP layer is closest to the battery core, and the nylon layer is farthest from the battery core.

The main functions of each layer composed of the soft film described in the present invention: a nylon layer, which can effectively prevent the penetration of air, especially oxygen, and maintain the internal environment of the cell, and at the same time, ensure that the packaging aluminum foil has a good deformation ability; aluminum (or steel) The metal layer can effectively prevent the penetration of moisture in the air and maintain the internal environment of the battery. It has a certain thickness and strength to prevent damage to the battery from the outside. The PP layer will not be dissolved and swelled by organic solvents in the battery. The most direct packaging protection of the internal environment of the battery cell is insulation, which effectively prevents the internal electrolyte, etc. from contacting the metal layer, and prevents the metal from being corroded.

Preferably, the metal layer is an aluminum layer or a steel layer.

Preferably, the packaging area is obtained by hot-melt PP layer.

Preferably, the thickness of the flexible envelope is 86-150 μm , for example, 88 μm , 90 μm , 95 μm , 100 μm , 105 μm , 110 μm , 113 μm , 120 μm , 125 μm , 130 μm , 135 μm , or 140 μm .

Preferably, the battery core is formed by winding a positive electrode sheet, a separator, and a negative electrode sheet.

Preferably, uncoated metal materials are left at the ends of the positive electrode sheet and the negative electrode sheet, respectively, and are ultrasonically welded with the aluminum strip and the nickel strip to which the sealant has been heat-sealed, respectively, as the positive electrode ear and the negative electrode ear.

Preferably, the positive and negative ears are led out along the gaps between the upper shell and the lower shell of the flexible envelope, and the two surfaces of the positive and negative ears are sealed with a sealant, respectively. The joint of the envelope is sealed.

Preferably, the pit depth of the upper shell is 2-10 mm, for example, 2.5 mm, 3 mm, 3.5 mm, 4 mm, 4.5 mm, 5 mm, 5.5 mm, 6 mm, 6.5 mm, 7 mm, 7.5 mm, 8 mm, 8.5 mm, 9 mm or 9.5 mm.

Preferably, the depth of the pits of the lower shell and the lower shell is 0.1 to 5 mm, such as 0.5 mm, 0.8 mm, 1 mm, 1.5 mm, 1.8 mm, 2 mm, 2.5 mm, 3 mm, 3.5 mm, 4 mm, or 4.5 mm.

Preferably, the maximum diameter of the pits of the upper shell is 4-12 mm, for example, 5 mm, 6 mm, 7 mm, 8 mm, 9 mm, 10 mm, or 11 mm.

Preferably, the maximum diameter of the pits of the lower shell is 4-12 mm, for example, 5 mm, 6 mm, 7 mm, 8 mm, 9 mm, 10 mm, or 11 mm.

Preferably, in the upper casing, the R1 is calculated by the following formula: $R1 = (\text{depth of the upper casing pit} - 0.5\text{mm}) / 2$.

Preferably, in the lower shell, the R3 is calculated by the following formula: $R3 = (\text{depth of the lower shell pit} - 0.5\text{mm}) / 2$.

Preferably, the depth of the pits of the upper shell or the lower shell is 5 to 10 mm (for example, 5.5 mm, 6 mm, 6.5 mm, 7 mm, 7.5 mm, 8 mm, 8.5 mm, 9 mm, or 9.5 mm, etc.). The maximum diameter is 4-12 mm (for example, 5 mm, 6 mm, 7 mm, 8 mm, 9 mm, 10 mm, or 11 mm, etc.), and the R2 and R4 are each independently 0.8 mm-1.2 mm (for example, 0.85 mm, 0.9 mm, 0.95 mm, 1 mm), 1.05 mm, 1.1 mm, or 1.15 mm, etc.), preferably $R2 = R4$.

Preferably, the pit depth of the upper casing and the lower casing is independently selected from: $0.1\text{mm} \leq \text{pit depth} < 5\text{mm}$ (for example, 0.2 mm, 0.5 mm, 1 mm, 1.5 mm, 2 mm, 2.5 mm, 2.8 mm), 3.0 mm, 3.2 mm, 3.5 mm, 4.0 mm, 4.2 mm, 4.5 mm, or 4.8 mm, etc.), the maximum diameter of the pit is 4-12 mm (for example, 5 mm, 6 mm, 7 mm, 8 mm, 9 mm, 10 mm, or 11 mm, etc.) The R2 and R4 are each independently 0.6 to 0.7 mm (for example, 0.61 mm, 0.62 mm, 0.64 mm, 0.65 mm, 0.66 mm, 0.68 mm, or 0.69 mm, etc.), and preferably $R2 = R4$.

The soft film according to the present invention uses a specially designed stamping mold to optimize the calculation of the soft film's lead angle (outside chamfer and inside chamfer), so that it can be stretched uniformly during the preparation process, which can effectively solve the problem of battery forming. Or stretch cracking during use, causing battery leakage or damage.

Another object of the present invention is to provide a method for preparing a micro button battery according to one of the objectives, the method includes the following steps:

(1) Punching the soft envelope to obtain an upper shell and a lower shell with a pit, respectively, and combining the upper shell and the lower shell with a pit to obtain a soft shell;

(2)The battery cell with a winding structure is put into the soft film casing, the positive and negative electrode ears are led out of the casing, and then packaged and baked to obtain a micro button battery.

The present invention does not specifically limit the packaging process, and those skilled in the art may select according to actual needs. In the packaging process of the present invention, the head uses a double semi-circular metal mold with good thermal conductivity on the upper and lower layers. Taking an aluminum-plastic film thickness of 88 μm as an example, the packaging temperature is 185 degrees, the packaging time is 3S, and the pressure is 0.3 to 0.4 MPa.

Preferably, the punching in step (1) is punching using a concave-convex die.

Preferably, the periphery of the surface roughness of the concave-convex mold is 0.2 μm , and the roughness of the template plane is 0.4 μm .

Preferably, in the process of punching, the depth of the pit is $\leq 5\text{mm}$ (for example, 0.1mm, 0.5mm, 1mm, 1.5mm, 1.8mm, 2.0mm, 2.5mm, 3.0mm, 3.5mm, 4.0mm or 4.5mm, etc.), The gap size of the concave-convex die is 0.23 to 0.26 mm (for example, 0.235 mm, 0.24 mm, 0.245 mm, 0.25 mm, 0.255 mm, etc.).

Preferably, during the punching process, the depth of the pit is 5 to 10 mm (for example, 5.5 mm, 6 mm, 6.5 mm, 7 mm, 7.5 mm, 8 mm, 8.5 mm, 9 mm, or 9.5 mm, etc.), and $113 \mu\text{m} \leq$ soft envelope Thickness $\leq 150 \mu\text{m}$ (for example, 115 μm , 120 μm , 125 μm , 130 μm , 132 μm , 135 μm , 140 μm , 145 μm , or 148 μm , etc.), the maximum diameter of the pit is 4 to 12 mm (for example, 5 mm, 6 mm, 7 mm, 8 mm, 9 mm, 10 mm, or 10 mm 11 mm, etc.), and the gap size of the concave-convex mold is 0.33 to 0.38 mm (for example, 0.34 mm, 0.35 mm, 0.36 mm, 0.37 mm, etc.).

Preferably, during the punching process, the depth of the pit is 5 to 10 mm (for example, 5.5 mm, 6 mm, 6.5 mm, 7 mm, 7.5 mm, 8 mm, 8.5 mm, 9 mm, or 9.5 mm, etc.), and $86 \mu\text{m} \leq$ soft envelope Thickness $\leq 113 \mu\text{m}$ (for example, 88 μm , 90 μm , 92 μm , 95 μm , 98 μm , 100 μm , 105 μm , 110 μm , or 112 μm , etc.), the maximum diameter of the pit is 4 to 12 mm (for example, 5 mm, 6 mm, 7 mm, 8 mm, 9 mm, 10 mm, or 10 mm 11 mm, etc.), and the gap size of the concave-convex mold is 0.28 to 0.32 mm (for example, 0.29 mm, 0.30 mm, 0.31 mm, etc.).

In the process of punching, the present invention selects the gap size of the concave-convex die according to the thickness of the soft film, the depth of the pit and the diameter of the pit, thereby solving the problem that the soft film is easy to crack during the punching process. The deeper the aluminum film is, the larger the expansion and contraction deformation is. In order to reduce the deformation force, the gap of the concave-convex mold becomes larger.

Preferably, the method for preparing a cell with a wound structure as described in step (2) includes: winding a positive electrode sheet, a separator (polyolefin porous membrane) and a negative electrode sheet to obtain a cell with a wound structure.

Preferably, the baking in step (2) is vacuum baking.

Preferably, after the baking in step (2), the method further includes a process of standing, forming, fixture shaping and second sealing.

Compared with the prior art, the present invention has the following beneficial effects:

(1)In the present invention, by using a soft package film as the outer packaging shell of the battery, the safety performance of this soft-packed micro-button battery is improved. When the internal abnormal gas production situation occurs, the internal pressure increases without bursting, which improves the battery safety performance; At the same time, optimize the calculation of the soft film envelope angle (outside chamfer and inside chamfer), which can effectively solve the problem of stretching and cracking of the battery during molding or use, causing battery leakage or damage, and further improving the safety performance of the battery;

(2)The battery structure design of the present invention can make full use of the effective space in the battery case, and increase the volume energy density and weight energy density of the battery. The battery of the same size is more lightweight, the power is more sufficient, and it is more suitable for miniaturization of electrical appliances. Demand.

BRIEF DESCRIPTION OF THE DRAWINGS

1 and 2 are schematic structural diagrams of a micro button battery according to a specific embodiment of the present invention;

FIG. 3 and FIG. 4 are schematic diagrams of the internal structure obtained by removing the upper case and the lower case in the micro button battery according to the specific embodiment of the present invention.

Among them, 1-upper case, 2-lower case, 3-cell, 4-positive ear, 5-negative ear, 6-sealant, 7-first outer chamfer, 8-first inner chamfer, 9-second outer chamfer, 10-second inner chamfer, 11-package area.

detailed description

To facilitate understanding of the present invention, the present invention is exemplified below. Those skilled in the art should understand that the embodiments are merely to help understand the present invention and should not be regarded as a specific limitation to the present invention.

The soft-pack lithium-ion micro button batteries described in the embodiments of the present invention are all prepared by the following methods:

(1)The positive electrode sheet, the separator (polyolefin porous film), and the negative electrode sheet are sequentially wound in order to obtain the battery core 3, and the ends of the positive electrode sheet and the negative electrode sheet are left with uncoated metal materials, respectively, and the sealant has been heat-sealed. The aluminum and nickel strips are ultrasonically welded and used as the positive and negative lugs 4 and 5 respectively.

(2)The soft film (aluminum plastic film) is subjected to a stamping process (punching through a molding punching mold) to form a micro button battery case (to obtain an upper shell with a first outer chamfer and a first inner chamfer, and The lower outer chamfer and the second inner chamfered lower case), after the battery is installed, the package temperature is 185 degrees, the package time is 3S, and the pressure is 0.4MPa, forming a circle of packaging area 11 surrounding the battery, the positive ear 4 and negative ear 5 are drawn along the gap between the upper and lower shells of the flexible envelope. The positive and negative ears 4 and 5 are covered with sealant 6 on both surfaces. Sealed at the joint of the soft envelope;

(3)Then perform vacuum baking at 120 ° C, and evaporate the water in the battery cell 3 through the unpacked open air bag reserved for the battery. When the water content of the battery cell 3 is less than 100ppm, fill the glove box with electrolyte, and leave it at room temperature for 32h. , After chemical conversion, fixture shaping, secondary sealing, and capacity testing, the preparation of the micro button battery is completed.

Example 1

This embodiment provides a micro button battery, whose structure diagrams are shown in FIG. 1 to FIG. 4. The micro button battery includes a soft film case and a wound structure cell 3 placed in the soft film case. The soft film shell is divided into an upper shell 1 and a lower shell 2 with pits. The upper shell 1 and the lower shell 2 are combined to form a hollow cavity, and the battery core 3 is placed in the cavity; the upper layer A first outer chamfer 7 having a radius R1 is formed between the side wall of the pit and the top layer of the pit in the shell 1; a first inner chamfer 8 having a radius R2 is formed in the edge of the pit opening in the upper shell 1; A second outer chamfer 9 having a radius of R3 is formed between the sidewall of the pit in the lower shell 2 and the top layer; a second inner chamfer 10 having a radius of R4 is formed at the edge of the recess in the lower shell 2; An edge of the upper casing 1 and the lower casing 2 is provided with a circle of encapsulation area 11 surrounding the battery cell; the battery cell is formed by winding a positive electrode sheet, a separator and a negative electrode sheet; the positive electrode sheet and the negative electrode sheet Uncoated metal materials are left at the ends of the aluminum alloy, respectively, and are ultrasonically welded to the aluminum and nickel strips that have been heat-sealed with the sealant. 4 and negative electrode ear 5; the positive electrode ear 4 and the negative electrode ear 5 are drawn along the gap between the upper casing and the lower casing of the soft film shell, and the two surfaces of the positive electrode ear 4 and the negative electrode ear 5 are sealed with a sealant 6, respectively. Seal the connection between the positive ear 4 and the negative ear 5 and the soft envelope.

The lithium ion micro button 1254 type battery provided by this embodiment: 5.4mm high and 12mm battery diameter;

The preparation process of the positive electrode sheet is: mixing the high-voltage positive electrode active material with a high voltage of 4.45V lithium cobaltate (LiCoO₂), CNTs (carbon nanotubes) and PVDF (polyvinylidene fluoride) according to a mass ratio of 98.2: 0.8: 1.0, and then dispersed. In N-methyl-2-pyrrolidone, a positive electrode slurry was obtained; the positive electrode slurry was evenly coated on both sides of a current collector aluminum foil having a thickness of 10 μm, dried, rolled, and cut into the required size, and then The positive electrode tab of aluminum sheet is welded in the blank to obtain the positive electrode sheet;

The negative electrode sheet is prepared by mixing silicon carbon negative electrode material, acetylene black, CMC (carboxymethyl cellulose), and LA136D binder in a mass ratio of 97.0: 1.0: 0.5: 1.5, and then dispersing it in deionized water to obtain a negative electrode. Slurry; apply the negative electrode slurry evenly on both sides of the current collector copper foil with a thickness of 6 μm, dry, roll, and cut to the required size, and weld the positive electrode tabs of the nickel sheet on the copper foil blank to obtain the negative electrode sheet;

Electrolyte preparation: In a glove box filled with nitrogen (O₂ (2ppm), H₂O (3ppm), ethylene carbonate, propylene carbonate, propyl propionate, and diethyl carbonate are mixed in a mass ratio of 2: 2: 1: 5 Uniform to obtain a non-aqueous organic solvent; then take a non-aqueous organic solvent that accounts for 72% of the total mass of the electrolyte, and add 5% FEC, 3% PS, 3% 1,1,2 based on the total mass of the electrolyte 2,2-tetrafluoroethyl-2,2,3,3-tetrafluoropropyl ether, 1% 1,3,6-hexanetrinitrile, 1% DTD, 0.5% 4-propyl ethylene sulfate Ester, 0.5% citraconic anhydride, 0.5% sodium hexametaphosphate, and adding 0.05% DCC dicyclohexylcarbodiimide (water-removing agent to reduce gas generation during battery formation) to obtain a mixed solution; and then add the mixed solution to the mixed solution Slowly add a mixture of lithium hexafluorophosphate and lithium difluorophosphate (the mass ratio of the lithium hexafluorophosphate to the lithium difluorophosphate is 10: 1), prepare a 1.1 mol / L lithium salt solution, and make an electrolyte after mixing well;

Preparation of micro button lithium ion battery: The positive electrode sheet, separator (polyolefin porous film), and negative electrode sheet are sequentially wound in order to obtain a bare cell, which is encapsulated by punching and forming an aluminum plastic film, then baked, filled with liquid, and left to stand , Chemical forming, fixture shaping, sealing, cutting, capacity testing, and completion of the preparation of micro button lithium-ion batteries;

The soft film shell uses an aluminum plastic film with a thickness of 88 μm. During the stamping process, the surface roughness of the convex and concave molds around the rounded corners is 0.2 μm (mirror surface). The surface roughness of the template is 0.4 μm.

The pit depth (pit depth) of the upper shell 1 is 3.9mm, the gap size of the concave-convex die is 0.25mm, the maximum diameter of the pit is 12mm, the radius R1 of the first outer chamfer 7 is 1.7mm, and the first inner The radius R2 of the chamfer 8 is 0.6mm;

The lower shell 2 has a pit depth of 1.5mm, a gap size of the concave-convex die of 0.25mm, a maximum diameter of the pit of 12mm, a radius R3 of the second outer chamfer 9 of 0.5mm, and a radius of the second inner chamfer 10 R4 is 0.6 mm.

Example 2

The difference from Embodiment 1 is that the pit depth (pit depth) of the upper shell 1 is 4.4 mm, the gap size of the concave-convex die is 0.25 mm, the maximum diameter of the pit is 12 mm, and the first outer chamfer 7 The radius R1 is 1.95mm, and the radius R2 of the first inner chamfer 8 is 0.6mm;

The lower case 2 has a pit depth of 1.0 mm, a gap size of the concave-convex die of 0.25 mm, a maximum diameter of the pit of 12 mm, a radius R3 of the second outer chamfer 9 of 0.25 mm, and a radius of the second inner chamfer 10 R4 is 0.6 mm.

Example 3

The difference from Example 1 is that the pit depth (pit depth) of the upper shell 1 is 6 mm, the gap size of the concave-convex die is 0.30 mm, the maximum diameter of the pit is 12 mm, and the first outer chamfer 7 The radius R1 is 2.75mm, and the radius R2 of the first inner chamfer 8 is 0.8mm;

The lower shell 2 has a pit depth of 4mm, a gap size of 0.25mm, a maximum diameter of the pit of 12mm, a radius R3 of the second outer chamfer 9 is 1.75mm, and a radius R4 of the second inner chamfer 10 When it is 0.8mm, the obtained battery model is 1210.

Comparative Example 1

Metal case (steel case) battery model 1254: The positive and negative electrode sheets and electrolyte preparation in this comparative example are the same as in Example 1. The difference is that the positive and negative electrodes do not lead out of the case, and the blank current collector is directly welded to the upper and lower metal cases inside the battery. On the inner wall, the case is formed by pressing, and the upper and lower cases are squeezed and sealed to form a battery.

Comparative Example 2

The difference from Example 1 is that the pit depth (pit depth) of the upper shell 1 is 5.4mm, the gap size of the concave-convex die is 0.30mm, the maximum diameter of the pit is 12mm, and the first outer chamfer 7 The radius R1 is 2.45mm, and the radius R2 of the first inner chamfer 8 is 0.8mm. The lower shell 2 is not subjected to a stamping process, and there are no pits.

Performance Testing:

The batteries obtained in the examples and comparative examples were tested as follows:

- (1) Cycling performance test at room temperature: At 25 ° C, charge the formed battery with a constant current of 0.2C and a constant voltage of 4.45V (cut-off current of 0.01C), and then discharge the current of 0.2C to 3.0V, and record the discharge capacity;
- (2) High temperature thermal shock damage test: test whether the package is cracked and the electrolyte is leaking under 150 ° C and 0.5h high temperature storage conditions;
- (3) Cycling performance test at room temperature: At 25 ° C, charge the formed battery with a constant current of 0.2C and a constant voltage of 4.45V (cut-off current of 0.01C), and then discharge it to a constant voltage of 3.0C with a constant current of 0.2C to calculate the charge / discharge 500. The retention rate of weekly cycle capacity is calculated as follows:

Capacity retention at 500 cycles (%) = 500th week cycle discharge capacity / 1st cycle discharge capacity × 100%.

Table 1

The product obtained in the embodiment of the present invention only swelled after being stored at 150 ° C. for 0.5 h, but the metal case micro button battery cracked at the package, and the electrolyte leakage was found, and the cycle life was basically the same. It shows that the invention effectively improves the battery safety performance. With the same size, shape and capacity, the soft pack micro button battery has a light weight.

The applicant states that the present invention illustrates the detailed process equipment and process flow of the present invention through the above embodiments, but the present invention is not limited to the above detailed process equipment and process flow, which does not mean that the present invention must rely on the above detailed process equipment and process Process flow can be implemented. Those skilled in the art should know

that any improvement to the present invention, equivalent replacement of the raw materials of the products of the present invention, addition of auxiliary components, selection of specific methods, etc., all fall within the scope of protection and disclosure of the present invention.

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1. A micro button battery, which is characterized in that the micro button battery includes a soft film case and a wound-type structured battery cell placed in the soft film case. The soft film case is divided into an upper layer with a pit. Shell and lower shell;

An arc-shaped external chamfer is formed between the sidewalls of the pits in the upper and lower shells and the top of the pits, and the edges of the pit openings in the upper and lower shells form internal chamfers.

2. The micro button battery according to claim 1, wherein a first outer chamfer having a radius R1 is formed between a side wall of the recess in the upper case and a top layer;

Preferably, a second outer chamfer having a radius R3 is formed between the side wall of the pit and the top layer in the lower shell.

3. The micro button battery according to claim 1 or 2, wherein a first inner chamfer having a radius of R2 is formed at an edge of the recessed portion in the upper casing;

Preferably, a second inner chamfer having a radius of R4 is formed at the edge of the recessed portion in the lower shell.

4. The micro button battery according to any one of claims 1 to 3, wherein an edge of the upper casing and the lower casing which are attached to each other is provided with a circle of packaging area surrounding the battery cell;

Preferably, the soft film casing is an aluminum plastic film casing, which includes a nylon layer, a metal layer and a PP layer in order from the outside to the inside;

Preferably, the metal layer is an aluminum layer or a steel layer;

Preferably, the packaging area is obtained by hot-melting a PP layer;

Preferably, the thickness of the flexible envelope is 86-150 μm ;

Preferably, the battery core is formed by winding a positive electrode sheet, a separator, and a negative electrode sheet;

Preferably, uncoated metal materials are left at the ends of the positive electrode sheet and the negative electrode sheet, respectively, and ultrasonic welding is performed with the aluminum strip and the nickel strip to which the sealant has been heat-sealed, respectively, as the positive electrode ear and the negative electrode ear;

Preferably, the positive and negative ears are led out along the gaps between the upper shell and the lower shell of the flexible envelope, and the two surfaces of the positive and negative ears are sealed with a sealant, respectively. The joint of the envelope is sealed.

5. The micro button battery according to any one of claims 1-4, wherein the depth of the pits of the upper casing is 2-10 mm;

Preferably, the depth of the pits of the lower shell is 0.1 to 5 mm;

Preferably, the maximum diameter of the recess of the upper shell is 4-12 mm;

Preferably, the maximum diameter of the recess of the lower shell is 4-12 mm.

6.The micro button battery according to any one of claims 1-5, wherein in the upper case, the R1 is calculated by the following formula: $R1 = (\text{depth of the upper case pit} - 0.5\text{mm}) / 2$;

Preferably, in the lower shell, the R3 is calculated by the following formula: $R3 = (\text{depth of the lower shell pit} - 0.5\text{mm}) / 2$;

Preferably, the depth of the pit of the upper shell or the lower shell is 5 to 10 mm, the maximum diameter of the pit is 4 to 12 mm, and the R2 and R4 are each independently 0.8 mm to 1.2 mm, preferably $R2 = R4$;

Preferably, the pit depths of the upper and lower shells are independently selected from the group consisting of: $0.1\text{mm} \leq \text{pit depth} < 5\text{mm}$, the maximum diameter of the pits is 4-12 mm, and the R2 and R4 are each independently 0.6 to 0.7 mm, preferably $R2 = R4$.

7.A method for preparing a micro button battery according to any one of claims 1-6, wherein the method includes the following steps:

(1)Punching the soft envelope to obtain an upper shell and a lower shell with a pit, respectively, and combining the upper shell and the lower shell with a pit to obtain a soft shell;

(2)The battery cell with a winding structure is put into the soft film casing, the positive and negative electrode ears are led out of the casing, and then packaged and baked to obtain a micro button battery.

8.The preparation method according to claim 7, wherein the punching in step (1) is punching using a concave-convex die;

Preferably, the perimeter of the rounded corners of the surface roughness of the concave-convex mold is $0.2\text{ }\mu\text{m}$, and the roughness of the template plane is $0.4\text{ }\mu\text{m}$;

Preferably, in the process of punching, the depth of the pit is $\leq 5\text{ mm}$, and the gap size of the concave-convex die is 0.23 to 0.26 mm;

Preferably, in the process of punching, the depth of the pit is 5 to 10 mm, $113\text{ }\mu\text{m} \leq \text{the thickness of the soft film} \leq 150\text{ }\mu\text{m}$, the maximum diameter of the pit is 4 to 12 mm, and the gap size of the concave-convex die is 0.33 to 0.38mm;

Preferably, in the process of punching, the depth of the pit is 5 to 10 mm, $86\text{ }\mu\text{m} \leq \text{the thickness of the soft film} < 113\text{ }\mu\text{m}$, the maximum diameter of the pit is 4 to 12 mm, and the gap size of the concave-convex die is 0.28 to 0.32mm.

9.The method according to claim 7 or 8, wherein the method for preparing a cell with a wound structure in step (2) comprises: performing a positive electrode sheet, a separator (polyolefin porous film) and a negative electrode sheet. Winding to obtain a cell with a winding structure.

10.The preparation method according to any one of claims 7 to 9, wherein the baking in step (2) is a vacuum baking;

Preferably, after the baking in step (2), the method further includes a process of standing, forming, fixture shaping and second sealing.



(12)发明专利申请

(10)申请公布号 CN 110739487 A

(43)申请公布日 2020.01.31

(21)申请号 201911189359.7

(22)申请日 2019.11.28

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(51)Int.Cl.

H01M 10/0525(2010.01)

H01M 2/02(2006.01)

H01M 10/0587(2010.01)

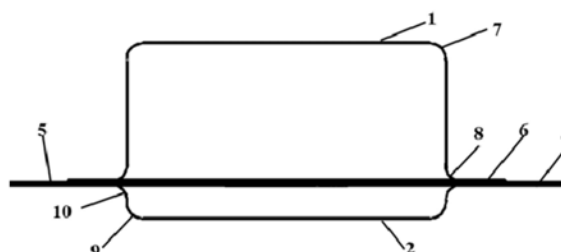
权利要求书2页 说明书7页 附图2页

(54)发明名称

一种微扣电池及其制备方法

(57)摘要

本发明涉及一种微扣电池。所述微扣电池包括软包膜外壳和置于软包膜外壳内的卷绕式结构的电芯,所述软包膜外壳分为具有凹坑的上层壳体 and 下层壳体;所述上层壳体和下层壳体中凹坑侧壁与凹坑顶层之间形成圆弧状的外倒角,所述上层壳体和下层壳体中凹坑口部边缘形成内倒角。本发明所述软包膜采用特殊设计的冲压成型模具,优化计算成型软包膜导角(外倒角和内倒角),进而可以有效解决电池在成型或使用过程中拉伸开裂,造成电池漏液或破损的问题;本发明采用卷绕式结构的电芯,并且软包膜外壳设置为凹坑结构,可以充分利用电池壳体内部的有效空间,提升了电池的体积能量密度,轻量化软包膜外壳的设计进一步提升了电池的能量密度。



1. 一种微扣电池,其特征在于,所述微扣电池包括软包膜外壳和置于软包膜外壳内的卷绕式结构的电芯,所述软包膜外壳分为具有凹坑的上层壳体 and 下层壳体;

所述上层壳体和下层壳体中凹坑侧壁与凹坑顶层之间形成圆弧状的外倒角,所述上层壳体和下层壳体中凹坑口部边缘形成内倒角。

2. 如权利要求1所述的微扣电池,其特征在于,所述上层壳体中凹坑侧壁与顶层之间形成半径为R1的第一外倒角;

优选地,所述下层壳体中凹坑侧壁与顶层之间形成半径为R3的第二外倒角。

3. 如权利要求1或2所述的微扣电池,其特征在于,所述上层壳体中凹坑口部边缘形成半径为R2的第一内倒角;

优选地,所述下层壳体中凹坑口部边缘形成半径为R4的第二内倒角。

4. 如权利要求1-3之一所述的微扣电池,其特征在于,所述上层壳体和下层壳体贴合的边缘设有环绕着电芯的一圈封装区;

优选地,所述软包膜外壳为铝塑膜外壳,其由外到内依次包括尼龙层、金属层和PP层;

优选地,所述金属层为铝层或钢层;

优选地,所述封装区通过热熔PP层得到;

优选地,所述软包膜外壳的厚度为86~150 μ m;

优选地,所述电芯由正极片、隔膜和负极片卷绕形成;

优选地,所述正极片和负极片的末端分别留下未涂覆的金属材料,分别与已热合了密封胶的铝带和镍带进行超声波焊接,分别作为正极耳和负极耳;

优选地,所述正极耳和负极耳沿软包膜外壳上层壳体和下层壳体贴合的缝隙引出,正极耳和负极耳的两个表面贴有密封胶,分别将正极耳和负极耳与软包膜外壳连接处密封。

5. 如权利要求1-4之一所述的微扣电池,其特征在于,所述上层壳体的凹坑深度为2~10mm;

优选地,所述下层壳体的凹坑深度为0.1~5mm;

优选地,所述上层壳体的凹坑的最大直径为4~12mm;

优选地,所述下层壳体的凹坑的最大直径为4~12mm。

6. 如权利要求1-5之一所述的微扣电池,其特征在于,所述上层壳体中,所述R1通过如下公式计算得到: $R1 = (\text{上层壳体凹坑深度} - 0.5\text{mm}) / 2$;

优选地,所述下层壳体中,所述R3通过如下公式计算得到: $R3 = (\text{下层壳体凹坑深度} - 0.5\text{mm}) / 2$;

优选地,所述上层壳体或下层壳体的凹坑深度为5~10mm,凹坑的最大直径为4~12mm,所述R2和R4各自独立的为0.8mm~1.2mm,优选 $R2 = R4$;

优选地,所述上层壳体和下层壳体的凹坑深度各自独立的选自: $0.1\text{mm} \leq \text{凹坑深度} < 5\text{mm}$,凹坑的最大直径为4~12mm,所述R2和R4各自独立的为0.6~0.7mm,优选 $R2 = R4$ 。

7. 一种如权利要求1-6之一所述微扣电池的制备方法,其特征在于,所述方法包括如下步骤:

(1) 将软包膜进行冲坑,分别得到具有凹坑的上层壳体和下层壳体,所述具有凹坑的上层壳体和下层壳体组合得到软包膜外壳;

(2) 将具有卷绕式结构的电芯放入所述软包膜外壳中,正负极耳引出壳体外,然后进行

封装和烘烤,得到微扣电池。

8. 如权利要求7所述的制备方法,其特征在于,步骤(1)所述冲坑为采用凹凸模进行冲坑;

优选地,所述凹凸模表面光洁度圆角周边为 $0.2\mu\text{m}$,模板平面粗糙度为 $0.4\mu\text{m}$;

优选地,所述冲坑的过程中,凹坑深度 $\leq 5\text{mm}$,所述凹凸模的间隙尺寸为 $0.23\sim 0.26\text{mm}$;

优选地,所述冲坑的过程中,凹坑深度为 $5\sim 10\text{mm}$, $113\mu\text{m}\leq$ 软包膜厚度 $\leq 150\mu\text{m}$,所述凹坑的最大直径为 $4\sim 12\text{mm}$,所述凹凸模的间隙尺寸为 $0.33\sim 0.38\text{mm}$;

优选地,所述冲坑的过程中,凹坑深度为 $5\sim 10\text{mm}$, $86\mu\text{m}\leq$ 软包膜厚度 $< 113\mu\text{m}$,所述凹坑的最大直径为 $4\sim 12\text{mm}$,所述凹凸模的间隙尺寸为 $0.28\sim 0.32\text{mm}$ 。

9. 如权利要求7或8所述的制备方法,其特征在于,步骤(2)所述具有卷绕式结构的电芯的制备方法包括:将正极片、隔膜(聚烯烃多孔膜)和负极片进行绕卷,得到具有卷绕式结构的电芯。

10. 如权利要求7-9之一所述的制备方法,其特征在于,步骤(2)所述烘烤为真空烘烤;

优选地,步骤(2)所述烘烤之后,还包括静置、化成、夹具整形和二封的过程。

一种微扣电池及其制备方法

技术领域

[0001] 本发明属于电池技术领域,具体涉及一种微扣电池及其制备方法。

背景技术

[0002] 锂离子电池因具有能量密度高、电压高、体积小、环保等特点而广泛应用于移动电子产品中,而锂离子电池的安全性一直是人们在使用过程中最为关注的重点,目前市场上常见的用于贴身人体使用的蓝牙和健康医疗电子设备内置的微扣电池普遍存在安性能不够高的问题,金属微扣电池常常在电池内压过大时会产生膨胀,开裂漏液,严重时会产生爆裂。

[0003] 目前,已有的金属微扣电池的安全结构设计也只是在盖板上冲切一个安全口,当内压达到一定程度时冲开,但空气中的水分也同时进入电池,造成电池当即失效,如果不及时更换电池会,安全开口的漏液会将用电设备腐蚀损坏;同时,市场上金属微扣电池,由于采用金属壳设计,重量能量密度偏低,并且增加了电子设备的重量,不能满足内置耳机等电子设备对微扣电池高能量密度的要求。

[0004] 现有的软包锂离子电池多采用铝塑膜包装,通过预先冲模成型使包装材料拉伸变形,铝塑膜在冲压成型后,若冲压模具设计不当,由于角位所受应力最大,变薄也最为严重,角位处铝层拉伸过大会造成角位破损,使电池存在安全风险。

[0005] CN209266448U公开了一种新型的铝塑膜纽扣电池,包括铝塑膜外壳和电芯;铝塑膜外壳分为上下内空的壳体结构,上下铝塑膜壳体折叠后形成电芯腔体;铝塑膜外壳的两层铝塑膜贴合的边缘通过热熔封装;铝塑膜封装区外圈上有锯齿结构,铝塑膜外圈向上翻叠时能够贴紧上层铝塑膜表面;电芯由正极片,隔膜和负极片通过叠层方式形成,极片末端未涂覆的区域连接极耳;极耳沿铝塑膜外壳上下层贴合的缝隙引出,极耳的上下面贴有极耳胶。但是,所述方法得到的铝塑膜纽扣电池在使用过程中,易拉伸开裂,造成电池漏液或破损。

[0006] 因此,本领域需要开发一种新型微扣电池,所述微扣电池具有优异的体积能量密度和安全性能,且制备过程简单,可工业化生产。

发明内容

[0007] 针对现有技术的不足,本发明的目的在于提供一种微扣电池及其制备方法。本发明所述微扣电池不仅可以充分利用了电池壳体内部的有效空间,提升了电池的体积能量密度,也可以防止电池在成型或使用过程中拉伸开裂,造成电池漏液或破损的问题。

[0008] 为达上述目的,本发明采用以下技术方案:

[0009] 本发明的目的之一在于提供一种微扣电池,所述微扣电池包括软包膜外壳和置于软包膜外壳内的卷绕式结构的电芯,所述软包膜外壳分为具有凹坑的上层壳体和下层壳体;

[0010] 所述上层壳体和下层壳体中凹坑侧壁与凹坑顶层之间形成圆弧状的外倒角,所述

上层壳体 and 下层壳体中凹坑口部边缘形成内倒角。

[0011] 本发明采用轻量化的软包膜包为外壳设计,由于微扣电池容量较小,即使在失效情况下,产气量也不是很大,通过软包膜的膨胀可以消化掉,不至于开裂漏液或爆裂;即使在滥用时,内压过大,也只是冲开密封区,不会对人体产生损害。

[0012] 本发明采用卷绕式结构的电芯,并且软包膜外壳设置为凹坑结构,可以充分利用电池壳体内的有效空间,提升了电池的体积能量密度,轻量化软包膜外壳的设计进一步提升了电池的能量密度。

[0013] 本发明的电池卷芯采用卷绕式结构,优点是正负极层间界面结合紧密,电池做成后,不用外压力的情况下,就能保证电池的极负极界面紧密结合,保证电池的电化学性能。卷绕电芯结构更有利于自动化生产,提升高生产效率。而现有技术中采用电芯的叠片结构由于要保证正负极的对位和负极包住正极的要求,要进行每层的对位要求,生产效率低。另外,叠片结构的电芯需要有外压的挤压才能保证正负极界面的紧密结合,而卷绕式卷芯则不需要。

[0014] 优选地,所述上层壳体中凹坑侧壁与顶层之间形成半径为R1的第一外倒角。

[0015] 优选地,所述下层壳体中凹坑侧壁与顶层之间形成半径为R3的第二外倒角。

[0016] 优选地,所述上层壳体中凹坑口部边缘形成半径为R2的第一内倒角。

[0017] 优选地,所述下层壳体中凹坑口部边缘形成半径为R4的第二内倒角。

[0018] 优选地,所述上层壳体和下层壳体贴合的边缘设有环绕着电芯的一圈封装区。

[0019] 优选地,所述软包膜外壳为铝塑膜外壳,其由外到内依次包括的尼龙层、金属层和PP层。

[0020] 本发明所述外到内依次包括的尼龙层、金属层和PP层为:靠近电芯一侧为内侧,即PP层离最靠近电芯,尼龙层离电芯最远。

[0021] 本发明所述软包膜组成的各层主要功能:尼龙层,可以有效阻止空气尤其是氧的渗透,维持电芯内部的环境,同时可以保证包装铝箔具备良好的形变能力;铝(或钢)金属层,可以有效阻止空气中水分的渗透,维持电芯内部的环境,具有一定的厚度强度能够防止外部对电芯的损伤;PP层,不会被电芯内有机溶剂溶解、溶胀等,是电芯内部环境的最直接的包装保护,绝缘,有效阻止内部电解质等与金属层接触,避免金属被腐蚀。

[0022] 优选地,所述金属层为铝层或钢层。

[0023] 优选地,所述封装区通过热熔PP层得到。

[0024] 优选地,所述软包膜外壳的厚度为86~150 μ m,例如88 μ m、90 μ m、95 μ m、100 μ m、105 μ m、110 μ m、113 μ m、120 μ m、125 μ m、130 μ m、135 μ m或140 μ m等。

[0025] 优选地,所述电芯由正极片、隔膜和负极片卷绕形成。

[0026] 优选地,所述正极片和负极片的末端分别留下未涂覆的金属材料,分别与已热合了密封胶的铝带和镍带进行超声波焊接,分别作为正极耳和负极耳。

[0027] 优选地,所述正极耳和负极耳沿软包膜外壳上层壳体和下层壳体贴合的缝隙引出,正极耳和负极耳的两个表面贴有密封胶,分别将正极耳和负极耳与软包膜外壳连接处密封。

[0028] 优选地,所述上层壳体的凹坑深度为2~10mm,例如2.5mm、3mm、3.5mm、4mm、4.5mm、5mm、5.5mm、6mm、6.5mm、7mm、7.5mm、8mm、8.5mm、9mm或9.5mm等。

[0029] 优选地,所述和下层壳体的凹坑深度为0.1~5mm,例如0.5mm、0.8mm、1mm、1.5mm、1.8mm、2mm、2.5mm、3mm、3.5mm、4mm或4.5mm等。

[0030] 优选地,所述上层壳体的凹坑的最大直径为4~12mm,例如5mm、6mm、7mm、8mm、9mm、10mm或11mm等。

[0031] 优选地,所述下层壳体的凹坑的最大直径为4~12mm,例如5mm、6mm、7mm、8mm、9mm、10mm或11mm等。

[0032] 优选地,所述上层壳体中,所述R1通过如下公式计算得到: $R1 = (\text{上层壳体凹坑深度} - 0.5\text{mm}) / 2$ 。

[0033] 优选地,所述下层壳体中,所述R3通过如下公式计算得到: $R3 = (\text{下层壳体凹坑深度} - 0.5\text{mm}) / 2$ 。

[0034] 优选地,所述上层壳体或下层壳体的凹坑深度为5~10mm(例如5.5mm、6mm、6.5mm、7mm、7.5mm、8mm、8.5mm、9mm或9.5mm等),凹坑的最大直径为4~12mm(例如5mm、6mm、7mm、8mm、9mm、10mm或11mm等),所述R2和R4各自独立的为0.8mm~1.2mm(例如0.85mm、0.9mm、0.95mm、1mm、1.05mm、1.1mm或1.15mm等),优选 $R2 = R4$ 。

[0035] 优选地,所述上层壳体和下层壳体的凹坑深度各自独立的选自: $0.1\text{mm} \leq \text{凹坑深度} < 5\text{mm}$ (例如0.2mm、0.5mm、1mm、1.5mm、2mm、2.5mm、2.8mm、3.0mm、3.2mm、3.5mm、4.0mm、4.2mm、4.5mm或4.8mm等),凹坑的最大直径为4~12mm(例如5mm、6mm、7mm、8mm、9mm、10mm或11mm等),所述R2和R4各自独立的为0.6~0.7mm(例如0.61mm、0.62mm、0.64mm、0.65mm、0.66mm、0.68mm或0.69mm等),优选 $R2 = R4$ 。

[0036] 本发明所述软包膜采用特殊设计的冲压成型模具,优化计算成型软包膜导角(外倒角和内倒角),使得在制备过程中可以均匀拉伸,进而可以有效解决电池在成型或使用过程中拉伸开裂,造成电池漏液或破损的问题。

[0037] 本发明的目的之二在于提供一种如目的之一所述微扣电池的制备方法,所述方法包括如下步骤:

[0038] (1) 将软包膜进行冲坑,分别得到具有凹坑的上层壳体 and 下层壳体,所述具有凹坑的上层壳体 and 下层壳体组合得到软包膜外壳;

[0039] (2) 将具有卷绕式结构的电芯放入所述软包膜外壳中,正负极耳引出壳体外,然后进行封装和烘烤,得到微扣电池。

[0040] 本发明对于所述封装过程不做具体限定,本领域技术人员可根据实际需要进行选择,本发明在封装过程中,封头采用上下层导热性较好的双半圆形金属模具,示例性的以铝塑膜厚度88 μm 为例,封装温度185度,封装时间3S,压力0.3~0.4MPa。

[0041] 优选地,步骤(1)所述冲坑为采用凹凸模进行冲坑。

[0042] 优选地,所述凹凸模表面光洁度圆角周边为0.2 μm ,模板平面粗糙度为0.4 μm 。

[0043] 优选地,所述冲坑的过程中,凹坑深度 $\leq 5\text{mm}$ (例如0.1mm、0.5mm、1mm、1.5mm、1.8mm、2.0mm、2.5mm、3.0mm、3.5mm、4.0mm或4.5mm等),所述凹凸模的间隙尺寸为0.23~0.26mm(例如0.235mm、0.24mm、0.245mm、0.25mm或0.255mm等)。

[0044] 优选地,所述冲坑的过程中,凹坑深度为5~10mm(例如5.5mm、6mm、6.5mm、7mm、7.5mm、8mm、8.5mm、9mm或9.5mm等), $113\mu\text{m} \leq \text{软包膜厚度} \leq 150\mu\text{m}$ (例如115 μm 、120 μm 、125 μm 、130 μm 、132 μm 、135 μm 、140 μm 、145 μm 或148 μm 等),所述凹坑的最大直径为4~12mm(例如5mm、

6mm、7mm、8mm、9mm、10mm或11mm等),所述凹凸模的间隙尺寸为0.33~0.38mm(例如0.34mm、0.35mm、0.36mm或0.37mm等)。

[0045] 优选地,所述冲坑的过程中,凹坑深度为5~10mm(例如5.5mm、6mm、6.5mm、7mm、7.5mm、8mm、8.5mm、9mm或9.5mm等), $86\mu\text{m}\leq\text{软包膜厚度}<113\mu\text{m}$ (例如88 μm 、90 μm 、92 μm 、95 μm 、98 μm 、100 μm 、105 μm 、110 μm 或112 μm 等),所述凹坑的最大直径为4~12mm(例如5mm、6mm、7mm、8mm、9mm、10mm或11mm等),所述凹凸模的间隙尺寸为0.28~0.32mm(例如0.29mm、0.30mm或0.31mm等)。

[0046] 本发明在冲坑的过程中,根据不同的软包膜厚度、凹坑深度和凹坑直径,对凹凸模的间隙尺寸进行选择,进而解决软包膜在冲压过程中易于开裂的问题,冲坑越深铝膜的伸缩形变越大,为减轻形变力,凹凸模的间隙变大。

[0047] 优选地,步骤(2)所述具有卷绕式结构的电芯的制备方法包括:将正极片、隔膜(聚烯烃多孔膜)和负极片进行绕卷,得到具有卷绕式结构的电芯。

[0048] 优选地,步骤(2)所述烘烤为真空烘烤。

[0049] 优选地,步骤(2)所述烘烤之后,还包括静置、化成、夹具整形和二封的过程。

[0050] 相对于现有技术,本发明具有以下有益效果:

[0051] (1) 本发明通过使用软包膜为电池的外包装外壳,这种软包型微扣电池的安全性能得到提升,当内部异常产气情况时,内压增大,不会爆裂,提升电池安全性能;同时优化计算成型软包膜导角(外倒角和内倒角),进而可以有效解决电池在成型或使用过程中拉伸开裂,造成电池漏液或破损的问题,进一步提升电池的安全性能;

[0052] (2) 本发明的电池结构设计,可以充分利用电池壳体内的有效空间,提升了电池的体积能量密度和重量能量密度,同样的体积大小的电池更加轻量化,电量更充足,更加适用于用电器小型化的需求。

附图说明

[0053] 图1和图2是本发明具体实施例部分所述的微扣电池的结构示意图;

[0054] 图3和图4是本发明具体实施例部分所述的微扣电池中,去掉上层壳体和下层壳体,得到的内部结构示意图。

[0055] 其中,1-上层壳体、2-下层壳体、3-电芯、4-正极耳、5-负极耳、6-密封胶、7-第一外倒角、8-第一内倒角、9-第二外倒角、10-第二内倒角、11-封装区。

具体实施方式

[0056] 为便于理解本发明,本发明列举实施例如下。本领域技术人员应该明了,所述实施例仅仅是帮助理解本发明,不应视为对本发明的具体限制。

[0057] 本发明实施例所述软包锂离子微扣电池皆采用如下方法进行制备:

[0058] (1) 将正极片、隔膜(聚烯烃多孔膜)、负极片按顺序排列绕卷得到电芯3,所述正极片和负极片的末端分别留下未涂覆的金属材料,分别与已热合了密封胶的铝带和镍带进行超声波焊接,分别用作焊接正极耳4和负极耳5;

[0059] (2) 将软包膜(铝塑膜)进行冲压成型过程(通过成型冲坑模具冲坑),成型为微扣电池外壳(得到具有第一外倒角和第一内倒角的上层壳体,和具有第二外倒角和第二内倒

角的下层壳体),装入电芯后,封装温度185度,封装时间3S,压力0.4MPa,形成环绕着电芯的一圈封装区11,正极耳4和负极耳5沿软包膜外壳上层壳体和下层壳体贴合的缝隙引出,正极耳4和负极耳5的两个表面贴有密封胶6,分别将正极耳4和负极耳5中与软包膜外壳连接处密封;

[0060] (3) 然后进行120℃真空烘烤,通过电池预留的未封装开口气袋处将电芯3内的水分蒸发掉,测试电芯3水分含量小于100ppm时,在手套箱注电解液,室温静置32h,经化成、夹具整形、二封、容量测试,完成微扣电池的制备。

[0061] 实施例1

[0062] 本实施例提供一种微扣电池,其结构示意图参见图1-图4,所述微扣电池包括软包膜外壳和置于软包膜外壳内的卷绕式结构的电芯3,所述软包膜外壳分为具有凹坑的上层壳体1和下层壳体2,上层壳体1和下层壳体2组合后形成中空的腔体,所述电芯3置于腔体内;所述上层壳体1中凹坑侧壁与凹坑顶层之间形成半径为R1的第一外倒角7;所述上层壳体1中凹坑口部边缘形成半径为R2的第一内倒角8;所述下层壳体2中凹坑侧壁与顶层之间形成半径为R3的第二外倒角9;所述下层壳体2中凹坑口部边缘形成半径为R4的第二内倒角10;所述上层壳体1和下层壳体2贴合的边缘设有环绕着电芯的一圈封装区11;所述电芯由正极片、隔膜和负极片卷绕形成;所述正极片和负极片的末端分别留下未涂覆的金属材料,分别与已热合了密封胶的铝带和镍带进行超声波焊接,分别作为正极耳4和负极耳5;所述正极耳4和负极耳5沿软包膜外壳上层壳体和下层壳体贴合的缝隙引出,正极耳4和负极耳5的两个表面贴有密封胶6,分别将正极耳4和负极耳5与软包膜外壳连接处密封。

[0063] 本实施例提供的锂离子微扣1254型电池:高5.4mm,电池直径12mm;

[0064] 正极片制备过程为:将高电压正极活性材料高电压4.45V钴酸锂(LiCoO_2)、CNTs(碳纳米管)和PVDF(聚偏氟乙烯)按照质量比98.2:0.8:1.0混合均匀,然后分散在N-甲基-2-吡咯烷酮中,得到正极浆料;将正极浆料均匀涂布于厚度为10 μm 集流体铝箔两面上,经烘干,辊压,经分切所需要尺寸,并在铝箔空白处焊接铝片正极耳,得到正极片;

[0065] 负极片制备过程为:将硅碳负极材料、乙炔黑、CMC(羧甲基纤维素)、LA136D粘接剂按照质量比97.0:1.0:0.5:1.5混合均匀,然后分散在去离子水中,得到负极浆料;将负极浆料均分涂布于厚度为6 μm 集流体铜箔两面上,经烘干,辊压,经分切所需要尺寸,并在铜箔空白处焊接镍片正极耳,得到负极片;

[0066] 电解液配制:在充满氮气的手套箱($\text{O}_2 < 2\text{ppm}$, $\text{H}_2\text{O} < 3\text{ppm}$)中,将碳酸乙烯酯、碳酸丙烯酯、丙酸丙酯、碳酸二乙酯按照质量比2:2:1:5混合均匀,制得非水有机溶剂;然后取占电解液总质量72%的非水有机溶剂,向其中加入基于电解液总质量5%的FEC、3%的PS、3%的1,1,2,2-四氟乙基-2,2,3,3-四氟丙基醚、1%的1,3,6-己烷三腈、1%的DTD、0.5%的4-丙基硫酸乙烯酯、0.5%的柠康酸酐、0.5%的六偏磷酸钠,并加入0.05%DCC二环己基碳二亚胺(除水剂,减少电池化成时产气体)得到混合溶液;再向混合溶液中缓慢加入六氟磷酸锂与二氟磷酸锂的混合物(所述六氟磷酸锂与二氟磷酸锂的质量比为10:1),配制成1.1mol/L的锂盐溶液,混合均匀后即制成电解液;

[0067] 微扣锂离子电池制备:将正极片、隔膜(聚烯烃多孔膜)、负极片按顺序排列绕卷得到裸电芯,经已冲压成型的铝塑膜封装、再烘烤、注液、静置、化成、夹具整形封切、容量测试,完成微扣锂离子电池的制备;

[0068] 软包膜外壳采用厚度为88 μ m的铝塑膜,在冲压成型过程中,凸凹模表面光洁度圆角周边0.2 μ m(镜面)模板平面粗糙度为0.4 μ m;

[0069] 上层壳体1冲压的坑深(凹坑深度)为3.9mm,凹凸模的间隙尺寸为0.25mm,凹坑的最大直径为12mm,第一外倒角7的半径R1为1.7mm,第一内倒角8的半径R2为0.6mm;

[0070] 下层壳体2冲压的坑深为1.5mm,凹凸模的间隙尺寸为0.25mm,凹坑的最大直径为12mm,第二外倒角9的半径R3为0.5mm,第二内倒角10的半径R4为0.6mm。

[0071] 实施例2

[0072] 与实施例1的区别在于,所述上层壳体1冲压的坑深(凹坑深度)为4.4mm,凹凸模的间隙尺寸为0.25mm,凹坑的最大直径为12mm,第一外倒角7的半径R1为1.95mm,第一内倒角8的半径R2为0.6mm;

[0073] 下层壳体2冲压的坑深为1.0mm,凹凸模的间隙尺寸为0.25mm,凹坑的最大直径为12mm,第二外倒角9的半径R3为0.25mm,第二内倒角10的半径R4为0.6mm。

[0074] 实施例3

[0075] 与实施例1的区别在于,所述上层壳体1冲压的坑深(凹坑深度)为6mm,凹凸模的间隙尺寸为0.30mm,凹坑的最大直径为12mm,第一外倒角7的半径R1为2.75mm,第一内倒角8的半径R2为0.8mm;

[0076] 下层壳体2冲压的坑深为4mm,凹凸模的间隙尺寸为0.25mm,凹坑的最大直径为12mm,第二外倒角9的半径R3为1.75mm,第二内倒角10的半径R4为0.8mm,得到的电池型号为1210。

[0077] 对比例1

[0078] 金属壳(钢壳)电池型号1254:本对比例中正负极片和电解液制备同实施例1,不同之处是正负极耳不引出壳体外,直接将空白集流体分别在电池内部焊接在上下金属壳体内壁上,壳体经冲压成型,通过上下壳体挤压互扣密封成电池。

[0079] 对比例2

[0080] 与实施例1的区别在于,所述上层壳体1冲压的坑深(凹坑深度)为5.4mm,凹凸模的间隙尺寸为0.30mm,凹坑的最大直径为12mm,第一外倒角7的半径R1为2.45mm,第一内倒角8的半径R2为0.8mm,下层壳体2不进行冲压过程,不存在凹坑。

[0081] 性能测试:

[0082] 将各实施例和对比例得到的电池进行如下测试:

[0083] (1) 常温循环性能测试:在25 $^{\circ}$ C下,将化成后的电池用0.2C恒流恒压充电至4.45V(截止电流为0.01C),然后用0.2C恒流放电至3.0V,计录放电容量;

[0084] (2) 高温热冲击破坏测试:测试在150度0.5h高温储存条件下,在封装处是否开裂,是否存在电解液漏液现象;

[0085] (3) 常温循环性能测试:在25 $^{\circ}$ C下,将化成后的电池用0.2C恒流恒压充电至4.45V(截止电流为0.01C),然后用0.2C恒流放电至3.0V,计算充/放电500周循环容量的保持率,其计算公式如下:

[0086] 循环500周容量保持率(%) = 第500周循环放电容量/第1次循环放电容量 $\times$ 100%。

[0087] 表1

[0088]		电池 直径 (mm)	电池 厚度 (mm)	电池 重量 (g)	工作电 压(V)	0.2C 放电 容量(mAh)	高温热冲击 破坏测试	500 次循 环性能(%)
	实施例 1	12	5.4	1.3	3.87	58	无	88%
	实施例 2	12	5.4	1.3	3.87	56	无	86%
	实施例 3	12	10	2.1	3.87	98	无	87%
	对比例 1	12	5.4	1.8	3.87	56	漏液	85%
	对比例 2	12	5.4	1.3	3.87	56	无	85%

[0089] 本发明实施例得到的产品经过过150℃储存0.5h只是发生膨胀,而金属壳微扣电池在封装处开裂,并发现电解液漏液现象,循环寿命基本相同。说明发明有效的改善了电池安全性能。同样的大小外形和容量,软包微扣电池具有轻量化的重量。

[0090] 申请人声明,本发明通过上述实施例来说明本发明的详细工艺设备和工艺流程,但本发明并不局限于上述详细工艺设备和工艺流程,即不意味着本发明必须依赖上述详细工艺设备和工艺流程才能实施。所属技术领域的技术人员应该明了,对本发明的任何改进,对本发明产品各原料的等效替换及辅助成分的添加、具体方式的选择等,均落在本发明的保护范围和公开范围之内。

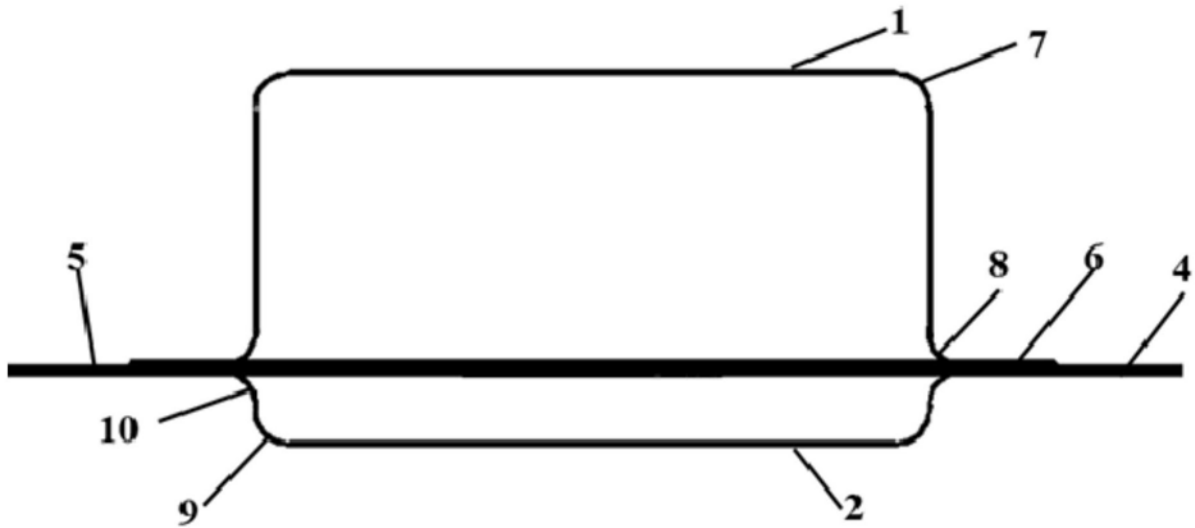


图1

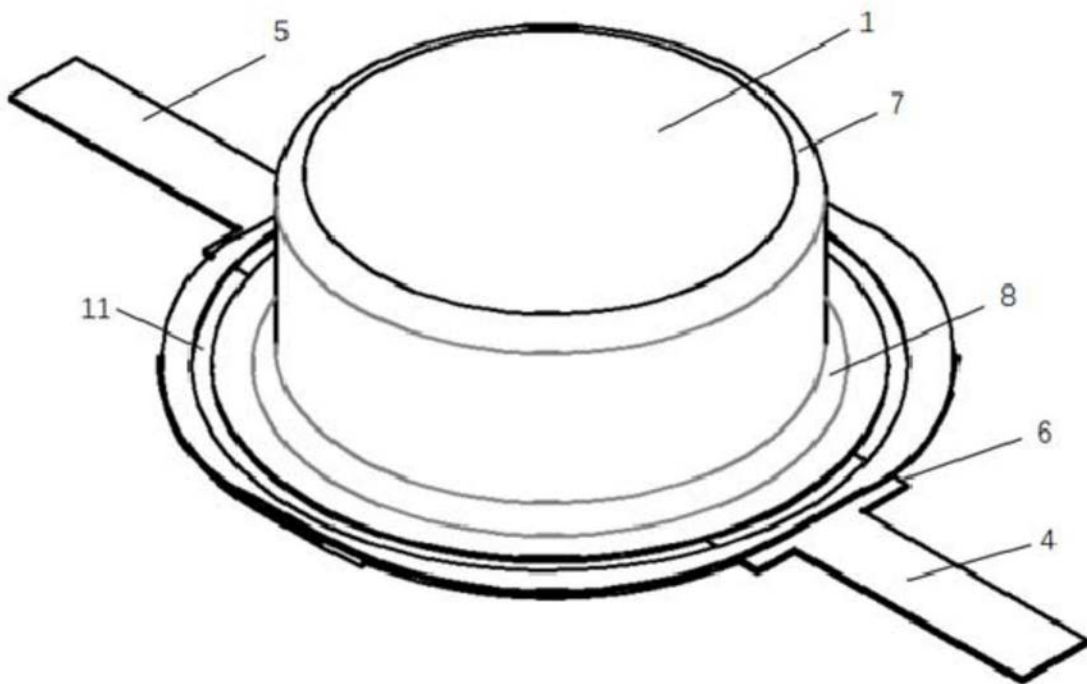


图2

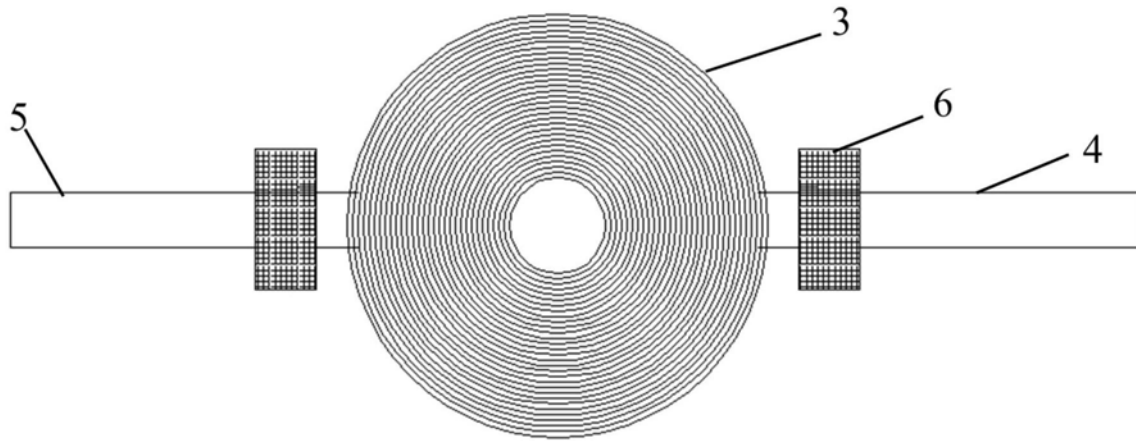


图3

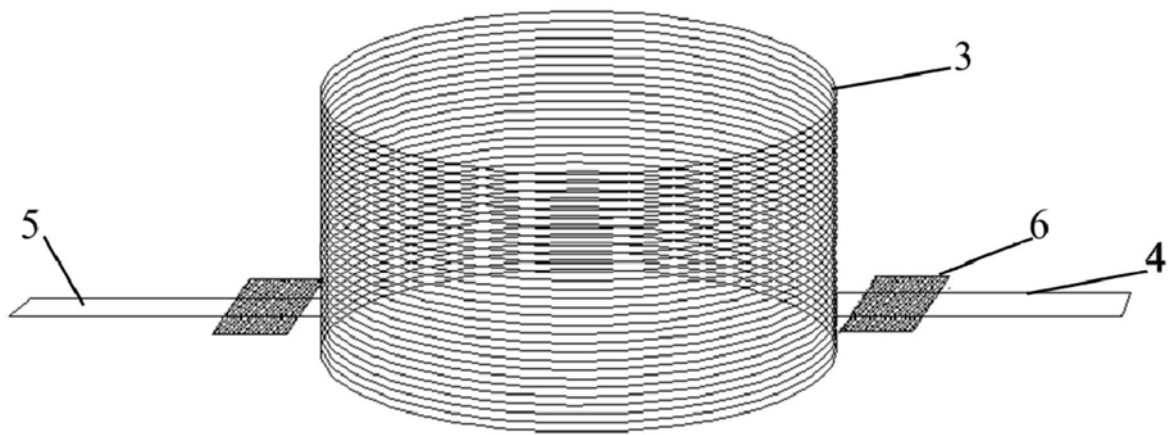


图4