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CYLINDRICAL BATTERY CELL, BATTERY, ELECTRICITY CONSUMING DEVICE, MANUFACTURING METHOD AND MANUFACTURING SYSTEM

Abstract

A cylindrical battery cell, a battery, an electricity consuming device, a manufacturing method and a manufacturing system are provided. The cylindrical battery cell includes a shell, including an opening; and an electrode assembly, disposed in the shell, the electrode assembly including a separator and a tab, and along an axial direction of the electrode assembly, the tab being located at one end of the electrode assembly and extending toward the opening, the tab including a first portion and a second portion, the second portion surrounding a periphery of the first portion, and the separator wrapping the second portion to isolate the second portion from the shell, wherein along the axial direction, the first portion extends beyond the second portion and the separator, and the second portion does not extend beyond the separator. The battery cell of the present application solves a problem of short circuit in the battery cell.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATION [0001] This application is a continuation of U.S. application Ser. No. 18/180,858, filed on Mar. 9, 2023, which is a continuation of International Application PCT/CN2021/113171, filed Aug. 18, 2021, which claims the priority of the Chinese Patent Application No.: 202011058155.2, filed on Sep. 30, 2020 and titled “Cylindrical Battery cell, Battery, Electricity Consuming device, Manufacturing Method and Manufacturing System”, which are incorporated herein by reference in their entireties.

TECHNICAL FIELD
[0002] The present disclosure relates to a technical field of battery, and particularly relates to a cylindrical battery cell, a battery, an electricity consuming device, a manufacturing method and a manufacturing system.
BACKGROUND
[0003] Since the rechargeable battery has the advantages of high energy density, high power density, many cycles of use and long storage time, it has been widely used in electric vehicles, mobile devices or electrical tools. The battery includes battery cells. However, during use of the battery cells, there is a problem of short circuit, which affects the safety of the use of the battery cells.
SUMMARY
[0004] The present disclosure provides a cylindrical battery cell, a battery, an electricity consuming device, a manufacturing method and a manufacturing system, which aims to solve the above-mentioned technical problem of short circuit of battery cell.
[0005] On one aspect, the present disclosure provides a cylindrical battery cell, including: [0006] a shell, including an opening; and [0007] an electrode assembly, disposed in the shell, the electrode assembly including a separator and a tab, and along an axial direction of the electrode assembly, the tab being located at one end of the electrode assembly and extending toward the opening, the tab including a first portion and a second portion, the second portion surrounding a periphery of the first portion, and the separator wrapping the second portion to isolate the second portion from the shell, [0008] wherein along the axial direction, the first portion extends beyond the second portion and the separator, and the second portion does not extend beyond the separator.
[0009] According to an embodiment of the present application, a dimension of the first portion

extending beyond the separator is H, and a difference between an outer diameter and an inner diameter of the second portion is L, wherein L is greater than H. When the first portion deforms and turns outward, the first portion cannot easily go beyond an edge of the second portion and come into lap contact with the shell, and the possibility of short circuit between the first portion and the shell can be reduced.

[0010] According to an embodiment of the present application, the dimension H of the first portion extending beyond the separator ranges from 1 mm to 8 mm.

[0011] According to an embodiment of the present application, the cylindrical battery cell further includes a cap and a first insulating member, the cap is configured to cover the opening and connected to the shell, the first insulating member is disposed on a side of the cap close to the electrode assembly, the first insulating member includes a recess, and at least part of the first portion is accommodated in the recess. When the first portion deforms due to the release of its own elastic restoring force, the first portion will be blocked by the first insulating member, thereby further reducing the possibility of the short circuit caused by the lap contact between the first portion and the shell.

[0012] According to an embodiment of the present application, the first insulating member is in contact with a part of the separator extending beyond the second portion. Therefore, it is not easy for the external conductive impurities to pass through the contact area between the first insulating member and the separator and come into contact with the first portion, and the possibility that the conductive impurities conduct the first portion with the shell and cause the short circuit between the first portion and the shell can be reduced.

[0013] According to an embodiment of the present application, the first insulating member includes a body portion and an extension portion connected with each other, the body portion is configured to connect with the cap, the extension portion extends and protrudes from the body portion and toward the electrode assembly to form the recess, the extension portion surrounds the periphery of the first portion, and the extension portion is in contact with a part of the separator extending beyond the second portion. When performing the assembly, the extension portion of the first insulating member can insert the gap between the first portion and the shell, and thus can guide the first portion to accurately insert into the recess of the first insulating member.

[0014] According to an embodiment of the present application, the extension portion is formed as a closed annular structure extending continuously, or is formed as an annular structure with a notch.

[0015] According to an embodiment of the present application, the electrode assembly further includes a second insulating member, and the second insulating member surrounds the first insulating member and the second portion, and covers an edge of the first insulating member and an edge of the second portion. The second insulating member can function as a protection, and can block the external conductive impurities.

[0016] According to an embodiment of the present application, the second insulating member presses against an outer side surface of the first insulating member facing the shell. A contact area may be formed between the second insulating member and the first insulating member, which is beneficial to further reduce the possibility of conductive impurities entering the tab from the outside of the second insulating member.

[0017] According to an embodiment of the present application, the outer side surface includes a guide inclined surface, and the guide inclined surface is inclined toward the recess in a direction away from the cap. The guide slope has a guiding function, so that the part of the first insulating member corresponding to the guide inclined surface can easily enter the space defined by the second insulating member.

[0018] According to an embodiment of the present application, the electrode assembly further includes a first electrode plate and a second electrode plate, the first electrode plate and the second electrode plate each includes a coated area and an uncoated area, the uncoated area of the first electrode plate or the second electrode plate forms the tab, the separator is adapted to isolate the

first electrode plate from the second electrode plate, and the first electrode plate, the second electrode plate and the separator are wound to form the electrode assembly.

[0019] The battery cell according to the embodiments of the present application includes a shell and an electrode assembly. The electrode assembly is arranged in the shell. The electrode assembly includes a main body portion, a separator and a tab. The tab is located at an end of the electrode assembly. The tab includes a first portion and a second portion. The second portion surrounds a periphery of the first portion. The separator wraps the second portion, thereby isolating the second portion from the shell, and reducing the possibility of contact and short circuit between a peripheral surface of the second portion and the shell. Along an axial direction of the electrode assembly, the first portion extends beyond the second portion and the separator, while the second portion does not extend beyond the separator. The separator can form a protection for the second portion to reduce the possibility of the second portion coming into contact with the shell. In addition, since the second portion does not need to be processed by a bending process or a flattening process, the second portion itself does not accumulate elastic potential energy or accumulates small elastic potential energy; therefore, the second portion is not easily deformed or is deformed slightly, and thus it is not easy for the second portion to deform and turn outwards and come into lap contact with the shell, thereby reducing the possibility of short circuit between the second portion and the shell. The second portion can also serve as a buffer area, so that it is not easy for the first portion to come into lap contact with the shell, thereby effectively reducing the possibility of the short circuit between the first portion and the shell.

[0020] On a further aspect, the present application provides a battery including the cylindrical battery cell according to the above embodiments.

[0021] On a further aspect, the present application provides an electricity consuming device, including the cylindrical battery cell according to the above embodiments, the cylindrical battery cell being adapted to provide electrical energy.

[0022] On a further aspect, the present application provides a manufacturing method of a cylindrical battery cell, the method including steps of: [0023] providing an electrode assembly, the electrode assembly including a separator and a tab, the tab including a first portion and a second portion, the second portion surrounding a periphery of the first portion, the separator wrapping the second portion to isolate the second portion from the shell, wherein along an axial direction, the first portion extends beyond the second portion and the separator, and the second portion does not extend beyond the separator; [0024] providing a shell including an opening; and [0025] loading the electrode assembly into the shell, wherein along the axial direction of the electrode assembly, the tab is located at one end of the electrode assembly and extends toward the opening.

[0026] According to an embodiment of the present application, a part of the tab of the electrode assembly is cut away to form the second portion.

[0027] On another aspect, the present application provides a manufacturing system for a cylindrical battery cell, including: [0028] a first assembling device, configured to provide an electrode assembly, the electrode assembly including a separator and a tab, the tab including a first portion and a second portion, the second portion surrounding a periphery of the first portion, the separator wrapping the second portion to isolate the second portion from the shell, wherein along an axial direction, the first portion extends beyond the second portion and the separator, and the second portion does not extend beyond the separator; [0029] a second assembling device, configured to provide a shell including an opening; and [0030] a third assembling device, configured to load the electrode assembly into the shell, wherein along the axial direction of the electrode assembly, the tab is located at one end of the electrode assembly and extends toward the opening.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] The features, advantages and technical effects of the exemplary embodiments of the present application will be described below with reference to the accompanying drawings.

[0032] FIG. **1** is a structural schematic diagram of a vehicle according to an embodiment of the present application;

[0033] FIG. **2** is a structural schematic diagram of a battery according to an embodiment of the application;

[0034] FIG. **3** is a structural schematic diagram of a battery module according to an embodiment of the present application;

[0035] FIG. **4** is an exploded structural schematic diagram of a battery module according to an embodiment of the present application;

[0036] FIG. **5** is an exploded structural schematic diagram of the battery cell according to an embodiment of the present application;

[0037] FIG. **6** is an structural schematic diagram of an electrode assembly according to an embodiment of the present application;

[0038] FIG. **7** is structure schematic diagram of a top view of a battery cell of the embodiment shown in FIG. **5** after the assembly is completed;

[0039] FIG. **8** is a cross-sectional structural schematic diagram along A-A in FIG. **7**;

[0040] FIG. **9** is an enlarged view of position B in FIG. **8**;

[0041] FIG. **10** is a partial cross-sectional structural schematic diagram of a battery cell according to an embodiment of the present application;

[0042] FIG. **11** is a structural schematic diagram of a cap assembly according to an embodiment of the present application;

[0043] FIG. **12** is a structural schematic diagram of a cap assembly according to another embodiment of the present application;

[0044] FIG. **13** is an exploded structural schematic diagram of a battery cell according to another embodiment of the present application;

[0045] FIG. **14** is a partial cross-sectional structural schematic diagram of a battery cell according to an embodiment of the present application;

[0046] FIG. **15** is a flow chart of a manufacturing method for a battery cell according to an embodiment of the present application;

[0047] FIG. **16** is a schematic diagram of a manufacturing system for a battery cell according to an embodiment of the present application.

[0048] In the accompanying drawings, the drawings are not necessarily drawn to actual scale.

DETAILED DESCRIPTION

[0049] The implementations of the present application are described below in further detail with reference to the accompanying drawings and embodiments. The following detailed description of the embodiments and the accompanying drawings are used to exemplarily illustrate the principle of the present application, but cannot be used to limit the scope of the present application, that is, the present application is not limited to the described embodiments.

[0050] In the description of the present application, it should be noted that, unless otherwise stated, “a plurality of” means two or more; the orientation or positional relationship indicated by the terms “upper”, “lower”, “left”, “right”, “inside”, “outside” or the like is merely used for convenience of describing the present application and simplifying the description, rather than indicating or implying that the device or element referred to must have a particular orientation, or be constructed and operated in a particular orientation, and therefore cannot be understood as a limitation to the present application. In addition, the terms “first”, “second”, “third”, or the like are only used for descriptive purposes, and cannot be understood as indicating or implying relative importance. “Perpendicularity” does not mean a strict perpendicularity, but allows an error within an allowed

range. “Parallel” does not mean a strict parallel but allows an error within an allowed range.
[0051] The orientation words appearing in the following description all refer to the directions shown in the drawings, and are not intended to define the specific structure of the present application. In the description of the present application, it should also be noted that, unless otherwise clearly defined and specified, the terms “install”, “connect”, and “couple” should be understood in a broad sense, for example, may refer to a fixed connection, a detachable connection, or an integral connection, and may refer to a direct connection or an indirect connection through an intermediate medium. For the person skilled in the art, the specific meaning of the above-mentioned terms in the present application can be understood according to specific circumstances.
[0052] After noticing the problem of short circuit in the battery cells of prior art, the applicant conducts research and analysis on the structure of the battery cells. The battery cell includes a shell, an electrode assembly, a cap, an electrode terminal, and an adapter piece. The electrode assembly is disposed in the shell. The cap is connected to the shell. The electrode terminal is disposed on the cap. The electrode assembly includes a main body portion and a tab. The tab extends from the main body portion in a direction away from the main body portion. The adapter piece connects the electrode terminals to the tab of the electrode assembly. The applicant found that the tab of the battery cell may lap and contact with the shell, which leads to the short circuit of the battery cell. The applicant has further researched and found that the tab of the electrode assembly may be processed by a bending process or a flattening process, so as to be deformed to meet the assembly requirements, and thus the tab itself will accumulate elastic restoring force. When the assembly of the battery cell is completed, the tab does not lap with the shell, and thus no short circuit occurs. However, after using for a period of time, the tab will release the elastic restoring force accumulated by itself and rebound, resulting in that the tab laps with the shell and the short circuit between the tab and the shell may occur.
[0053] Based on the above problems found by the applicant, the applicant improved the structure of the battery cell. The embodiments of the present application are further described below.
[0054] In order to better understand the present application, the embodiments of the present application are described below with reference to FIGS. **1** to **16**.
[0055] The embodiment of the present application provides an electricity consuming device using a battery **10** as a power source. The electricity consuming device can be, but not limited to, a vehicle, a ship, or an aircraft. Referring to FIG. **1**, an embodiment of the present application provides a vehicle **1**. The vehicle **1** may be a fuel vehicle, a gas vehicle or a new energy vehicle. The new energy vehicle can be a pure electric vehicle, a hybrid vehicle or an extended-range vehicle. In an embodiment of the present application, the vehicle **1** may include a motor **1***a*, a controller **1***b* and a battery **10**. The controller **1***b* is used to control the battery **10** to supply power to the motor **1***a*. The motor **1***a* is connected to the wheels through a transmission mechanism, and thus drives the vehicle **1** to travel. The battery **10** can be used as a driving power source of the vehicle **1** to provide driving power for the vehicle **1** in place of or partially in place of fuel or natural gas. In an example, the battery **10** may be provided at the bottom or at the head or tail of the vehicle **1**. The battery **10** may be used to supply electrical power to the vehicle **1**. In an example, the battery **10** may be used as an operating power source of the vehicle **1** for an electrical system of the vehicle **1**. By way of example, the battery **10** may be used to satisfy the operating power requirements of the vehicle **1** for starting, navigating, and operating.
[0056] Referring to FIGS. **2** and **3**, the battery **10** includes a case. The type of the case is not limited. The case may be a frame-shaped case, a disc-shaped case, a box-shaped case, or the like. Exemplarily, the case includes a lower case **11** and an upper cover **12** for covering and closing the lower case **11**. The lower case **11** and the upper case **12** cover and close each other to form a receiving portion. The battery **10** includes a plurality of cylindrical battery cells **40**. The cylindrical battery cell **40** refers to a battery cell **40** which is formed in a cylindrical shape in appearance. The plurality of battery cells **40** may form the battery **10**, or the plurality of battery cells **40** may form

battery modules **20** at first, and then a plurality of battery modules **20** may form the battery **10**. FIG. **3** schematically shows the battery module **20** according to an embodiment, and the battery module **20** is disposed in the receiving portion of the case.

[0057] In some embodiments, in order to meet different power usage requirements, the battery **10** may include a plurality of battery cells **40**, wherein the plurality of battery cells **40** may be connected in series, in parallel or in a mixed manner, and the mixed manner refers to a mix of series and parallel connections. That is to say, the plurality of battery cells **40** may be directly disposed in the receiving portion of the case to form the battery **10**.

[0058] Referring to FIGS. **3** and **4**, the battery module **20** includes a casing **30** and battery cells **40** disposed in the casing **30**. In an example, the casing **30** includes a tubular body **31**, a first cover body **32** and a second cover body **33**. The first cover body **32** and the second cover body **33** are respectively disposed on two ends of the tubular body **31**. The first cover body **32** and the second cover body **33** are respectively detachably connected to the tubular body **31**. For example, the first cover body **32** and the second cover body **33** can be respectively connected to the tubular body **31** in a snapping manner or by screws. The tubular body **31**, the first cover body **32** and the second cover body **33** are assembled to form an accommodating space. The battery cells **40** are arranged in the accommodating space of the casing **30**.

[0059] Referring to FIG. **5**, the battery cell **40** of the embodiment of the present application includes a shell **41** and an electrode assembly **42** disposed in the shell **41**. The shell **41** in the embodiment of the present application is formed as a tubular structure. The shell **41** includes an inner space for accommodating the electrode assembly **42** and electrolyte, and an opening **411** communicating with the inner space. The electrode assembly **42** can be loaded into the shell **41** through the opening **411** of the shell **41**. The shell **41** may be made of materials such as aluminum, aluminum alloy, or plastic. The electrode assembly **42** includes a main body portion **421** in a shape of column and a tab **422**. Along an axial direction X of the electrode assembly **42**, the tab **422** is located at one end of the electrode assembly **42**. The main body portion **421** includes an end portion **421***a*. The electrode assembly **42** is disposed in the shell **41**, the end portion **421***a* of the main body portion **421** faces the opening **411** of the shell **41**, and the tab **422** extend from the end portion **421***a* of the main body portion **421** towards the opening **411** of the shell **41**. The tab **422** includes a first portion **422***a* and a second portion **422***b*. The second portion **422***b* surrounds a periphery of the first portion **422***a*. Along the axial direction X of the electrode assembly **42**, an orthographic projection of the first portion **422***a* is located inside an orthographic projection of the second portion **422***b*.

[0060] Referring to FIG. **5**, the battery cell **40** of the embodiment of the present application further includes a cap assembly **43** and an adapter piece **44**. The cap assembly **43** is used to close the opening **411** of the shell **41**. The cap assembly **43** includes a cap **431**, a first insulating member **432** and an electrode terminal **433**. The cap **431** is configured to cover the opening **411** of the shell **41** and is connected to the shell **41**. For example, the cap **431** may be welded to the shell **41**. The first insulating member **432** and the electrode terminal **433** are both disposed on the cap **431**. The first insulating member **432** is disposed on a side of the cap **431** close to an inside of the shell **41**. The electrode terminal **433** is electrically connected with the electrode assembly **42** through the adapter piece **44**. Exemplarily, the shell **41** includes two openings **411** opposite each other. The number of the cap assemblies **43** and the number of the adapter pieces **44** are both two. Two caps **431** cover the two openings **411** respectively and are both connected with the shell **41**. Each of the two ends of the electrode assembly **42** opposite each other is provided with one cap assembly **43** and one adapter piece **44** correspondingly.

[0061] Referring to FIG. **6**, the electrode assembly **42** of the embodiment of the present application can be formed by winding a first electrode plate **42***a*, a second electrode plate **42***b* and a separator **42***c* together, wherein the separator **42***c* is an insulator interposed between the first electrode plate **42***a* and the second electrode plate **42***b*. The separator **42***c* is used for insulating and isolating the

first electrode plate **42***a* and the second electrode plate **42***b*, so as to prevent the first electrode plate **42***a* and the second electrode plate **42***b* from contacting with each other. The first electrode plate **42***a* and the second electrode plate **42***b* each include a coated area and an uncoated area. An active material of the first electrode plate **42***a* is coated on the coated area of the first electrode plate **42***a*, and an active material of the second electrode plate **42***b* is coated on the coated area of the second electrode plate **42***b*. In the coated area, the active material is coated on a current collector formed of a metal sheet, while no active material is coated in the uncoated area. The part of the electrode assembly **42** corresponding to the coated area of the first electrode plate **42***a* and the second electrode plate **42***b* is the main body portion **421**. The uncoated area of the first electrode plate **42***a* or the uncoated area of the second electrode plate **42***b* forms the tab **422**. The main body portion **421** includes two end portions **421***a* opposite each other. The tab **422** extends from one end portion **421***a* of the main body portion **421**. The tab **422** in the electrode assembly **42** is formed in a multi-layer structure. Exemplarily, the uncoated area of the first electrode plate **42***a* are stacked to form a positive tab, while the uncoated area of the second electrode plate **42***b* are stacked to form a negative tab. The positive tab and the negative tab respectively extend from one end portion **421***a* of the main body portion **421**. When the first electrode plate **42***a*, the second electrode plate **42***b*, and the separator **42***c* are wound together, the separator **42***c* is individually wound by a predetermined number of additional turns, at the end of the winding process.

[0062] In the embodiment of the present application, along the axial direction X of the electrode assembly **42**, the dimension of the separator **42***c* is larger than that of the coated area of the first electrode plate **42***a*, and is also larger than the dimension of the coated area of the second electrode plate **42***b*. Therefore, along the axial direction X of the electrode assembly **42**, a part of the separator **42***c* of the electrode assembly **42** extends beyond the main body portion **421**.

[0063] Referring to FIGS. **7** and **8**, the cap **431** and the shell **41** are connected to enclose the electrode assembly **42** in the shell **41**. The first insulating member **432** may isolate the electrode assembly **42** from the cap **431**. The electrode assembly **42** includes two tabs **422** opposite each other. The two tabs **422** extend from two end portions **421***a* of the main body portion **421**, respectively. The two tabs **422** have opposite polarities. Two electrode terminals **433** are respectively connected to the two tabs **422**. Two first insulating members **432** are respectively connected to the two caps **431**.

[0064] Referring to FIG. **9**, the separator **42***c* wraps the second portion **422***b* to isolate the second portion **422***b* from the shell **41**, thereby reducing the possibility that second portion **422***b* facing the shell **41** comes into contact with the shell **41** and causes the short circuit between the second portion **422***b* and the shell **41**. The separator **42***c* extends from a periphery of the main body portion **421** to the second portion **422***b* in the axial direction X so as to wrap the second portion **422***b*. Along the axial direction X of the electrode assembly **42**, the first portion **422***a* of the tab **422** extends beyond the second portion **422***b* of the tab **422** and the separator **42***c*. The first portion **422***a* of the tab **422** is connected with the adapter piece **44**. For example, the first portion **422***a* is welded to the adapter piece **44**. Along the axial direction X of the electrode assembly **42**, the second portion **422***b* of the tab **422** does not extend beyond the separator **42***c*. In some examples, along the axial direction X of the electrode assembly **42**, the separator **42***c* extends beyond the second portion **422***b*. Since the separator **42***c* can form an insulating protection for the second portion **422***b*, the possibility of contact and short circuit between the second portion **422***b* and the shell **41** can be reduced.

[0065] In some embodiments, the electrode plate (the first electrode plate **42***a* or the second electrode plate **42***b*) is subjected to a cutting process during manufacturing process, so that the width (the dimension along the axial direction X) of the area corresponding to the second portion **422***b* on the electrode plate is smaller than the width (the dimension along the axial direction X) of the area corresponding to the first portion **422***a* on the electrode plate, and thus, after the winding process of the electrode plates and the separator **42***c* is completed, it can be ensured that the first

portion **422***a* of the electrode plate extends beyond the second portion **422***b*.

[0066] In some embodiments, an end of the first portion **422***a* of the electrode plate away from the main body portion **421** is used to connect with the adapter piece **44**, and the second portion **422***b* of the electrode plate does not need to connect with the adapter piece **44**. The end of the first portion **422***a* of the electrode plate away from the main body portion **421** needs to be processed by a bending process or a flattening process. After processed by the bending process or the flattening process, the end of the first portion **422***a* away from the main body portion **421** will become more compact.

[0067] The battery cell **40** of the embodiments of the present application includes a shell **41** and an electrode assembly **42**. The electrode assembly **42** is disposed in the shell **41**. The electrode assembly **42** includes a main body portion **421**, a separator **42***c* and a tab **422**. The tab **422** is located at an end of the main body portion **421**. The tab **422** includes a first portion **422***a* and a second portion **422***b*. The second portion **422***b* surrounds a periphery of the first portion **422***a*. The separator **42***c* extends from a periphery of the main body portion **421** to the second portion **422***b* and wraps the second portion **422***b*, thereby isolating the second portion **422***b* from the shell **41**, and reducing the possibility of contact and short circuit between a peripheral surface of the second portion **422***b* and the shell **41**. Along an axial direction X of the electrode assembly **42**, the first portion **422***a* extends beyond the second portion **422***b* and the separator **42***c*, while the second portion **422***b* does not extend beyond the separator **42***c*. The separator **42***c* can form a protection for the second portion **422***b* and reduce the possibility of the second portion **422***b* coming into contact with the shell **41**. In addition, since the second portion **422***b* does not need to be processed by a bending process or a flattening process, the second portion **422***b* itself does not accumulate elastic potential energy or accumulates small elastic potential energy; therefore, the second portion **422***b* is not easily deformed or is deformed slightly, and thus it is not easy for the second portion **422***b* to deform and turn outwards, and come into lap contact with the shell **41**, thereby reducing the possibility of short circuit between the second portion **422***b* and the shell **41**. The second portion **422***b* can also serve as a buffer area, so that it is not easy for the first portion **422***a* to come into lap contact with the shell **41**, thereby effectively reducing the possibility of the short circuit between the first portion **422***a* and the shell **41**.

[0068] In some embodiments, as shown in FIG. **9**, along the axial direction X of the electrode assembly **42**, the dimension of the first portion **422***a* extending beyond the separator **42***c* is H, and along a radial direction of the main body portion **421**, the difference between an outer diameter and an inner diameter of the second portion **422***b* is L, where L is greater than H. In this way, when the first portion **422***a* deforms and turns outwards, it is not easy for the first portion **422***a* to extend beyond an edge of the second portion **422***b* and make lap contact with the shell **41**, thereby reducing the possibility of the short circuit between the first portion **422***a* and the shell **41**. In some examples, L takes a value from 1.1H to 1.5H. The dimension H of the first portion **422***a* extending beyond the separator **42***c* ranges from 1 millimeter (mm) to 8 millimeters (mm).

[0069] In some embodiments, as shown in FIG. **10**, the first insulating member **432** includes a recess **432***a*. The recess **432***a* is formed by recessing from a surface of the first insulating member **432** away from the cap **431** toward the cap **431** so that an opening of the recess **432***a* faces the electrode assembly **42**. At least part of the first portion **422***a* is received in the recess **432***a*. The first insulating member **432** forms a protection on the periphery of the first portion **422***a*, thereby isolating the first portion **422***a* from the shell **41**. During the use of the battery cell **40**, when the first portion **422***a* deforms due to the release of its own elastic restoring force, the first portion **422***a* will be blocked by the first insulating member **432**, and thus the possibility of short circuit between the first portion **422***a* and the shell **41** due to the lap contact between them can be further reduced.

[0070] In some embodiments, as shown in FIG. **10**, the first insulating member **432** is in contact with a part of the separator **42***c* extending beyond the second portion **422***b*, thereby forming a contact area. In this way, it is not easy for external conductive impurities to pass through the

contact area between the first insulating member **432** and the separator **42***c* and come into contact with the first portion **422***a*, and thus, the possibility of short circuit between the first portion **422***a* and the shell **41** due to conduction between the first portion **422***a* and the shell **41** through the conductive impurities can be reduced.

[0071] In some embodiments, as shown in FIGS. **10** and **11**, the first insulating member **432** includes a body portion **4321** and an extension portion **4322** connected to each other. The first insulating member **432** is connected to the cap **431** through the body portion **4321**. The extension portion **4322** extends and protrudes from the body portion **4321** toward the electrode assembly **42**. The body portion **4321** and the extension portion **4322** intersect with each other. The body portion **4321** and the extension portion **4322** form the recess **432***a*. The extension portion **4322** is disposed on a peripheral side of the first portion **422***a* of the tab **422**, and corresponds to the second portion **422***b* in position along the axial direction X. The extension portion **4322** extends along the peripheral side of the first portion **422***a*. The first insulating member **432** is in contact with the part of the separator **42***c* extending beyond the second portion **422***b* through the extension portion **4322**. The first insulating member **432** can be connected and fixed to the cap **431** in advance through the body portion **4321**, and then the cap **431** carried with the first insulating member **432** is assembled with the shell **41**. Since the first insulating member **432** includes the extension portion **4322**, the extension portion **4322** of the first insulating member **432** can be inserted into a gap between the first portion **422***a* and the shell **41** during assembly, and thus, the extension portion **4322** can guide the first portion **422***a* to accurately insert into the recess **432***a* of the first insulating member **432**, thereby reducing the possibility that the first portion **422***a* is compressed and deformed during the assembly due to the first insulating member **432** pressing the first portion **422***a* along the axial direction X, and meanwhile making the extension portion **4322** to protect and limit the first portion **422***a* early during the assembly process.

[0072] In some examples, the first insulating member **432** may be a cover body of a spherical structure. A surface of the first insulating member **432** where the recess **432***a* is formed, is a spherical surface.

[0073] In some embodiments, as shown in FIGS. **10** and **11**, the adapter piece **44** includes a first adapter portion **441** and a second adapter portion **442**. The first adapter portion **441** and the second adapter portion **442** are connected to each other. The adapter piece **44** is connected with the first portion **422***a* of the tab **422** through the first adapter portion **441**. For example, the first adapter portion **441** and the first portion **422***a* are connected by welding. The adapter piece **44** is connected with the electrode terminal **433** through the second adapter portion **442**. For example, the second adapter portion **442** and the electrode terminal **433** are connected by rivets. Referring to FIG. **10**, after the assembly of the battery cell **40** is completed, the first adapter portion **441** is bent relative to the second adapter portion **442**. The first adapter portion **441** is located between the first insulating member **432** and the electrode assembly **42** and is located in the recess **432***a*. The first insulating member **432** and the electrode assembly **42** press the first adapter portion **441** together, so that the first adapter portion **441** cannot move relative to the electrode assembly **42** in position easily, and thus it is beneficial to reduce the possibility of disconnection between the first adapter portion **441** and the first portion **422***a* caused by the movement of the first adapter portion **441** relative to the electrode assembly **42**. In one example, the body portion **4321** of the first insulating member **432** and the electrode assembly **42** press the first adapter portion **441** together.

[0074] In some embodiments, FIG. **11** schematically shows a state in which the adapter piece **44** is connected with the electrode terminal **433** but is not bent. Referring to FIG. **11**, the extension portion **4322** is formed as an annular structure with a notch **43221**, so that an end surface of the extension portion **4322** away from the cap **431** is formed as a structure of a split annulus. The notch **43221** of the extension portion **4322** can avoid the second adapter portion **442**. The second adapter portion **442** of the adapter piece **44** can pass through the notch **43221**, and thus, during the manufacturing process of the adapter piece **44**, the first adapter portion **441** and the second adapter

portion **442** of the adapter piece **44** remain in a flat state, and processing steps of the adapter piece **44** can be reduced. All the parts of the extension portion **4322** except the notch **43221** can press against the separator **42***c*.

[0075] In some embodiments, FIG. **12** schematically shows a state in which the adapter piece **44** is connected with the electrode terminal **433** but is not bent. Referring to FIG. **12**, the extension portion **4322** is formed as a closed annular structure, so that an end surface of the extension portion **4322** away from the cap **431** is formed as a structure of a closed annulus. The first adapter portion **441** and the second adapter portion **442** of the adapter piece **44** need to be bent during manufacturing, so that the adapter piece **44** can avoid the extension portion **4322** after the second adapter portion **442** and the electrode terminal **433** are connected. The extension portion **4322** can press against the separator **42***c*, and since the end surface of the extension portion **4322** away from the cap **431** is formed as a structure of a closed annulus, the extension portion **4322** can form a protection and isolation for the first portion **422***a* on the entire periphery of the first portion **422***a*, which is beneficial to further improve the isolation and protection effect.

[0076] In some embodiments, as shown in FIGS. **13** and **14**, the electrode assembly **42** further includes a second insulating member **423**. The second insulating member **423** surrounds the first insulating member **432** and the second portion **422***b*, and covers an edge of the first insulating member **432** and an edge of the second portion **422***b*. Along the axial direction X of the electrode assembly **42**, the edge of the first insulating member **432** faces the edge of the second portion **422***b*. The second insulating member **423** can provide protection, so as to reduce the possibility that the external conductive impurities enter the position between the first insulating member **432** and the second portion **422***b* and short-circuit the second portion **422***b* and the shell **41**, or, reduce the possibility that the external conductive impurities pass through the position between the first insulating member **432** and the second portion **422***b* and short-circuit the first portion **422***a* and the shell **41**.

[0077] In some examples, the first insulating member **432** includes the extension portion **4322**. The second insulating member **423** covers an edge of the extension portion **4322** and an edge of the second portion **422***b*. In some examples, the second insulating member **423** is formed as an annular structure. The second insulating member **423** continuously extends along a peripheral side of the extension portion **4322**, so as to form a protection in the entire peripheral direction of the extension portion **4322**.

[0078] In some examples, the second insulating member **423** may be a separate structural member. In the assembling process, it is necessary to assemble the second insulating member **423** to the periphery of the first portion **422***a* in advance. Then, the electrode assembly **42** carried with the second insulating member **423** is loaded into the shell **41**.

[0079] In some embodiments, the first insulating member **432** includes an outer side surface **432***b* facing the shell **41**. One end of the second insulating member **423** presses against the outer side surface **432***b* of the first insulating member **432**, so that a contact area can be formed between the second insulating member **423** and the first insulating member **432**, which is beneficial to further reduce the possibility that the conductive impurities enter the tab **422** from the outside of the first insulating member **432**.

[0080] In some examples, the outer side surface **432***b* includes a guide inclined surface. In a direction away from the cap **431**, the guide inclined surface is inclined toward the recess **432***a*. As such, when the cap assembly **43** is assembled after the electrode assembly **42** carried with the second insulating member **423** is loaded into the shell **41** in advance, under the guiding action of the guiding inclined surface, the part of the first insulating member **432** corresponding to the guiding inclined surface can easily enter the space defined by the second insulating member **423**, which is beneficial to reduce the possibility of the collapse of the second insulating member **423** and the loss of the isolating function of the second insulating member **423** caused by the first insulating member **432** directly pressing against the second insulating member **423**. In the

embodiments in which the first insulating member **432** includes the body portion **4321** and the extension portion **4322**, the guide inclined surface provided on the first insulating member **432** makes the peripheral surface of the extension portion **4322** tapered.

[0081] In some examples, the second insulating member **423** is adhered to the outer side surface **432***b* of the first insulating member **432**, which is beneficial to improve the connection reliability and stability between the second insulating member **423** and the first insulating member **432**, and reduce the possibility that the second insulating member **423** and the first insulating member **432** are out of contact due to shock, vibration and other working conditions during the use of the battery cell **40**. Exemplarily, the second insulating member **423** may be adhered to the outer side surface **432***b* of the first insulating member **432** by tapes or adhesives.

[0082] In some examples, an area through which the second insulating member **423** presses against the outer side surface **432***b* of the first insulating member **432** is closer to the cap **431** than the tab **422**, so that the contact area between the second insulating member **423** and the first insulating member **432** is closer to the cap **431**. During the assembly process, the first insulating member **432** can come into contact with the second insulating member **423** more quickly, thereby further reducing the possibility that the conductive impurities enters the tab **422** through the gap between the first insulating member **432** and the second insulating member **423** that are still not contact with each other, during the assembly process.

[0083] Referring to FIG. **15**, based on the battery cell **40** of the above-mentioned embodiments, the embodiments of the present application further provide a manufacturing method for the battery cell **40**, the method includes steps of: [0084] providing an electrode assembly **42**, the electrode assembly **42** including a separator **42***c* and a tab **422**, the tab **422** including a first portion **422***a* and a second portion **422***b*, the second portion **422***b* surrounding a periphery of the first portion **422***a*, and the separator **42***c* wrapping the second portion **422***b* to isolate the second portion **422***b* from a shell **41**, wherein along an axial direction X, the first portion **422***a* extends beyond the second portion **422***b* and the separator **42***c*, and the second portion **422***b* does not extend beyond the separator **42***c;* [0085] providing the shell **41** including an opening; and [0086] loading the electrode assembly **42** into the shell **41**, wherein along the axial direction X of the electrode assembly **42**, the tab **422** is located at one end of the electrode assembly **42** and extends toward the opening.

[0087] In the battery cell **40** manufactured by the manufacturing method for the battery cell **40** according to the embodiments of the present application, the electrode assembly **42** including the separator **42***c* and the tab **422** is loaded into the shell **41**, and the tab **422** is oriented to the opening of the shell **41**. When manufacturing the electrode assembly **42**, the tab **422** is made to include a first portion **422***a* and a second portion **422***b*, and the second portion **422***b* is made to surround a periphery of the first portion **422***a*, and the separator **42***c* is made to wrap the second portion **422***b* so as to isolate the second portion **422***b* from the shell **41**. Along the axial direction X of the electrode assembly **42**, the first portion **422***a* extends beyond the second portion **422***b* and the separator **42***c*, while the second portion **422***b* does not extend beyond the separator **42***c*. As such, the separator **42***c* can form a protection for the second portion **422***b*, and reduce the possibility of the second portion **422***b* coming into contact with the shell **41**. In addition, since the second portion **422***b* does not need to connect with the adapter piece **44**, the second portion **422***b* does not need to undergo a bending process or a flattening process, so that the second portion **422***b* itself does not accumulate elastic potential energy or accumulates small elastic potential energy; therefore, the second portion **422***b* is not easily deformed or deforms with a small amount, and thus it is not easy for the second portion **422***b* to come into lap contact with the shell **41**, thereby reducing the possibility of short circuit caused by the lap contact between the second portion **422***b* and the shell **41**. The second portion **422***b* can also serve as a buffer area, so that it is not easy for the first portion **422***a* to come into lap contact with the shell **41**, thereby effectively reducing the possibility of short circuit caused by the lap contact between the first portion **422***a* and the shell **41**.

[0088] In some embodiments, a part of the tab **422** of the electrode assembly **42** is cut away to form

the second portion **422***b*.
[0089] Referring to FIG. **16**, based on the battery cell **40** of the above-mentioned embodiments, embodiments of the present application further provide a manufacturing system **50** for the battery cell **40**, the system **50** includes: [0090] a first assembling device **51**, configured to manufacture an electrode assembly **42** including a separator **42***c* and a tab **422**, the tab **422** including a first portion **422***a* and a second portion **422***b,* the second portion **422***b* surrounding a periphery of the first portion **422***a,* and the separator **42***c* wrapping the second portion **422***b* to isolate the second portion **422***b* from the shell **41**, wherein along an axial direction X, the first portion **422***a* extends beyond the second portion **422***b* and the separator **42***c,* and the second portion **422***b* does not extend beyond the separator **42***c;* [0091] a second assembling device **52**, configured to provide the shell **41** including an opening; and [0092] a third assembling device **53**, configured to load the electrode assembly **42** into the shell **41**, wherein in the axial direction X of the electrode assembly **42**, the tab **422** is located at one end of the electrode assembly **42** and extends toward the opening.
[0093] While the present application has been described with reference to the preferred embodiments, various modifications may be made to the present application and components therein can be replaced with equivalents. In particular, as long as there is no structural conflict, various technical features mentioned in various embodiments can be combined in any manner. The present application is not limited to the specific embodiments disclosed herein, but includes all technical solutions falling within the scope of the claims.

Claims

1. A cylindrical battery cell, comprising: a shell, comprising an opening; and an electrode assembly, disposed in the shell, the electrode assembly comprising a separator and a tab, along an axial direction of the electrode assembly, the tab being located at one end of the electrode assembly and extending toward the opening, the tab comprising a first portion and a second portion, the second portion surrounding a periphery of the first portion, and the separator wrapping the second portion to isolate the second portion from the shell, wherein along the axial direction, the first portion extends beyond the second portion and the separator, and the second portion does not extend beyond the separator, and the separator is integrated in a winding with the tab.
2. The cylindrical battery cell according to claim 1, wherein a dimension of the first portion extending beyond the separator is H, and a difference between an outer diameter and an inner diameter of the second portion is L, wherein L is greater than H.
3. The cylindrical battery cell according to claim 2, wherein the dimension H of the first portion extending beyond the separator ranges from 1 mm to 8 mm.
4. The cylindrical battery cell according to claim 1, wherein the cylindrical battery cell further comprises a cap and a first insulating member, wherein the cap is configured to cover the opening and connected to the shell, the first insulating member is disposed on a side of the cap close to the electrode assembly, the first insulating member comprises a recess, and at least part of the first portion is accommodated in the recess.
5. The cylindrical battery cell according to claim 4, wherein the first insulating member is in contact with a part of the separator extending beyond the second portion.
6. The cylindrical battery cell according to claim 4, wherein the first insulating member comprises a body portion and an extension portion connected with each other, the body portion is configured to connect with the cap, the extension portion extends and protrudes from the body portion and toward the electrode assembly to form the recess, the extension portion surrounds the periphery of the first portion, and the extension portion is in contact with a part of the separator extending beyond the second portion.
7. The cylindrical battery cell according to claim 6, wherein the extension portion is formed as a closed annular structure extending continuously, or is formed as an annular structure with a notch.

8. The cylindrical battery cell according to claim 5, wherein the electrode assembly further comprises a second insulating member, wherein the second insulating member surrounds the first insulating member and the second portion, and covers an edge of the first insulating member and an edge of the second portion.
9. The cylindrical battery cell according to claim 8, wherein the second insulating member presses against an outer side surface of the first insulating member facing the shell.
10. The cylindrical battery cell according to claim 9, wherein the outer side surface comprises a guide inclined surface, the guide inclined surface being inclined toward the recess in a direction away from the cap.
11. The cylindrical battery cell according to claim 1, wherein the electrode assembly further comprises a first electrode plate and a second electrode plate, wherein the first electrode plate and the second electrode plate each comprises a coated area and an uncoated area, the uncoated area of the first electrode plate or the second electrode plate forms the tab, the separator is adapted to isolate the first electrode plate from the second electrode plate, and the first electrode plate, the second electrode plate and the separator are wound to form the electrode assembly.
12. A battery comprising the cylindrical battery cell according to claim 1.
13. An electricity consuming device, comprising the cylindrical battery cell according to claim 1, the cylindrical battery cell being adapted to provide electrical energy.
14. A manufacturing method of a cylindrical battery cell, the method comprising: providing an electrode assembly, the electrode assembly comprising a separator and a tab, the tab comprising a first portion and a second portion, the second portion surrounding a periphery of the first portion, the separator wrapping the second portion to isolate the second portion from the shell, wherein along an axial direction of the electrode assembly, the first portion extends beyond the second portion and the separator, and the second portion does not extend beyond the separator, wherein the separator is integrated in a winding with the tab; providing a shell comprising an opening; and loading the electrode assembly into the shell, wherein along the axial direction of the electrode assembly, the tab is located at one end of the electrode assembly and extends toward the opening.
15. The manufacturing method of the cylindrical battery cell according to claim 14, wherein the manufacturing method further comprises: cutting away a part of the tab of the electrode assembly to form the second portion.
16. A manufacturing system for a cylindrical battery cell, comprising: a first assembling device, configured to provide an electrode assembly, the electrode assembly comprising a separator and a tab, the tab comprising a first portion and a second portion, the second portion surrounding a periphery of the first portion, the separator wrapping the second portion to isolate the second portion from the shell, wherein along an axial direction of the electrode assembly, the first portion extends beyond the second portion and the separator, and the second portion does not extend beyond the separator, wherein the separator is integrated in a winding with the tab; a second assembling device, configured to provide a shell comprising an opening; and a third assembling device, configured to load the electrode assembly into the shell, wherein along the axial direction of the electrode assembly, the tab is located at one end of the electrode assembly and extends toward the opening.