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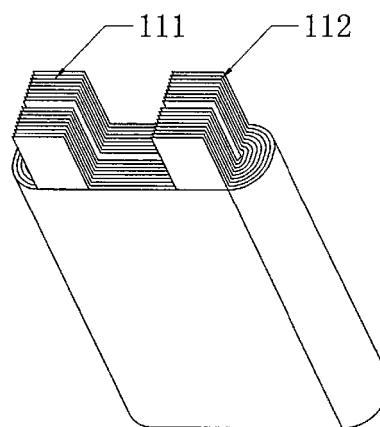
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(54) Title of Invention

A Multi-Tab Spiral-Wound Lithium-Ion Battery and Its
Manufacturing Method

(57) Abstract

The present invention relates to a multi-tab spiral-wound lithium-ion battery and its manufacturing method, belonging to the field of batteries. The battery comprises a positive electrode plate, a negative electrode plate, and a separator disposed therebetween. An active material is made into a mixed paste and coated onto a current collector; a blank area is reserved on the front side of one edge of the positive electrode plate along its longitudinal direction, and a blank area is reserved on the back side of the same edge, with the remainder fully coated with the paste. An active material is made into a mixed paste and coated onto a current collector; a blank area is reserved on the front side of one edge of the negative electrode plate along its longitudinal direction, and a blank area is reserved on the back side of the same edge, with the remainder fully coated with the paste. The battery is characterized in that spaced-apart tabs are provided on the reserved blank area of the positive electrode plate, and spaced-apart tabs are provided on the reserved blank area of the negative electrode plate. The present invention reduces the distance from the electrode plate to the electrode terminal, thereby reducing internal resistance, decreasing heat generation during discharge, and improving safety, while also increasing product yield and solving the problem that small batteries are unsuitable for the stacking process.



1. A spiral-wound multi-tab lithium-ion battery electrode plate, wherein an active material is thoroughly mixed with a conductive agent and a binder in a predetermined ratio to form a mixed paste, which is coated onto a current collector; a blank area is reserved on the front side of one edge of the electrode plate along its longitudinal direction, and a blank area is reserved on the back side of the same edge, with the remainder fully coated with the paste; characterized in that a plurality of spaced-apart tabs are provided on the reserved blank area of the electrode plate.

2. The spiral-wound multi-tab lithium-ion battery electrode plate according to claim 1, characterized in that the spaced-apart tabs are of the same polarity which, after being shaped, overlap upon winding, forming a neatly stacked and independently arranged row of tabs at the end.

3. A spiral-wound multi-tab lithium-ion battery, comprising a positive electrode plate, a negative electrode plate, and a separator disposed therebetween, wherein an active material is made into a mixed paste and coated onto a current collector; a blank area is reserved on the front side of one edge of the positive electrode plate along its longitudinal direction, and a blank area is reserved on the back side of the same edge, with the remainder fully coated with the paste; an active material is made into a mixed paste and coated onto a current collector; a blank area is reserved on the front side of one edge of the negative electrode plate along its longitudinal direction, and a blank area is reserved on the back side of the same edge, with the remainder fully coated with the paste; characterized in that a plurality of spaced-apart tabs are provided on the reserved blank area of the positive electrode plate, and a plurality of spaced-apart tabs are provided on the reserved blank area of the negative electrode plate.

4. The spiral multi-tab lithium-ion battery according to Claim 3, characterized in that the spaced tabs follow the polar coordinate equation below: $\rho = a\theta + P_0$,

wherein: a is the Archimedean spiral coefficient, in $\text{mm}/^\circ$, representing the increase (or decrease) in polar radius per degree of rotation, $a = L/360$;

θ is the polar angle, in degrees, representing the total angle through which the Archimedean spiral has rotated; θ is used to determine the position at which the tabs are formed,

P_0 is the polar radius when $t = 0^\circ$, in mm,

L = thickness of the positive electrode plate + thickness of the negative electrode plate + thickness of two layers of separator, in mm.

5. The spiral-wound multi-tab lithium-ion battery according to claim 3, characterized in that the spaced-apart tabs are of the same polarity which, after being shaped, overlap upon winding, forming a neatly stacked and independently arranged row of tabs at the end.

6. A method for manufacturing a spiral-wound multi-tab lithium-ion battery, comprising: preparing a positive electrode plate by making an active material into a mixed paste and coating it onto a current collector, reserving a blank area on the front side of one edge of the positive electrode plate along its longitudinal direction, reserving a blank area on the back side of the same edge, and fully coating the remainder with the paste; preparing a negative electrode plate by making an active material into a mixed paste and coating it onto a current collector, reserving a blank area on the front side of one edge of the negative electrode plate along its longitudinal direction, reserving a blank area on the back side of the same edge, and fully coating the remainder with the paste; placing the negative electrode plate on a separator by winding, winding the positive electrode plate, the separator, and the negative electrode plate into a cell, securing the cell with a terminating tape, welding the positive and negative electrodes of the cell, and subjecting the cell to subsequent processes including packaging, vacuum drying, electrolyte injection, sealing, formation, capacity grading, and inspection to obtain the battery; characterized in that a plurality of spaced-apart tabs are provided on the reserved blank area of the positive electrode plate, and a plurality of spaced-apart tabs are provided on the reserved blank area of the negative electrode plate.

7. The method for manufacturing a spiral-wound multi-tab lithium-ion battery according to claim 6, characterized in that the spaced-apart tabs follow the polar coordinate equation: $\rho = a\theta + P_0$,

wherein: a is the Archimedean spiral coefficient, in $\text{mm}/^\circ$, $a = L/360$;

θ is the polar angle, in degrees, θ is used to determine the position at which the tabs are formed,

P_0 is the polar radius when $t = 0^\circ$, in mm,

L = thickness of the positive electrode plate + thickness of the negative electrode plate + thickness of two layers of separator, in mm.

8. The method for manufacturing a spiral-wound multi-tab lithium-ion battery according to claim 6, characterized in that the tabs are formed according to a tab-forming template by roll cutting, die cutting, or laser cutting; the tab-forming template is obtained by winding the electrode plate into a cell, marking the tab positions on

the wound cell, unwinding the electrode plate, measuring the dimensions of the marked points on the electrode plate, and thereby obtaining the spacing dimensions of the multiple tabs on the electrode plate, which serve as the tab-forming template.

9. The method for manufacturing a spiral-wound multi-tab lithium-ion battery according to claim 6, characterized in that the spaced-apart tabs are of the same polarity which, after being shaped, overlap upon winding, forming a neatly stacked and independently arranged row of tabs at the end. The positive tabs and the negative tabs are independently and neatly arranged, and the positive and negative tabs may be disposed at the same end of the cell, or at opposite ends of the cell, respectively.

A Multi-Tab Spiral-Wound Lithium-Ion Battery and Its Manufacturing Method

Technical Field

[0001] The present invention relates to a multi-tab spiral-wound lithium-ion battery and a manufacturing method thereof, belonging to the field of batteries, and in particular to the fabrication of a rechargeable secondary lithium-ion battery having high-rate discharge performance.

Background Art

[0002] Since the advent of lithium-ion batteries, cell assembly has remained a bottleneck in mass battery production and has also played a critical role in battery electrical performance. At present, cell formation for lithium-ion batteries is mainly divided into two types: winding-type and stacking-type, each of which has its own advantages and disadvantages in terms of production and battery performance. The advantage of the winding type is its simple structure, requiring only one positive electrode plate and one negative electrode plate, resulting in a high specific energy; its disadvantage is its long electrode plates, leading to high internal resistance, which is unfavorable for high-current charging and discharging and results in low specific power. The advantage of the stacking type is its short electrode plates, resulting in relatively low internal resistance, which is favorable for high-current charging and discharging; its disadvantages are that the battery requires many electrode plates and numerous edge cuts, making it difficult to control burrs on the cut edges of the plates and generating a large amount of edge scrap. In addition, the stacking process requires many individual plates to be aligned and stacked one by one, resulting in extremely low production efficiency, only about one-tenth that of winding-type batteries. Furthermore, welding multiple layers of electrode plates is difficult, particularly for multi-layer negative electrodes made of copper foil: copper foil has good electrical conductivity, which is unfavorable for resistance welding, and its high melting point is also unfavorable for ultrasonic welding, which may result in cold joints, weak welds, or overwelding. Partial or complete fracture of the electrode plates due to cold joints or overwelding can render part of the negative electrode inactive, resulting in low battery capacity; more seriously, if the positive electrode remains active while the negative electrode becomes inactive, lithium plating may occur during use, resulting in safety accidents. Existing winding-type and stacking-type lithium batteries each have their own drawbacks, which are unfavorable for fast charging and high-current discharging. Even if the positive and negative electrode plates are coated very uniformly, an unreasonable electrode structure and cell design will still result in non-uniform current density distribution during high-current charging and discharging, thereby affecting the battery's safety performance, fast-charging performance, and cycle life under high-current charge-discharge conditions.

[0003] In the existing method for manufacturing multi-tab batteries, multiple tabs protruding from both ends of the cell are obtained by punching the excess foil after the electrode plates have been wound; this method is only suitable for prismatic batteries with tabs extending from both ends, and cannot be used to manufacture cylindrical multi-tab lithium-ion batteries or multi-tab lithium-ion batteries with tabs extending from the same end. Moreover, punching multiple layers of foil makes it difficult to ensure the integrity of the electrode plates.

Summary of the Invention

[0004] An object of the present invention is to overcome the deficiencies of the prior art by providing a multi-tab lithium-ion battery capable of high-rate discharge, which has a simple structure, a high specific energy, relatively low internal resistance, facilitates control of the cut edges of the electrode plates, ensures the integrity of the electrode plates, and offers high production efficiency.

[0005] Another object of the present invention is to overcome the deficiencies of the prior art by providing a method for manufacturing a multi-tab lithium-ion battery having high-rate discharge performance, which has a simple structure, a high specific energy, relatively low internal resistance, facilitates control of the cut edges of the electrode plates, ensures the integrity of the electrode plates, offers high production efficiency, and prevents partial failure of the electrode plates due to poor welding.

[0006] The objects of the present invention are achieved by the following measures. A multi-tab lithium-ion battery electrode plate, wherein an active material is thoroughly mixed with a conductive agent and a binder in a predetermined ratio to form a mixed paste, which is coated onto a current collector; a blank area is reserved on the front side of one edge of the electrode plate along its longitudinal direction, and a blank area is reserved on the back side of the same edge, with the remainder fully coated with the paste; a plurality of spaced-apart tabs are provided on the reserved blank area of the electrode plate.

[0007] A multi-tab lithium-ion battery, comprising a positive electrode plate, a negative electrode plate, and a separator disposed therebetween, wherein an active material is made into a mixed paste and coated onto a current collector; a blank area is reserved on the front side of one edge of the positive electrode plate along its longitudinal direction, and a blank area is reserved on the back side of the same edge, with the remainder fully coated with the

paste; an active material is made into a mixed paste and coated onto a current collector; a blank area is reserved on the front side of one edge of the negative electrode plate along its longitudinal direction, and a blank area is reserved on the back side of the same edge, with the remainder fully coated with the paste; a plurality of spaced-apart tabs are provided on the reserved blank area of the positive electrode plate, and a plurality of spaced-apart tabs are provided on the reserved blank area of the negative electrode plate.

[0008] A method for manufacturing a multi-tab lithium-ion battery, comprising: preparing a positive electrode plate by making an active material into a mixed paste and coating it onto a current collector, reserving a blank area on the front side of one edge of the positive electrode plate along its longitudinal direction, reserving a blank area on the back side of the same edge, and fully coating the remainder with the paste; preparing a negative electrode plate by making an active material into a mixed paste and coating it onto a current collector, reserving a blank area on the front side of one edge of the negative electrode plate along its longitudinal direction, reserving a blank area on the back side of the same edge, and fully coating the remainder with the paste; placing the negative electrode plate on a separator by winding, winding the positive electrode plate, the separator, and the negative electrode plate into a cell, securing the cell with a terminating tape, welding the positive and negative electrodes of the cell, and subjecting the cell to subsequent processes including packaging, vacuum drying, electrolyte injection, sealing, formation, capacity grading, and inspection to obtain the battery; a plurality of spaced-apart tabs are provided on the reserved blank area of the positive electrode plate, and a plurality of spaced-apart tabs are provided on the reserved blank area of the negative electrode plate.

[0009] A lithium-ion battery, comprising: a positive electrode plate, a negative electrode plate, and a separator disposed therebetween, wherein the positive and negative electrode plates each comprise a current collector and an electrode material. A conductive salt is dissolved in an organic solution to form an electrolyte, which permeates the layers of the positive electrode plate, the negative electrode plate, and the separator to activate the battery. The electrode plates are prepared by thoroughly mixing an active material with a conductive agent and a binder in a predetermined ratio to form a mixed paste, which is coated onto the current collector by roll coating, blade coating, spray coating, or the like. To prepare the positive electrode plate, an active material is thoroughly mixed with a conductive agent and a binder in a predetermined ratio to form a mixed paste, which is coated onto a current collector by roll coating, blade coating, spray coating, or the like. A blank area is reserved on the front side of one edge of the positive electrode plate along its longitudinal direction, and a blank area is reserved on the back side of the same edge for use as a tab-welding location; a blank strip is also reserved on the back side of the positive electrode, with the remainder fully coated with the paste. To prepare the negative electrode plate, an active material is thoroughly mixed with a conductive agent and a binder in a predetermined ratio to form a mixed paste, which is coated onto a current collector by roll coating, blade coating, spray coating, or the like. A blank area is reserved on the front side of one edge of the negative electrode plate along its longitudinal direction, and a blank area is reserved on the back side of the same edge, with the remainder fully coated with the paste. A plurality of spaced-apart tabs are provided on the reserved blank area of the positive electrode plate, the spaced-apart tabs being formed by roll cutting, die cutting, or laser cutting. The width of the tabs may be determined based on a comprehensive consideration of the cell width and current-carrying capacity. A plurality of spaced-apart tabs are provided on the reserved blank area of the negative electrode plate, the spaced-apart tabs being formed by roll cutting, die cutting, or laser cutting. The width of the tabs may be determined based on a comprehensive consideration of the cell width and current-carrying capacity. The negative electrode plate is placed on a separator by winding, and the separator is used to wrap the negative electrode plate, with the blank tabs of the negative electrode plate protruding from one side of the separator. After winding half a turn, the positive electrode plate is inserted between the winding pin and the separator, with the blank tabs of the positive electrode plate protruding from the same side as, or the opposite side to, the blank tabs of the negative electrode plate. The positive electrode plate, the separator, and the negative electrode plate are wound into a cell, with the separator wrapped around the outermost layer of the cell and secured with a terminating tape, wherein the separator is 2 mm to 3 mm wider than the negative electrode, and the negative electrode is 1 mm to 2 mm wider than the positive electrode. A neatly stacked row of blank tabs of the negative electrode plate and a neatly stacked row of blank tabs of the positive electrode plate are independently arranged on the cell, formed by a corresponding tab position protruding from each layer of the electrode plate in the cell. The tabs of the positive electrode plate are welded to the positive terminal of the battery, which may be an adhesive-coated aluminum tab of various thicknesses, a cap of a steel-cased battery, or a casing of an aluminum-cased battery. The tabs of the negative electrode plate are welded to the negative terminal of the battery, which may be an adhesive-coated nickel, nickel-plated copper, or copper-nickel alloy tab of various sizes, or a casing of a steel-cased battery, or a cap of an aluminum-cased battery. The cell with the welded positive and negative electrodes is then subjected to subsequent processes including packaging, vacuum drying, electrolyte injection, sealing, formation, capacity grading, and inspection to obtain the battery.

[0010] In the present invention, the plurality of spaced-apart tabs are of the same polarity which, after being shaped, may overlap upon winding, forming a neatly stacked and independently arranged row of tabs at the end, resulting from a corresponding tab position protruding from each layer of the electrode plate.

[0011] In the present invention, the plurality of spaced-apart tabs having a spiral distribution pattern follow the polar coordinate equation:

[0012] $\rho = a\theta + P_0$

- [0013] wherein: a is the Archimedean spiral coefficient, in $\text{mm}/^\circ$, representing the increase (or decrease) in polar radius per degree of rotation, i.e., $a = L/360$;
- [0014] θ is the polar angle, in degrees, representing the total angle through which the Archimedean spiral has rotated;
- [0015] P_0 is the polar radius when $t = 0^\circ$, in mm.
- [0016] L = thickness of the positive electrode plate + thickness of the negative electrode plate + thickness of two layers of separator, in mm.
- [0017] θ is used to determine the position at which the tabs are formed; when the polar angle θ is incremented by integer multiples of π , tabs of the same polarity are ensured to overlap after being formed and wound.
- [0018] In the present invention, the plurality of spaced-apart tabs are formed according to a tab-forming template by roll cutting, die cutting, or laser cutting. The tab-forming template is obtained by winding the electrode plate into a cell, marking the tab positions on the wound cell, unwinding the electrode plate, measuring the dimensions of the marked points on the electrode plate, and thereby obtaining the spacing dimensions of the multiple tabs on the electrode plate to serve as the tab-forming template.
- [0019] When winding is performed using a rectangular winding pin according to the present invention, the tab positions on the wound prismatic cell are marked, the electrode plate is then unwound, and the dimensions of the marked points on the electrode plate are measured to obtain the spacing dimensions of the multiple tabs on the electrode plate, which serve as the tab-forming template for the prismatic cell.
- [0020] When winding is performed using an elliptical winding pin according to the present invention, the tab positions on the wound elliptical cell are marked, the electrode plate is then unwound, and the dimensions of the marked points on the electrode plate are measured to obtain the spacing dimensions of the multiple tabs on the electrode plate, which serve as the tab-forming template for the elliptical cell.
- [0021] The present invention reduces the distance from the electrode plate to the electrode terminal, thereby reducing internal resistance and decreasing heat generation during discharge, and improving safety; it reduces the voltage drop caused by internal resistance, thereby raising the discharge plateau. Since only one positive electrode plate and one negative electrode plate are required, the consistency of the electrode plates is improved, edge corners of the electrode plates are reduced, and burrs are reduced, which reduces internal short circuits and low-voltage defective products compared with stacked-type batteries, thereby improving product yield and assembly efficiency. It also reduces the risk of complete failure of the electrode plate caused by breakage of an individual tab, and is suitable for high-rate discharge, with uniform current density distribution during charging and discharging. Lithium plating is unlikely to occur during high-current charging and discharging, resulting in a long battery cycle life and high safety. Since the positive and negative electrode plates are each formed as a single continuous piece, low-capacity phenomena do not occur, and localized lithium plating leading to safety accidents is highly suppressed; this solves the problem of small batteries being unsuitable for the stacking process.

Brief Description of the Drawings

- [0022] FIG. 1 is a front view of the coated positive electrode plate of the present invention.
- [0023] FIG. 2 is a rear view of the coated positive electrode plate of the present invention.
- [0024] FIG. 3 is a cross-sectional view of the positive electrode plate of the present invention.
- [0025] FIG. 4 is a front view of the coated negative electrode plate of the present invention.
- [0026] FIG. 5 is a rear view of the coated negative electrode plate of the present invention.
- [0027] FIG. 6 is a cross-sectional view of the negative electrode plate of the present invention.
- [0028] FIG. 7 is a front view of the positive electrode plate of the present invention after tab formation.
- [0029] FIG. 8 is a front view of the negative electrode plate of the present invention after tab formation.
- [0030] FIG. 9 is a schematic view showing the positions of the positive electrode, the negative electrode, and the separator during winding according to the present invention.
- [0031] FIG. 10 is a schematic cross-sectional view taken along line Z-Z of FIG. 9.
- [0032] FIG. 11 is a schematic view of the cell after winding according to the present invention.
- [0033] FIG. 12 is a schematic view of the cell assembly after the tabs have been welded according to the present invention.

Detailed Description of Embodiments

[0034] The present invention is further described below with reference to the accompanying drawings.

[0035] As shown in FIGS. 1, 2, and 3, in the present invention, an active material is thoroughly mixed with a conductive agent and a binder in a predetermined ratio to form a mixed paste, which is coated onto a current collector by roll coating, blade coating, spray coating, or the like. Paste 12 is coated on the front side of the positive electrode plate, with a blank area 11 reserved on the front side of one edge of the positive electrode plate along its longitudinal direction; paste 22 is coated on the back side of the positive electrode plate, with a blank area 21 reserved on the back side of the same edge along the longitudinal direction.

[0036] As shown in FIGS. 4, 5, and 6, in the present invention, a blank area 41 is reserved on the front side of one edge of the negative electrode plate along its longitudinal direction, with the remainder coated with paste 42; a blank area 51 is reserved on the back side of the same edge along the longitudinal direction, with the remainder coated with paste 52. To accommodate the tail-wrapping of the negative electrode at the end of winding, in addition to the blank area 51 reserved at one edge on the back side of the negative electrode plate, an additional blank strip 53 is reserved on the back side to reduce battery weight, with the remainder fully coated.

[0037] As shown in FIG. 7, in the present invention, a plurality of spaced-apart tabs 71 are provided on the reserved blank area of the positive electrode plate, the spaced-apart tabs being formed by roll cutting, die cutting, or laser cutting. The width of the tabs may be determined based on a comprehensive consideration of the cell width and current-carrying capacity.

[0038] A plurality of spaced-apart tabs 71 are provided on the reserved blank area of the positive electrode plate, the spaced-apart tabs being formed by roll cutting, die cutting, or laser cutting. The width of the tabs may be determined based on a comprehensive consideration of the cell width and current-carrying capacity. In this embodiment, the tabs having a spiral distribution pattern have a width of 6.5 mm, and the tab spacing varies with the number of turns of the wound electrode plate. Using a rectangular winding pin according to the present invention, the tab positions on the wound prismatic cell are marked, the electrode plate is then unwound, and the dimensions of the marked points on the electrode plate are measured, yielding the following specific spacing distribution of the multiple tabs on the electrode plate: 1.5 mm, 30.5 mm, 6 mm, 31 mm, 6.5 mm, 32 mm, 7.5 mm, 33 mm, 8.5 mm, 34 mm, 9 mm, 35 mm, 9.5 mm, 36 mm, and 10.5 mm.

[0039] As shown in FIG. 8, in the present invention, spaced-apart tabs 81 are provided on the reserved blank area of the negative electrode plate, the spaced-apart tabs being formed by roll cutting, die cutting, or laser cutting. The width of the tabs may be determined based on a comprehensive consideration of the cell width and current-carrying capacity. In this embodiment, the tabs having a spiral distribution pattern have a width of 6.5 mm, and the tab spacing varies with the number of turns of the wound electrode plate. Using a rectangular winding pin according to the present invention, the tab positions on the wound prismatic cell are marked, the electrode plate is then unwound, and the dimensions of the marked points on the electrode plate are measured, yielding the following specific spacing distribution of the multiple tabs on the electrode plate: 1.5 mm, 30.5 mm, 6 mm, 31 mm, 6.5 mm, 32 mm, 7.5 mm, 33 mm, 8.5 mm, 34 mm, 9 mm, 35 mm, 9.5 mm, 36 mm, 10.5 mm, and 36.5 mm.

[0040] The spaced-apart tabs follow the polar coordinate equation:

$$[0041] \quad \rho = a\theta + P_0$$

[0042] wherein:

[0043] a is the Archimedean spiral coefficient, in mm/°, representing the increase (or decrease) in polar radius per degree of rotation, i.e., $a = L/360$;

[0044] θ is the polar angle, in degrees, representing the total angle through which the Archimedean spiral has rotated;

[0045] P_0 is the polar radius when $t = 0^\circ$, in mm.

[0046] L = thickness of the positive electrode plate + thickness of the negative electrode plate + thickness of two layers of separator.

[0047] θ is used to determine the position at which the tabs are formed; when the polar angle θ is incremented by integer multiples of π , tabs of the same polarity are ensured to overlap after being formed and wound.

[0048] As shown in FIGS. 9 and 10, during winding according to the present invention, the negative electrode plate 102 is placed on the separator 103, and the separator wraps the negative electrode plate entirely; the negative electrode plate 102 is disposed within the separator 103, with the tabs 81 of the negative electrode plate protruding

from one side of the separator, and the coated portion of the negative electrode plate positioned centrally within the separator. After winding half a turn, the positive electrode plate 101 is placed on the separator, with the tabs 71 of the positive electrode plate protruding from the same side of the separator as the tabs of the negative electrode plate. The positive electrode plate, the separator, and the negative electrode plate are wound into a cell, with the separator wrapping the outermost layer and secured with a terminating tape.

[0049] As shown in FIG. 11, a neatly stacked row of negative electrode plate tabs 111 and a neatly stacked row of positive electrode plate tabs 112 are formed at the top of the cell according to the present invention. First, a tab-forming template is prepared: after the electrode plate is wound into a cell, the tab positions on the wound cell are marked, the electrode plate is then unwound, and the dimensions of the marked points on the electrode plate are measured to obtain the spacing dimensions of the multiple tabs on the electrode plate, thereby obtaining the tab-forming template. The spaced-apart tabs of the negative electrode plate are then formed in accordance with the tab-forming template by roll cutting, die cutting, or laser cutting. The spaced-apart tabs of the positive electrode plate are formed in accordance with the tab-forming template by roll cutting, die cutting, or laser cutting. The negative electrode plate is placed on the separator by winding, and the separator wraps the negative electrode plate, with the blank tabs of the negative electrode plate protruding from one side of the separator. After winding half a turn, the positive electrode plate is inserted between the winding pin and the separator, with the blank tabs of the positive electrode plate also protruding from the same side as the blank tabs of the negative electrode plate. The positive electrode plate, the separator, and the negative electrode plate are wound into a cell, with the separator wrapping the outermost layer of the cell and secured with a terminating tape, wherein the separator is 2 mm to 3 mm wider than the negative electrode, and the negative electrode is 1 mm to 2 mm wider than the positive electrode. A neatly stacked row of blank tabs of the negative electrode plate and a neatly stacked row of blank tabs of the positive electrode plate are independently arranged on the cell, resulting from a corresponding tab position protruding from each layer of the electrode plate in the cell.

[0050] As shown in FIG. 12, in the present invention, the neatly stacked row of positive electrode plate tabs is welded and secured to an adhesive-coated aluminum tab 121 by ultrasonic welding, and likewise, the neatly stacked row of negative electrode plate tabs is welded and secured to an adhesive-coated nickel tab 122 by ultrasonic welding, thereby completing the assembly of the wound cell having multiple tabs distributed according to a spiral pattern.

[0051] The cell with the welded positive and negative electrodes is then subjected to subsequent processes including packaging, vacuum drying, electrolyte injection, sealing, formation, capacity grading, and inspection to obtain the battery.

[0052] The implementation methods are not limited to the examples described above; any manufacture of lithium-ion batteries by winding and assembly employing the essence of the present invention falls within the scope of protection of the present invention. For example, although the present invention preferably winds one positive electrode, one separator, and one negative electrode into a single cell, it is also possible to intentionally wind two or more positive electrodes, two or more separators, and two or more negative electrodes into two or more cells, which are then stacked and welded in parallel to increase capacity; alternatively, one or more additional turns of separator may be intentionally wound around the outside of the wound cell. Similarly, although the present invention preferably has the tabs protruding from the same end of the cell, they may also protrude separately from both ends of the cell. Likewise, although the present invention preferably employs a prismatic battery, it may also be made into an elliptical or cylindrical battery.

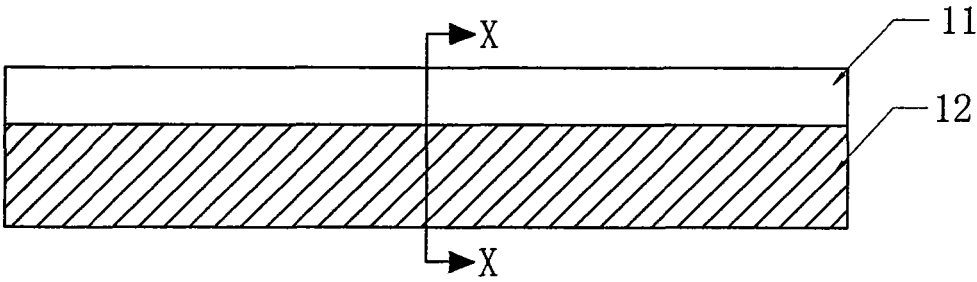


FIG. 1

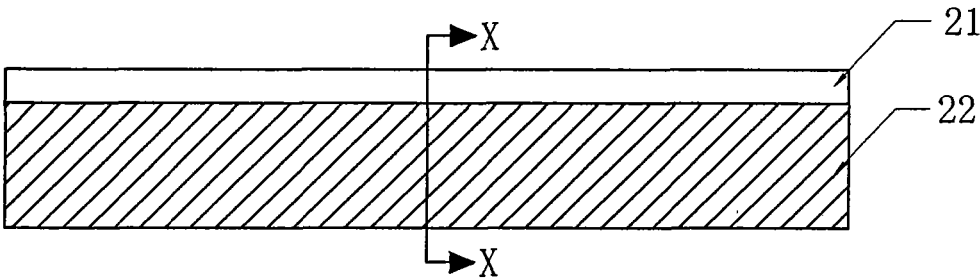
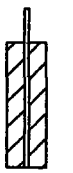


FIG. 2



X-X

FIG. 3

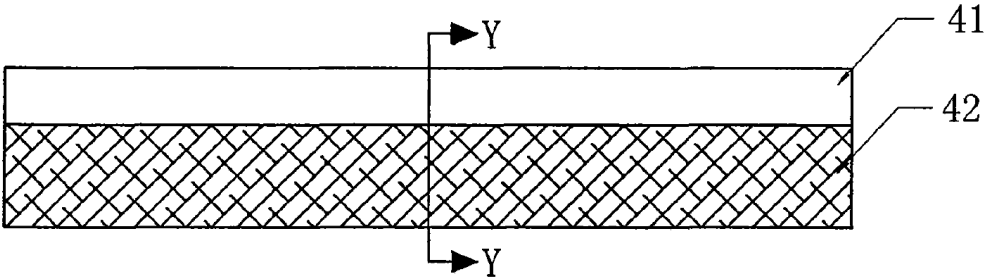


FIG. 4

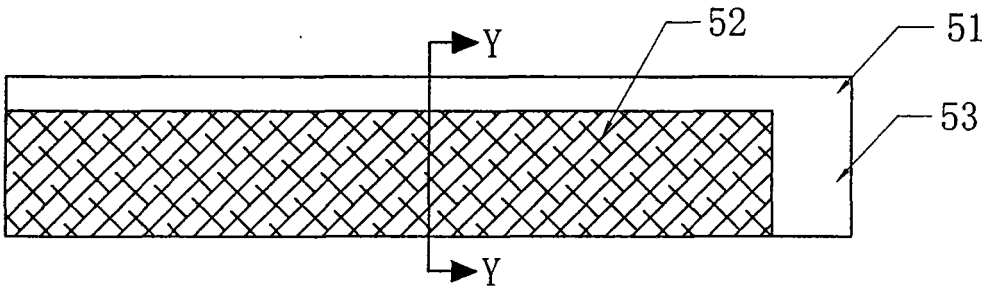


FIG. 5



Y-Y

FIG. 6

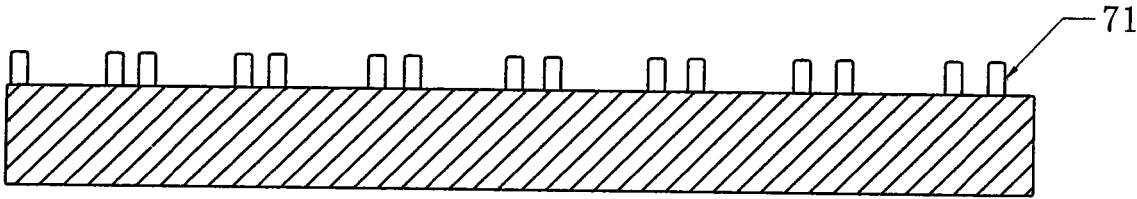


FIG. 7

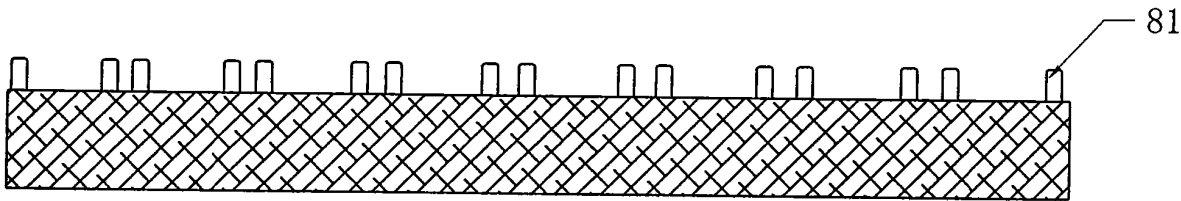


FIG. 8

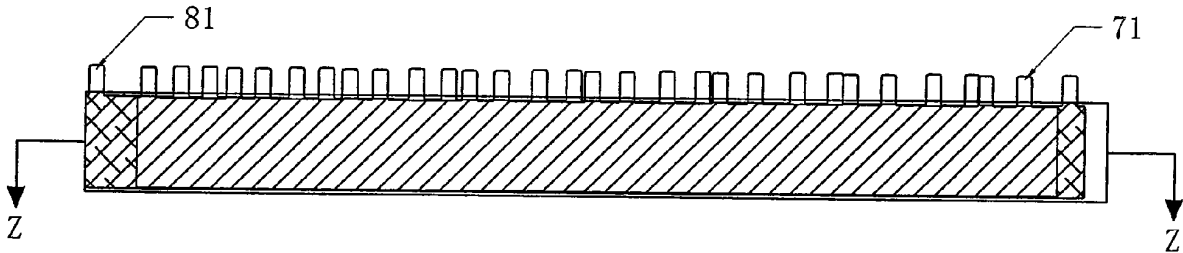


FIG. 9

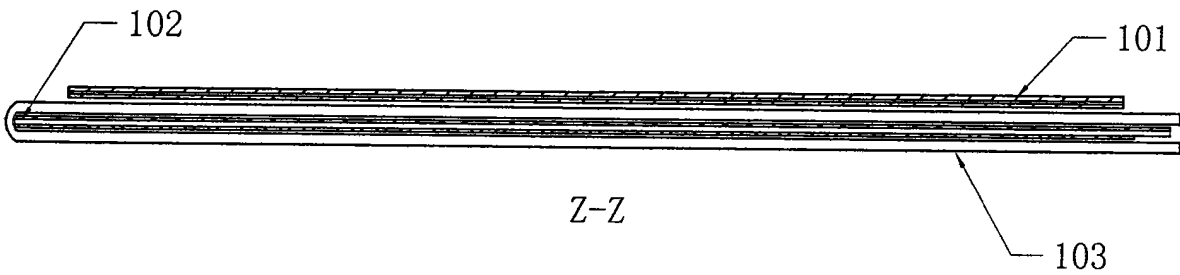


FIG. 10

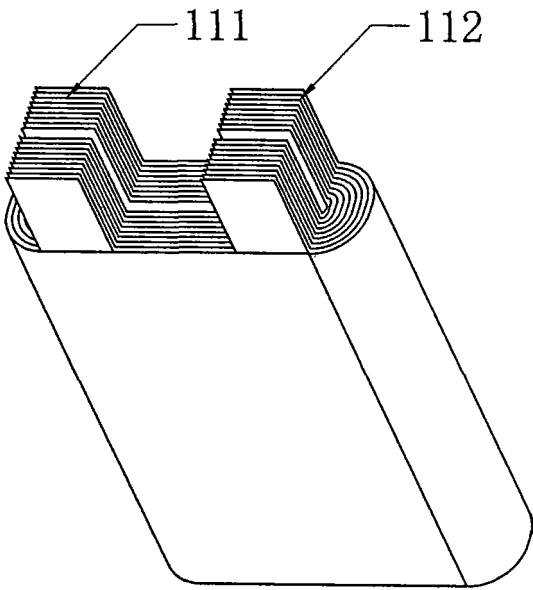


FIG. 11

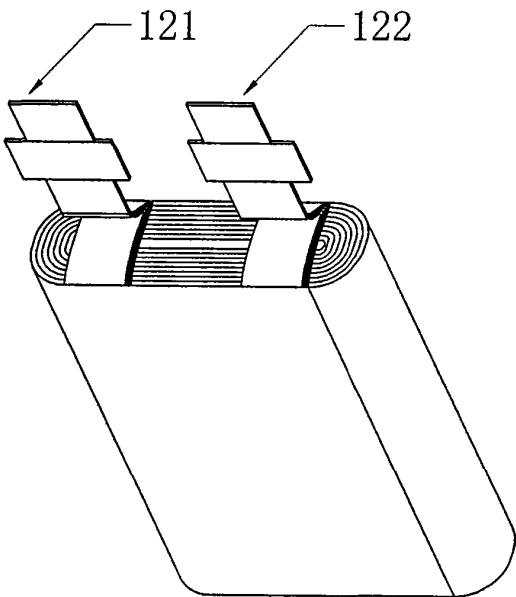


FIG. 12



DECLARATION OF TRANSLATOR

I, Ma Yanli, hereby declare as follows:

1. I personally performed the attached translation from Chinese into English of the patent that is entitled “CN_101714624_A” in Chinese and “CN_101714624_A” in English (also attached).
2. The attached translation is, to the best of my knowledge, a true, full and accurate translation of the attached Chinese document.
3. I am competent to perform this translation because I hold a Test for English Majors-Band 8 (TEM-8) certificate, and have over 20 years of professional translation experience.
4. I declare under the penalty of perjury under the laws of the United States that the foregoing is true and correct; and further declare that I am aware that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 1001 of Title 18 of the United States Code.

Dated: 6 July 2026

TRANSLATORS' SIGNATURE

Ma Yan Li

(Bibliographic information, abstract, specifications)

(Claims, drawings)



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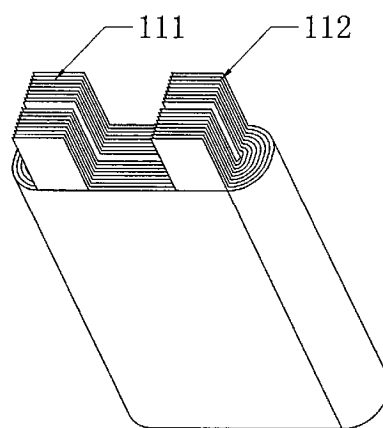
权利要求书 2 页 说明书 5 页 附图 3 页

(54) 发明名称

一种螺旋线多极耳锂离子电池及其制造方法

(57) 摘要

本发明一种螺旋线多极耳锂离子电池及其制造方法属于电池领域,包括正极片、负极片和置于其间的隔膜,活性物质制成混合膏体涂覆到集流体上,在正极片的长度方向的 1 个边缘正面预留出空白位置,在正极片的长度方向的 1 个边缘背面预留出空白位置,其余部分涂满膏体,活性物质制成混合膏体涂覆到集流体上,在负极片的长度方向的 1 个边缘正面预留出空白位置,在负极片的长度方向的 1 个边缘背面预留出空白位置,其余部分涂满膏体,其特征是在正极片的预留空白位置上设置有间隔的极耳,在负极片的预留空白位置上设置有间隔的极耳。本发明减小极片到电极端子的距离,减小内阻,放电时减少热生成,提高安全性,提高成品率,解决小电池不适于叠片的难题。



1. 一种螺旋线多极耳锂离子电池极片, 活性物质与导电剂、粘接剂按一定比例充分混合后制成混合膏体, 涂覆到集流体上, 在极片的长度方向的 1 个边缘正面预留出空白位置, 在极片的长度方向的 1 个边缘背面预留出空白位置, 其余部分涂满膏体, 其特征是在极片的预留空白位置上设置多条有间隔的极耳。

2. 根据权利要求 1 所述的一种螺旋线多极耳锂离子电池极片, 其特征是间隔的极耳是同一极性的极耳成型后, 卷绕出来重叠, 在端部有一叠整齐的极耳独立排列。

3. 一种螺旋线多极耳锂离子电池, 包括正极片、负极片和置于其间的隔膜, 活性物质制成混合膏体涂覆到集流体上, 在正极片的长度方向的 1 个边缘正面预留出空白位置, 在正极片的长度方向的 1 个边缘背面预留出空白位置, 其余部分涂满膏体, 活性物质制成混合膏体涂覆到集流体上, 在负极片的长度方向的 1 个边缘正面预留出空白位置, 在负极片的长度方向的 1 个边缘背面预留出空白位置, 其余部分涂满膏体, 其特征是在正极片的预留空白位置上设置多条有间隔的极耳, 在负极片的预留空白位置上设置多条有间隔的极耳。

4. 根据权利要求 3 所述的一种螺旋线多极耳锂离子电池, 其特征是间隔的极耳是遵循以下极坐标方程: $\rho = a\theta + P_0$,

式中: a -阿基米德螺旋线系数, 单位为 $\text{mm}/^\circ$, 表示每旋转 1 度时极径的增加 (或减小) 量, $a = L/360$;

θ -极角, 单位为度, 表示阿基米德螺旋线转过的总度数; θ 用来确定极耳成型的位置,

P_0 -当 $t = 0^\circ$ 时的极径, 单位为 mm ,

L = 正极片厚度 + 负极片厚度 + 2 层隔膜厚度, 单位为 mm 。

5. 根据权利要求 3 所述的一种螺旋线多极耳锂离子电池, 其特征是间隔的极耳是同一极性的极耳成型后, 卷绕出来重叠, 在端部有一叠整齐的极耳独立排列。

6. 一种螺旋线多极耳锂离子电池制造方法, 制作正极片, 将活性物质制成混合膏体涂覆到集流体上, 在正极片的长度方向的 1 个边缘正面预留出空白位置, 在正极片的长度方向的 1 个边缘背面预留出空白位置, 其余部分涂满膏体, 制作负极片, 将活性物质制成混合膏体涂覆到集流体上, 在负极片的长度方向的 1 个边缘正面预留出空白位置, 在负极片的长度方向的 1 个边缘背面预留出空白位置, 其余部分涂满膏体, 采用卷绕的方式将负极片放在隔膜上, 将正极片、隔膜和负极片卷绕成电芯, 用终止胶带固定, 将焊好正、负极的电芯进行后工序的封装、真空干燥、注液、封口、化成、分容、检验, 得到电池, 其特征是在正极片的预留空白位置上设置多条有间隔的极耳, 在负极片的预留空白位置上设置多条有间隔的极耳。

7. 根据权利要求 6 所述的一种螺旋线多极耳锂离子电池制造方法, 其特征是间隔的极耳是遵循以下极坐标方程: $\rho = a\theta + P_0$,

式中: a -阿基米德螺旋线系数, 单位为 $\text{mm}/^\circ$, $a = L/360$;

θ -极角, 单位为度, θ 用来确定极耳成型的位置,

P_0 -当 $t = 0^\circ$ 时的极径, 单位为 mm ,

L = 正极片厚度 + 负极片厚度 + 2 层隔膜厚度, 单位为 mm 。

8. 根据权利要求 6 所述的一种螺旋线多极耳锂离子电池制造方法, 其特征是极耳是通过按照极耳成型模板, 通过滚切或刀模冲切或激光切割方式制作, 极耳成型模板是通过极

片卷绕成电芯后,对卷绕好的电芯的极耳位置作出标记后,展开极片,测量极片上标记点的尺寸,获得极片上多极耳间距的尺寸,作为极耳成型模板。

9. 根据权利要求6所述的一种螺旋线多极耳锂离子电池制造方法,其特征是间隔的极耳是同一极性的极耳成型后,卷绕出来重叠,在端部有一叠整齐的极耳独立排列。正极耳和负极耳独立整齐排列,正、负极耳可以分布在电芯的同一端,也可以分别在电芯的两端。

一种螺旋线多极耳锂离子电池及其制造方法

技术领域

[0001] 本发明一种螺旋线多极耳锂离子电池及其制造方法属于电池领域,特别是涉及一种有高倍率放电性能的可充放电的二次锂离子电池的制作。

背景技术

[0002] 锂离子电池自问世以来,电芯的装配一直是电池批量生产的瓶颈,同时对电性能的影响也起着关键的作用。目前,锂离子电池的电芯成型主要分为卷绕式和叠片式两类,这两种装配方式在生产和电池性能上各有其优缺点:卷绕式的优点是结构简单,只需 1 片正极和 1 片负极,电池比能量大,其缺点是,极片长,电池内阻大,不利于大电流充放电,比功率小;叠片式的优点是极片短,电池内阻相对较小,有利于大电流充放电,其缺点是电池极片多,切边多,不利于极片切边毛刺的控制,产生边料多,叠片过程需由很多片一片一片对位堆叠而成,生产效率极低,只有卷绕电池的 10 分之 1,另外,多层极片焊接有困难,特别多层负极,使用的是铜箔,铜箔导电性好,不利于电阻焊,铜箔熔点高,也不利于超声焊,可能虚焊,焊不牢,也可能过焊,部分极片焊断或部分焊断,出现虚焊和过焊,都会使部分负极或不起作用,电池低容,更严重的是正极起作用而负极不起作用,会在使用过程中产生析锂而出现安全事故。现有的卷绕式和叠片式锂电池,都各有缺点,不利于快速充电和大电流放电。即使正负极片涂布非常均匀,不合理的电极结构和电芯设计,在大电流充放电时都会表现出电流密度分布不均匀,从而影响电池的安全性能、快充性能和大电流充放电循环寿命。

[0003] 现有的多极耳电池的制作方法是通过极片卷绕后对多余的箔料进行冲切得到从电芯两头伸出的多极耳,这种方式只适合于两头出极耳的方形电池,无法实现圆柱形多极耳锂离子电池和同一头出极耳的多极耳锂离子电池的制作,并且对多层箔料进行冲切,很难保证极片的完整性。

发明内容

[0004] 本发明的目的在于避免现有技术的不足之处,而提供一种结构简单,电池比能量大,电池内阻相对较小,有利于极片切边控制,保证极片的完整性,生产效率高的多极耳锂离子电池。

[0005] 本发明的目的在于避免现有技术的不足之处,而提供一种结构简单,电池比能量大,电池内阻相对较小,有利于极片切边控制,保证极片的完整性,生产效率高的多极耳锂离子电池的,防止部分极片由于焊接不良失效的多极耳锂离子电池制造方法。

[0006] 本发明的目的是通过以下措施来达到的,多极耳锂离子电池极片,活性物质与导电剂、粘接剂按一定比例充分混合后制成混合膏体,涂覆到集流体上,在极片的长度方向的 1 个边缘正面预留出空白位置,在极片的长度方向的 1 个边缘背面预留出空白位置,其余部分涂满膏体,在极片的预留空白位置上设置多条有间隔的极耳。

[0007] 多极耳锂离子电池,包括正极片、负极片和置于其间的隔膜,活性物质制成混合膏体涂覆到集流体上,在正极片的长度方向的 1 个边缘正面预留出空白位置,在正极片的长

度方向的 1 个边缘背面预留出空白位置,其余部分涂满膏体,活性物质制成混合膏体涂覆到集流体上,在负极片的长度方向的 1 个边缘正面预留出空白位置,在负极片的长度方向的 1 个边缘背面预留出空白位置,其余部分涂满膏体,在正极片的预留空白位置上设置有间隔的极耳,在负极片的预留空白位置上设置多条有间隔的极耳。

[0008] 多极耳锂离子电池制造方法,制作正极片,将活性物质制成混合膏体涂覆到集流体上,在正极片的长度方向的 1 个边缘正面预留出空白位置,在正极片的长度方向的 1 个边缘背面预留出空白位置,其余部分涂满膏体,制作负极片,将活性物质制成混合膏体涂覆到集流体上,在负极片的长度方向的 1 个边缘正面预留出空白位置,在负极片的长度方向的 1 个边缘背面预留出空白位置,其余部分涂满膏体,采用卷绕的方式将负极片放在隔膜上,将正极片、隔膜和负极片卷绕成电芯,用终止胶带固定,将焊好正、负极的电芯进行后工序的封装、真空干燥、注液、封口、化成、分容、检验,得到电池,在正极片的预留空白位置上设置多条有间隔的极耳,在负极片的预留空白位置上设置多条有间隔的极耳。

[0009] 锂离子电池,包括正极片、负极片和置于其间的隔膜,正、负极片都分别包含集流体和电极物质,导电盐溶解于有机溶液中构成电解液,渗透到正极片、负极片和隔膜各层间,激活电池,极片是通过将活性物质与导电剂、粘接剂按一定比例充分混合后制成混合膏体,通过辊涂、刮涂或喷涂等方法涂覆到集流体上。制作正极片,将活性物质与导电剂、粘接剂按一定比例充分混合后制成混合膏体,通过辊涂、刮涂或喷涂等方法涂覆到集流体上,在正极片的长度方向的 1 个边缘正面预留出空白位置,在正极片的长度方向的 1 个边缘背面预留出空白位置,用于极耳焊接位,正极背面留出一圈空白,其余部分涂满膏体。制作负极片,将活性物质与导电剂、粘接剂按一定比例充分混合后制成混合膏体,通过辊涂、刮涂或喷涂等方法涂覆到集流体上,在负极片的长度方向的 1 个边缘正面预留出空白位置,在负极片的长度方向的 1 个边缘背面预留出空白位置,其余部分涂满膏体。在正极片的预留空白位置上设置多条有间隔的极耳,间隔的极耳是通过滚切、刀模冲切或激光切割方式制作。极耳的宽度可以根据电芯宽度和过电流能力综合考虑得到。在负极片的预留空白位置上设置多条有间隔的极耳,间隔的极耳是通过滚切、刀模冲切或激光切割方式制作。极耳的宽度可以根据电芯宽度和过电流能力综合考虑得到。采用卷绕的方式将负极片放在隔膜上,用隔膜将负极片包裹住,负极片的空白极耳在隔膜一侧边伸出,卷半圈后将正极片插入卷针和隔膜之间,正极片的空白极耳也在负极片的空白极耳同一侧或另一侧伸出,将正极片、隔膜和负极片卷绕成电芯,隔膜围绕电芯外圈,用终止胶带固定,其中隔膜比负极宽 2-3mm,负极比正极宽 1-2mm;在电芯上有一叠整齐的负极片的空白极耳和一叠整齐的正极片的空白极耳独立排列,这是由电芯的每一层极片上均有一条相应的极耳位伸出形成,将正极片极耳跟电池的正极焊接,正极可以是各种厚度的带胶铝极耳,也可以是钢壳电池的盖帽、铝壳电池的外壳,将负极片极耳跟电池的负极焊接,负极可以是各种尺寸的带胶镍、镀镍铜、铜镍合金极耳或者是钢壳电池的外壳、铝壳电池的盖帽,将焊好正、负极的电芯进行后工序的封装、真空干燥、注液、封口、化成、分容、检验,得到电池。

[0010] 本发明多条间隔的极耳是同一极性的极耳成型后,卷绕出来可以重叠,在端部有一叠整齐的极耳独立排列,这是由每一层极片上均有一条相应的极耳位伸出形成。

[0011] 本发明具有螺旋线分布规律多条间隔的极耳是遵循以下极坐标方程:

[0012] $\rho = a \theta + P_0$

[0013] 式中： a —阿基米德螺旋线系数，单位为 $\text{mm}/^\circ$ ，表示每旋转 1 度时极径的增加（或减小）量，即 $a = L/360$ ；

[0014] θ —极角，单位为度，表示阿基米德螺旋线转过的总度数；

[0015] P_0 —当 $t = 0^\circ$ 时的极径，单位为 mm 。

[0016] L = 正极片厚度 + 负极片厚度 + 2 层隔膜厚度，单位为 mm 。

[0017] θ 用来确定极耳成型的位置，当极角 θ 以 π 的整数倍递增时，保证同一极性的极耳成型后卷绕出来可以重叠。

[0018] 本发明多条间隔的极耳是通过按照极耳成型模板，通过滚切或刀模冲切或激光切割方式制作。极耳成型模板是通过极片卷绕成电芯后，对卷绕好的电芯的极耳位置作出标记后，展开极片，测量极片上标记点的尺寸，获得极片上多条极耳间距的尺寸，作为极耳成型模板。

[0019] 本发明使用方形卷针进行卷绕时，对卷绕好的方形电芯的极耳位置作出标记后，展开极片，测量极片上标记点的尺寸，获得极片上多条极耳间距的尺寸，作为方形电芯的极耳成型模板。

[0020] 本发明使用椭圆形卷针进行卷绕时，对卷绕好的椭圆形电芯的极耳位置作出标记后，展开极片，测量极片上标记点的尺寸，获得极片上多条极耳间距的尺寸，作为椭圆形电芯的极耳成型模板。

[0021] 本发明减小极片到电极端子的距离，减小内阻，放电时减少热生成，提高安全性；减小内阻产生的压降，提高放电平台；正极只需要 1 片，负极也只需要 1 片，提高了极片的一致性，极片边角减少，毛刺减少，比叠片型电池减少内短路和低压的不良品，提高成品率，提高装配效率，同时也减小了个别极耳断裂导致极片完全失效的风险，适于高倍率放电，充放电电流分布均匀，在进行大电流充放电时，不容易产生析锂，电池循环寿命长，安全性高；正、负极片是连通一体的，不会出现低容现象，也不易发生局部析锂而产生安全事故；解决小电池不适于叠片的难题。

附图说明

[0022] 附图 1 是本发明涂覆后的正极片正面图。

[0023] 附图 2 是本发明涂覆后正极片反面图。

[0024] 附图 3 是本发明正极片截面图。

[0025] 附图 4 是本发明涂覆后负极片正面图。

[0026] 附图 5 是本发明涂覆后负极片反面图。

[0027] 附图 6 是本发明负极片截面图。

[0028] 附图 7 是本发明极耳成型后的正极片正面图。

[0029] 附图 8 是本发明极耳成型后的负极片正面图。

[0030] 附图 9 是本发明卷绕时正极、负极、隔膜位置示意图。

[0031] 附图 10 是本发明附图 9 的 Z-Z 截面示意图。

[0032] 附图 11 是本发明卷绕后电芯示意图。

[0033] 附图 12 是本发明电芯装配焊接极耳后的示意图。

具体实施方式

[0034] 以下结合附图对本发明作进一步说明。

[0035] 如附图 1、附图 2、附图 3 所示,本发明将活性物质与导电剂、粘接剂按一定比例充分混合后制成混合膏体,通过辊涂、刮涂或喷涂等方法涂覆到集流体上,在正极片的正面涂覆膏体 12,在正极片的长度方向的 1 个边缘正面预留出空白位置 11,在正极片的背面涂覆膏体 22,在正极片的长度方向的 1 个边缘背面预留出空白位置 21。

[0036] 如附图 4、附图 5、附图 6 所示,本发明负极片在长度方向的 1 个边缘正面留出空白位置 41,其余部分涂满膏体 42,负极片在长度方向的同 1 个边缘背面留出空白位置 51,其余部分涂满膏体 52;设计卷绕结束负极包尾,负极片背面除了 1 个边缘留出空白位置 51,背面再留出一圈空白位置 53,以减轻电池重量,其余涂满。

[0037] 如附图 7 所示,本发明在正极片的预留空白位置上设置多条有间隔的极耳 71,间隔的极耳是通过滚切或刀模冲切或激光切割方式制作。极耳的宽度可以根据电芯宽度和过电流能力综合考虑得到。

[0038] 在正极片的预留空白位置上设置多条有间隔的极耳 71,间隔的极耳是通过滚切或刀模冲切或激光切割方式制作。极耳的宽度可以根据电芯宽度和过电流能力综合考虑得到,本案例涉及的具有螺旋线分布规律的极耳宽度为 6.5mm,极耳间距是随着极片卷绕的圈数而变,由本发明使用方形卷针进行卷绕,对卷绕好的方形电芯的极耳位置作出标记后,展开极片,测量极片上标记点的尺寸,获得极片上多极耳具体间距分布为:1.5mm、30.5mm、6mm、31mm、6.5mm、32mm、7.5mm、33mm、8.5mm、34mm、9mm、35mm、9.5mm、36mm、10.5mm。

[0039] 如附图 8 所示,本发明在负极片的预留空白位置上设置有间隔的极耳 81,间隔的极耳是通过滚切、刀模冲切或激光切割方式制作。极耳的宽度可以根据电芯宽度和过电流能力综合考虑得到,本案例涉及的具有螺旋线分布规律的极耳宽度为 6.5mm,极耳间距是随着极片卷绕的圈数而变,由本发明使用方形卷针进行卷绕,对卷绕好的方形电芯的极耳位置作出标记后,展开极片,测量极片上标记点的尺寸,获得极片上多极耳具体间距分布为:1.5mm、30.5mm、6mm、31mm、6.5mm、32mm、7.5mm、33mm、8.5mm、34mm、9mm、35mm、9.5mm、36mm、10.5mm、36.5mm。

[0040] 间隔的极耳是遵循以下极坐标方程:

$$[0041] \quad \rho = a \theta + P_0$$

[0042] 式中:

[0043] a —阿基米德螺旋线系数,mm/°,表示每旋转 1 度时极径的增加(或减小)量,即 $a = L/360$;

[0044] θ —极角,单位为度,表示阿基米德螺旋线转过的总度数;

[0045] P_0 —当 $t = 0^\circ$ 时的极径,mm。

[0046] $L = \text{正极片厚度} + \text{负极片厚度} + 2 \text{ 层隔膜厚度}$ 。

[0047] θ 用来确定极耳成型的位置,当极角 θ 以 π 的整数倍递增时,保证同一极性的极耳成型后卷绕出来可以重叠。

[0048] 如附图 9 和附图 10 所示,本发明卷绕时负极片 102 放在隔膜 103 上,用隔膜将负极片整个包裹住,负极片 102 在隔膜 103 中,负极片极耳 81 在隔膜一侧边伸出,负极片的敷料部分处于隔膜的居中位置;先卷绕半圈再将正极片 101 放在隔膜上,正极片极耳 71 与负

极片在隔膜的同一边伸出,将正极片、隔膜和负极片卷绕成电芯,隔膜包裹最外圈,用终止胶带固定。

[0049] 如附图 11 所示,本发明电芯顶部形成一叠整齐的负极片极耳 111 和一叠整齐的正极片极耳 112。首先制作极耳成型模板,通过极片卷绕成电芯后,对卷绕好的电芯的极耳位置作出标记后,展开极片,测量极片上标记点的尺寸,获得极片上多极耳间距的尺寸,得到极耳成型模板,负极片间隔的极耳是通过按照极耳成型模板,通过滚切、刀模冲切或激光切割方式制作。正极片间隔的极耳是通过按照极耳成型模板,通过滚切、刀模冲切或激光切割方式制作。采用卷绕的方式将负极片放在隔膜上,用隔膜将负极片包裹住,负极片的空白极耳在隔膜一侧边伸出,卷半圈后将正极片插入卷针和隔膜之间,正极片的空白极耳也在负极片的空白极耳同一侧伸出,将正极片、隔膜和负极片卷绕成电芯,隔膜围绕电芯外圈,用终止胶带固定,其中隔膜比负极宽 2-3mm,负极比正极宽 1-2mm;在电芯上有一叠整齐的负极片的空白极耳和一叠整齐的正极片的空白极耳独立排列,这是由电芯的每一层极片上均有一条相应的极耳位伸出形成。

[0050] 如附 12 所示,本发明通过超声波焊接将一叠整齐的正极片极耳与带极耳胶的铝极耳 121 焊接固定,同样通过超声波焊接将一叠整齐的负极片极耳与带极耳胶的镍极耳 122 焊接固定,即完成了具有螺旋线规律分布的多极耳卷绕电芯的装配。

[0051] 将焊好正、负极的电芯进行后工序的封装、真空干燥、注液、封口、化成、分容、检验,得到电池。

[0052] 实施的方法不限于上述例子,只要使用本发明的精髓进行卷绕和组装来制造锂离子电池,都属于本发明的保护范围。比如本发明优选 1 条正极、1 条隔膜、1 条负极卷绕成 1 个电芯,也可以刻意将 2 条或多条正极、2 条或多条隔膜、2 条或多条负极卷绕成 2 个或多个电芯,再叠合并联焊接,以加大容量;或者刻意在卷绕电芯外多卷一圈或一圈以上的隔膜;比如本发明优选极耳在电芯的同一端伸出,也可以分别从电芯的两端伸出;比如本发明优选方形电池,也可以制作成椭圆形或是圆柱形电池。

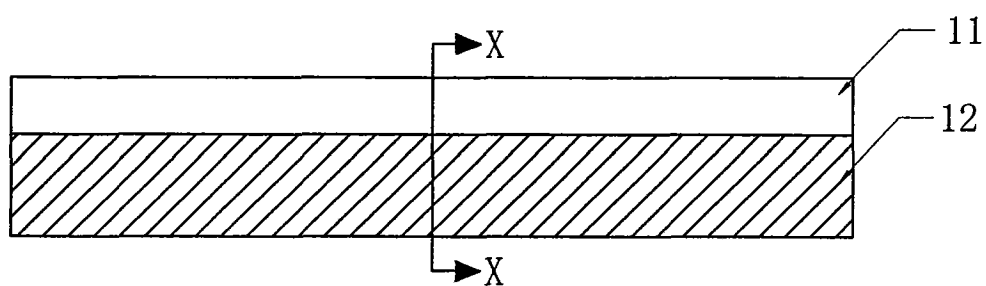


图 1

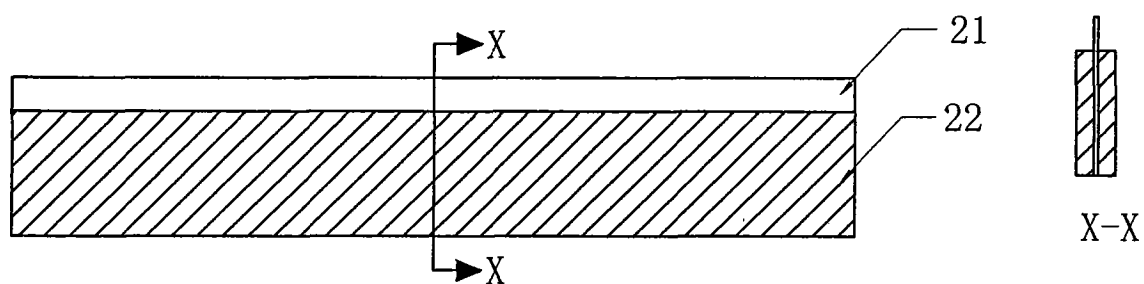


图 3

图 2

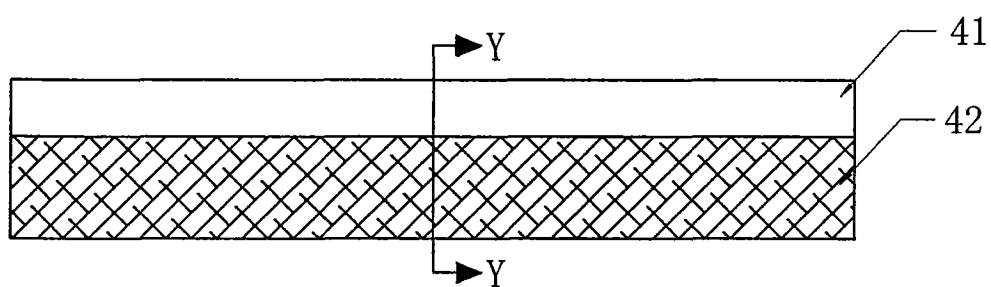


图 4

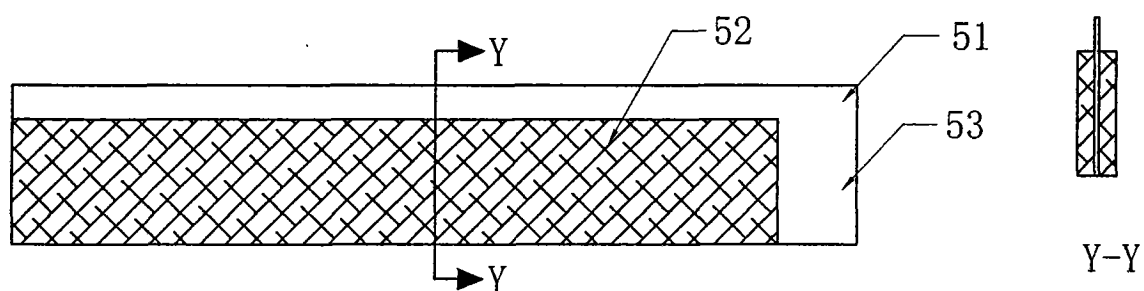


图 6

图 5

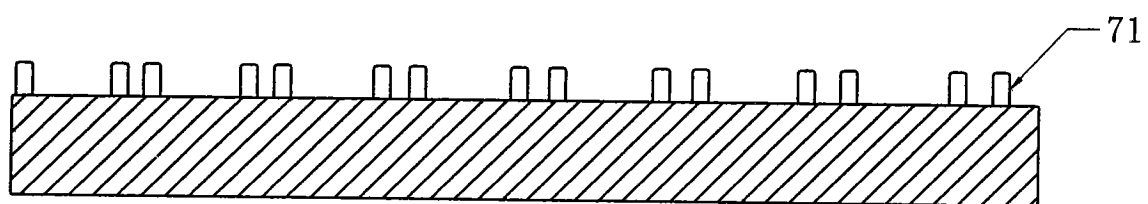


图 7

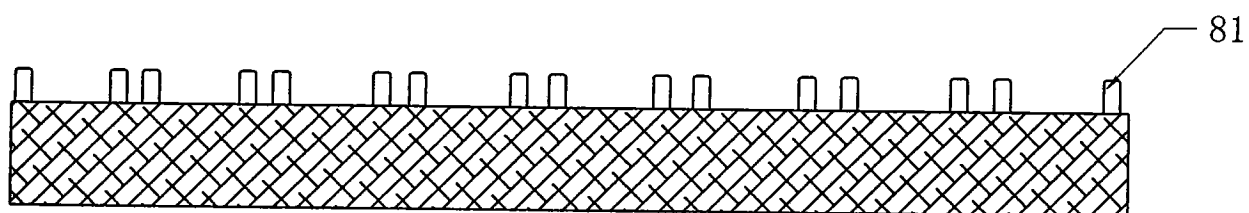


图 8

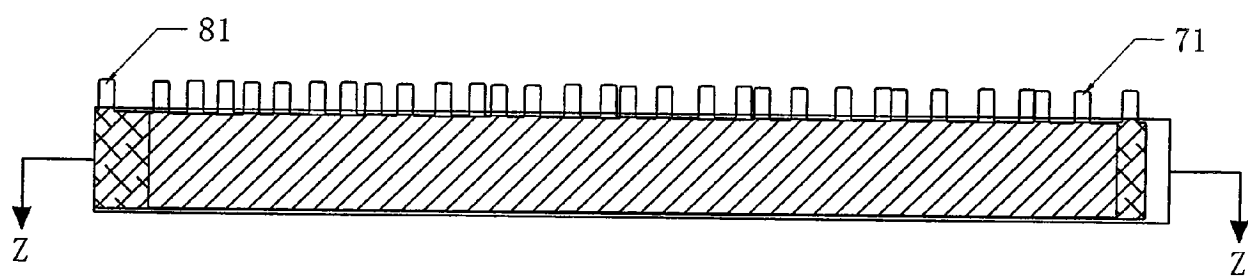


图 9

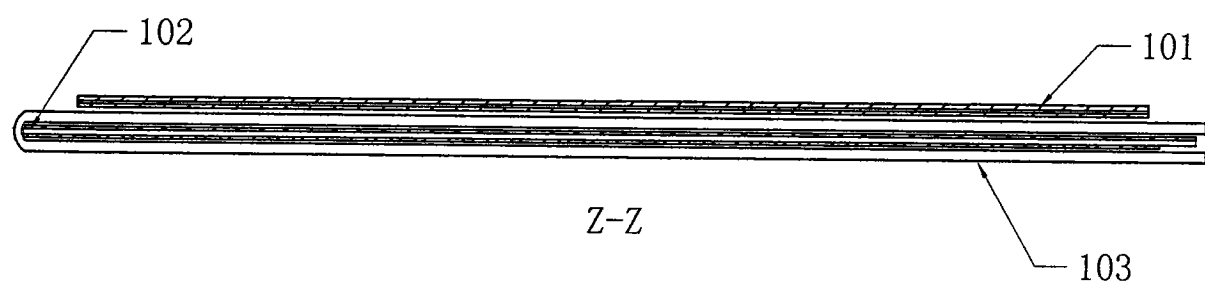


图 10

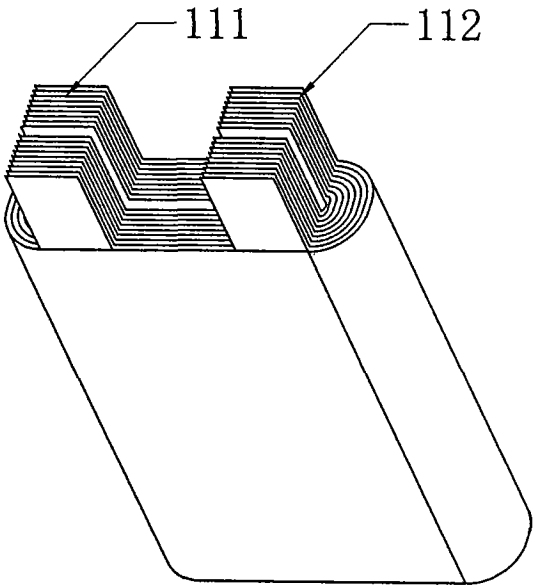


图 11

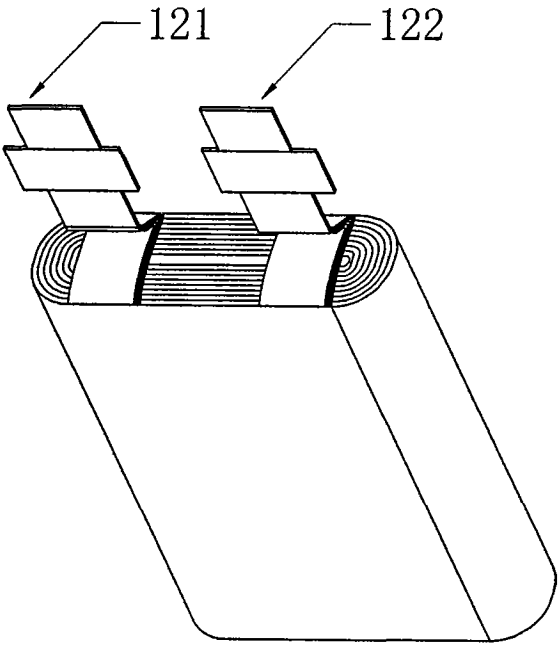


图 12