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### ELECTRODE TAB AND SECONDARY BATTERY INCLUDING THE SAME

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#### Abstract

An electrode tab includes a first tab body, a second tab body facing the first tab body, a connection member between the first tab body and the second tab body, and a buffer member in at least one of the first tab body or the second tab body.

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#### Background/Summary

##### CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to and the benefit of Korean Patent Application No.

10-2024-0022526, filed on Feb. 16, 2024, in the Korean Intellectual Property Office, the entire content of which is incorporated herein by reference.

## BACKGROUND

### 1. Field

[0002] Embodiments of the present disclosure relate to an electrode tab and a secondary battery including the same.

### 2. Description of the Related Art

[0003] In general, due to the recent proliferation of electronic devices using batteries, such as mobile phones, notebook computers, and electric vehicles, the demand for secondary batteries having relatively high energy density and relatively high capacity has rapidly increased.

Accordingly, research and development for improving the performance of a lithium secondary battery (e.g., rechargeable lithium batteries) are being actively conducted.

[0004] A lithium secondary battery can be a battery including a positive electrode and a negative electrode including an active material capable of intercalating and deintercalating lithium ions, and an electrolyte solution, and may generate energy through oxidation/reduction reactions when lithium ions are intercalated/deintercalated at the positive and negative electrodes.

[0005] The above-described information disclosed in the technology that forms the Background is only intended to improve understanding of the background, and thus may include information that does not constitute the prior art.

## SUMMARY

[0006] Aspects of one or more embodiments of the present disclosure are directed toward providing an electrode tab capable of preventing or reducing damage to an electrode assembly and a secondary battery including the same.

[0007] Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the presented embodiments of the disclosure.

[0008] According to one or more embodiments of the present disclosure, an electrode tab includes a first tab body, a second tab body facing the first tab body, a connection member between the first tab body and the second tab body, and a buffer member in at least one of the first tab body and/or the second tab body.

[0009] In one or more embodiments, the first tab body and the second tab body may be rotatably connected about the connection member.

[0010] In one or more embodiments, the first tab body may include a first center part, a first inner end part extending from one side of the first center part and connected to the connection member, and a first outer end part extending from the other side of the first center part and spaced and/or apart (e.g., spaced apart or separated) from the first inner end part, and the second tab body may include a second center part, a second inner end part extending from one side of the second center part and connected to the connection member, and a second outer end part extending from the other side of the second center part and spaced and/or apart (e.g., spaced apart or separated) from the second inner end part.

[0011] In one or more embodiments, a cross-sectional area of the first tab body may decrease from the first center part toward the first outer end part, and a cross-sectional area of the second tab body may decrease from the second center part toward the second outer end part.

[0012] In one or more embodiments, a surface of each of the first outer end part and the second outer end part may have a curved shape.

[0013] In one or more embodiments, the cross-sectional area of the first tab body may decrease from the first center part toward the first inner end part, and the cross-sectional area of the second tab body may decrease from the second center part toward the second inner end part.

[0014] In one or more embodiments, a cross-sectional shape of each of the first tab body and the second tab body may be a circular shape or an elliptical shape.

[0015] In one or more embodiments, the connection member may extend in (along) a longitudinal direction of (each of) the first tab body and the second tab body.

[0016] In one or more embodiments, the connection member may include a plurality of connection beads arranged in the longitudinal direction of (each of) the first tab body and the second tab body.

[0017] In one or more embodiments, the buffer member may include a first chamber inside the first tab body, and a second chamber inside the second tab body.

[0018] In one or more embodiments, the first chamber and the second chamber may be separated from each other.

[0019] In one or more embodiments, cross-sectional shapes of the first chamber and the second chamber may be the same as cross-sectional shapes of the first tab body and the second tab body, respectively.

[0020] In one or more embodiments, the first chamber and the second chamber may extend in (along) longitudinal directions of the first tab body and the second tab body, respectively.

[0021] In one or more embodiments, the first chamber and the second chamber may pass through the first tab body and the second tab body, respectively.

[0022] In one or more embodiments, the electrode tab may further include a third tab body between the first tab body and the second tab body, and the connection member may include a first connection member between the first tab body and the third tab body, and a second connection member between the second tab body and the third tab body.

[0023] In one or more embodiments, the buffer member may include a first chamber inside the first tab body, a second chamber inside the second tab body, and a third chamber inside the third tab body.

[0024] In one or more embodiments, the third tab body may be provided as a plurality of third tab bodies, and the connection member may further include one or more third connection members between the third tab bodies adjacent to each other.

[0025] According to one or more embodiments of the present disclosure, a secondary battery includes a case, an electrode assembly in which an electrode plate and a separator are alternately stacked, the electrode assembly being inside the case, and an electrode tab connected to the electrode plate, wherein the electrode tab may include a first tab body, a second tab body facing the first tab body, a connection member between the first tab body and the second tab body, and a buffer member in at least one of the first tab body and the second tab body.

[0026] In one or more embodiments, the electrode assembly may be wound around a winding axis, and a longitudinal direction of each of the first tab body and the second tab body may be parallel (e.g., substantially parallel) to the winding axis.

[0027] In one or more embodiments, the connection member may be fixed to the electrode plate, and the first tab body and the second tab body may be separated from the electrode plate.

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## Description

### BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The drawings attached to this specification illustrate certain embodiments of the present disclosure, and further describe aspects and features of the present disclosure together with the detailed description of the present disclosure. However, the present disclosure should not be construed as being limited to the drawings. In the drawings:

[0029] FIG. 1 is a perspective view schematically illustrating a configuration of a secondary battery according to one or more embodiments of the present disclosure;

[0030] FIG. 2 is a front cross-sectional view schematically illustrating a configuration of the secondary battery of FIG. 1, according to one or more embodiments of the present disclosure;

[0031] FIG. 3 is a plan cross-sectional view schematically illustrating a configuration of an

electrode assembly of the secondary battery of FIG. 1, according to one or more embodiments of the present disclosure;

[0032] FIG. 4 is an enlarged cross-sectional view schematically illustrating an installation state of an electrode tab according to one or more embodiments of the present disclosure;

[0033] FIG. 5 is a perspective view schematically illustrating a configuration of the electrode tab according to one or more embodiments of the present disclosure;

[0034] FIG. 6 is a cross-sectional view schematically illustrating a configuration of the electrode tab according to one or more embodiments of the present disclosure;

[0035] FIGS. 7 and 8 are each a schematic view illustrating a manufacturing process of the secondary battery according to one or more embodiments of the present disclosure;

[0036] FIGS. 9 and 10 are each a cross-sectional view schematically illustrating an operation of the secondary battery according to one or more embodiments of the present disclosure;

[0037] FIG. 11 is a perspective view schematically illustrating a configuration of an electrode tab according to one or more embodiments of the present disclosure;

[0038] FIG. 12 is a plan view schematically illustrating a configuration of the electrode tab of FIG. 11, according to one or more embodiments of the present disclosure;

[0039] FIG. 13 is a perspective view schematically illustrating a configuration of an electrode tab according to one or more embodiments of the present disclosure;

[0040] FIG. 14 is a cross-sectional view schematically illustrating a configuration of the electrode tab of FIG. 13, according to one or more embodiments of the present disclosure;

[0041] FIG. 15 is a perspective view schematically illustrating a configuration of an electrode tab according to one or more embodiments of the present disclosure;

[0042] FIG. 16 is a plan view schematically illustrating a configuration of the electrode tab of FIG. 15, according to one or more embodiments of the present disclosure;

[0043] FIG. 17 is a perspective view schematically illustrating a configuration of an electrode tab according to one or more embodiments of the present disclosure;

[0044] FIG. 18 is a cross-sectional view schematically illustrating a configuration of the electrode tab of FIG. 17, according to one or more embodiments of the present disclosure;

[0045] FIG. 19 is a perspective view schematically illustrating a configuration of an electrode tab according to one or more embodiments of the present disclosure; and

[0046] FIG. 20 is a plan view schematically illustrating a configuration of the electrode tab of FIG. 19, according to one or more embodiments of the present disclosure.

#### DETAILED DESCRIPTION

[0047] The present disclosure may be modified in many alternate forms, and thus specific embodiments will be illustrated in the drawings and described in more detail. It should be understood, however, that this is not intended to limit the present disclosure to the particular forms disclosed, but rather, is intended to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the present disclosure.

[0048] Herein, one or more embodiments of the present disclosure will be described, in further detail, with reference to the accompanying drawings. The present disclosure, however, may be embodied in various different forms, and should not be construed as being limited to only the illustrated embodiments herein. Rather, these embodiments are provided as examples so that this disclosure will be thorough and complete, and will fully convey the aspects and features of the present disclosure to those skilled in the art. Accordingly, processes, elements, and techniques that are not necessary to those having ordinary skill in the art for a complete understanding of the aspects and features of the present disclosure may not be described.

[0049] The embodiments described in this specification and the configurations shown in the drawings are provided as some example embodiments of the present disclosure and do not represent all of the technical ideas, aspects, and features of the present disclosure. Accordingly, it is to be understood that there may be one or more suitable equivalents and modifications that may

replace or modify the embodiments described herein.

[0050] It is to be understood that when an element, such as an area, layer, film, region or portion, is referred to as being “on,” “connected to,” or “coupled to” another element or layer, it may be directly on, connected, or coupled to the other element or one or more intervening elements may also be present. When an element or layer is referred to as being “directly on,” “directly connected to,” or “directly coupled to” another element or layer, there are no intervening elements or layers present. For example, when a first element is described as being “coupled” or “connected” to a second element, the first element may be directly coupled or connected to the second element or the first element may be indirectly coupled or connected to the second element via one or more intervening elements. In addition, it will also be understood that when an element is referred to as being “between” two elements, it can be the only element between the two elements, or one or more intervening elements may also be present.

[0051] In the drawings, relative dimensions and/or sizes of the various elements, layers, etc. may be exaggerated for clarity of illustration. Unless otherwise noted, like reference numerals denote like elements throughout the attached drawings and the written description, and thus, duplicative descriptions thereof may not be provided.

[0052] As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items. Further, the use of “may” when describing embodiments of the present disclosure refers to “one or more embodiments of the present disclosure.” Unless otherwise apparent from the disclosure, expressions such as “at least one of,” “a plurality of,” “one of,” and other prepositional phrases, when preceding a list of elements, should be understood as including the disjunctive if written as a conjunctive list and vice versa. For example, the expressions “at least one of a, b, or c,” “at least one of a, b, and/or c,” “one selected from the group consisting of a, b, and c,” “at least one selected from a, b, and c,” “at least one from among a, b, and c,” “one from among a, b, and c,” “at least one of a to c” may refer to any and all suitable combinations or a subset indicating only a, only b, only c, both a and b, both a and c, both b and c, all of a, b, and c, or variations thereof.

[0053] As used herein, the terms “use,” “using,” and “used” may be considered synonymous with the terms “utilize,” “utilizing,” and “utilized,” respectively.

[0054] As used herein, the term “substantially,” “about,” and similar terms are used as terms of approximation and not as terms of degree, and are intended to account for the inherent deviations in measured or calculated values that would be recognized by those of ordinary skill in the art.

“Substantially” as used herein, is inclusive of the stated value and means within an acceptable range of deviation for the particular value as determined by one of ordinary skill in the art, considering the measurement in question and the error associated with measurement of the particular quantity (i.e., the limitations of the measurement system). For example, “substantially” may mean within one or more standard deviations, or within  $\pm 30\%$ ,  $20\%$ ,  $10\%$ ,  $5\%$  of the stated value.

[0055] It is to be understood that, although the terms “first,” “second,” “third,” etc., may be used herein to describe various elements, components, regions, layers, and/or sections, these elements, components, regions, layers, and/or sections should not be limited by these terms. These terms are used to distinguish one element, component, region, layer, or section from another element, component, region, layer, or section. Thus, a first element, component, region, layer, or section discussed below could be termed a second element, component, region, layer, or section without departing from the spirit and scope of the present disclosure.

[0056] Spatially relative terms, such as “beneath,” “below,” “lower,” “above,” “upper,” and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the drawings. It is to be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation, in addition to the orientation depicted in the drawings. For example, if the device in the

drawings is turned over, elements described as “below” or “beneath” other elements or features would then be oriented “above” or “over” the other elements or features. Thus, the term “below” may encompass both an orientation of above and below. The device may be otherwise oriented (e.g., rotated 90 degrees or at other orientations), and the spatially relative descriptors used herein should be interpreted accordingly.

[0057] The terminology used herein is for the purpose of describing particular embodiments of the present disclosure only and is not intended to be limiting of the present disclosure. As used herein, the singular forms “a,” “an,” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It is to be further understood that the terms “includes,” “including,” “comprises,” and/or “comprising,” when used in this specification, specify the presence of the stated features, integers, steps, operations, elements, and/or components but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0058] Also, any numerical range disclosed and/or recited herein is intended to include all sub-ranges of the same numerical precision subsumed within the recited range. For example, a range of “1.0 to 10.0” is intended to include all subranges between (and including) the recited minimum value of 1.0 and the recited maximum value of 10.0, that is, having a minimum value equal to or greater than 1.0 and a maximum value equal to or less than 10.0, such as, for example, 2.4 to 7.6. Any maximum numerical limitation recited herein is intended to include all lower numerical limitations subsumed therein, and any minimum numerical limitation recited in this specification is intended to include all higher numerical limitations subsumed therein. Accordingly, Applicant reserves the right to amend this specification, including the claims, to expressly recite any sub-range subsumed within the ranges expressly recited herein.

[0059] References to two compared elements, features, etc. as being “the same” may mean that they are “substantially the same.” Thus, the phrase “substantially the same” may include a case having a deviation that is considered low in the art, for example, a deviation of 5% or less. In addition, when a certain parameter is referred to as being uniform in a given region, it may mean that it is uniform in terms of an average.

[0060] Throughout the specification, unless otherwise stated, each element may be singular or plural.

[0061] When an element is referred to as being arranged (or located or positioned) on the “above (or below)” or “on (or under)” a component, it may mean that the arbitrary element is placed in contact with the upper (or lower) surface of the component and may also mean that another component may be interposed between the component and any element arranged (or located or positioned) on (or under) the component.

[0062] In addition, it is to be understood that when an element is referred to as being “coupled,” “linked,” or “connected” to another element, the elements may be directly “coupled,” “linked,” or “connected” to each other, or one or more intervening elements may be present therebetween, through which the element may be “coupled,” “linked,” or “connected” to another element. In addition, when a part is referred to as being “electrically coupled” to another part, the part may be directly electrically connected to another part or one or more intervening parts may be present therebetween such that the part and the another part are indirectly electrically connected to each other.

[0063] Throughout the specification, when “A and/or B” is stated, it means A, B, or A and B, unless otherwise stated. That is, “and/or” includes any or all combinations of a plurality of items enumerated. When “C to D” is stated, it means C or more and D or less, unless otherwise specified.

[0064] The terms used in the present specification are for describing embodiments of the present disclosure and are not intended to limit the present disclosure.

[0065] FIG. 1 is a perspective view schematically illustrating a configuration of a secondary battery according to one or more embodiments of the present disclosure, FIG. 2 is a front cross-sectional

view schematically illustrating a configuration of the secondary battery of FIG. 1, according to one or more embodiments of the present disclosure, and FIG. 3 is a plan cross-sectional view schematically illustrating a configuration of an electrode assembly of the secondary battery of FIG. 1, according to one or more embodiments of the present disclosure.

[0066] Referring to FIGS. 1 to 3, the secondary battery according to one or more embodiments may include a case **100**, an electrode assembly **200**, and an electrode tab **30**.

[0067] Hereinafter, a case in which the secondary battery is a lithium-ion secondary battery having a cylindrical shape will be described as an example. However, the present disclosure is not limited thereto, and the secondary battery may be a lithium-polymer battery or a prismatic battery.

[0068] The case **100** forms a schematic exterior of the secondary battery, and may entirely support the electrode assembly **200** and the electrode tab **30** to be described in more detail below.

[0069] The case **100** may include a can **110**, a cap assembly **120**, and a gasket **130**.

[0070] The can **110** may include a bottom part **111** having a substantially circular shape and a cylindrical side wall **112** extending a set or predetermined length upward from a circumference of the bottom part **111**. An upper side of the can **110** may be formed to be open. Accordingly, the electrode assembly **200**, which will be described in more detail below, may be inserted into the can **110** together with an electrolyte during the assembly process of the secondary battery. The can **110** may be provided to be electrically conductive. For example, the can **110** may include at least one material selected from the group consisting of steel, stainless steel, aluminum, and an aluminum alloy.

[0071] The cap assembly **120** is formed to be substantially plate shaped (e.g., in a form of a plate), and may be arranged to face the open side of the can **110**, i.e., the upper side of the can **110**. The cap assembly **120** may be provided to be electrically conductive. For example, the cap assembly **120** may include at least one material selected from the group consisting of steel, stainless steel, aluminum, and an aluminum alloy. The cap assembly **120** may include a cap-up, a safety vent, a cap-down, an insulating member, and a sub-plate, but the present disclosure is not limited to these examples, and may be modified in one or more suitable forms.

[0072] The gasket **130** may be arranged between the can **110** and the cap assembly **120**. The gasket **130** may be formed of an electrically insulating material such as rubber, silicone, and/or the like. The gasket **130** may be arranged such that an inner side surface thereof is around (e.g., entirely surrounds) a circumferential surface of the cap assembly **120**. The inner side surface of the gasket **130** may be fixed to the circumferential surface of the cap assembly **120** by one or more suitable types (kinds) of coupling methods such as adhesion, welding, pressing, and/or the like.

[0073] The case **100** may further include a beading part **140** formed to be inwardly recessed from an outer side surface of the can **110** and a crimping part **150** bent and extending from an upper part of the beading part **140**.

[0074] The beading part **140** may be formed by pressing inward a circumference of an outer circumferential surface of the can **110** at (e.g., near) the open side of the can **110**. The beading part **140** may be arranged between the cap assembly **120** and the electrode assembly **20**. The beading part **140** may prevent or reduce the movement of the electrode assembly **200** inside the can **110**, and may determine a position in which the cap assembly **120** is seated on the upper side of the can **110**.

[0075] The crimping part **150** may be bent and extend from the upper part of the beading part **140**. An inner side surface of the crimping part **150** may be arranged to be around (e.g., to entirely surround) an outer side surface of the gasket **130**. The crimping part **150** may press an edge of the cap assembly **120** through the gasket **130** to firmly fix the cap assembly **120** to the can **110**.

[0076] The electrode assembly **200** may function as a unit structure for performing a power charging and discharging operation in the secondary battery.

[0077] The electrode assembly **200** may include an electrode plate **210** and a separator **220** which are alternately stacked.

[0078] The electrode plate **210** may include a positive electrode plate **211** and a negative electrode plate **213**.

[0079] The positive electrode plate **211** may function as a positive electrode of the electrode assembly **20**. The positive electrode plate **211** may be formed in the form of a foil including a metal material such as aluminum or an aluminum alloy.

[0080] The type, kind, size, shape, and/or the like of the positive electrode plate **211** is not particularly limited as long as the positive electrode plate **211** has conductivity (e.g., is a conductor) and does not cause chemical changes in the secondary battery.

[0081] A positive electrode active material layer **212** may be applied onto at least a part of the positive electrode plate **211**. The positive electrode plate **211** may include a first coated region **211a** onto which the positive electrode active material layer **212** is applied, and a first uncoated region **211b** onto which the positive electrode active material layer **212** is not applied. A plurality of first coated regions **211a** and a plurality of first uncoated regions **211b** may be provided. The first coated regions **211a** and the first uncoated regions **211b** may be alternately arranged in an extending direction of the positive electrode plate **211**.

[0082] The positive electrode active material layer **212** may be applied onto both surfaces (e.g., opposite surfaces) of the first coated region **211a**, or alternatively, may be applied onto only one surface of the first coated region **211a**.

[0083] The positive electrode active material layer **212** may include a positive electrode active material.

[0084] The positive electrode active material may include a compound (e.g., a lithiated intercalation compound) capable of reversibly intercalating and deintercalating lithium. More specifically, the positive electrode active material may include one or more types (kinds) of composite oxides of lithium and a metal selected from among cobalt, manganese, nickel, iron, and/or a (e.g., any suitable) combination thereof.

[0085] For example, the positive electrode active material may include at least one of lithium-iron-phosphate oxide ( $\text{LiFePO}_4$ , LFP), lithium-manganese-iron-phosphate oxide ( $\text{LiMnFePO}_4$ , LMFP), and lithium-nickel-cobalt-manganese oxide ( $\text{LiNi}_x\text{Co}_y\text{Mn}_z\text{O}_2$ , NCM). Here, conditions of  $0 < x < 1$ ,  $0 < y < 1$ ,  $0 < z < 1$ , and  $x + y + z = 1$  may be satisfied. The positive electrode active material may include any one of  $\text{LiFePO}_4$ ,  $\text{LiMnFePO}_4$ , and/or  $\text{LiNi}_x\text{Co}_y\text{Mn}_z\text{O}_2$ , and may also include two or all of  $\text{LiFePO}_4$ ,  $\text{LiMnFePO}_4$ , and/or  $\text{LiNi}_x\text{Co}_y\text{Mn}_z\text{O}_2$ .

[0086] The positive electrode active material layer **212** may further include a positive electrode conductive material.

[0087] The positive electrode conductive material is used to impart conductivity to the positive electrode active material layer **212**, and any electrically conductive material that does not cause a chemical change in the battery may be used. Examples of the positive electrode conductive material may include a carbon-based material such as natural graphite, artificial graphite, carbon black, acetylene black, ketjen black, carbon fiber, carbon nanofiber, carbon nanotubes, and/or the like; a metal-based material of a metal powder or metal fiber including copper, nickel, aluminum, silver, and/or the like; a conductive polymer such as a polyphenylene derivative; and/or a (e.g., any suitable) mixture thereof.

[0088] The positive electrode active material layer **212** may further include a positive electrode binder.

[0089] The positive electrode binder serves to suitably adhere particles constituting the positive electrode active material to each other, and to suitably adhere the positive electrode active material to the positive electrode plate **211**.

[0090] Examples of the positive electrode binder may include a non-aqueous binder, an aqueous binder, a dry binder, and/or a (e.g., any suitable) combination thereof.

[0091] The non-aqueous binder may include polyvinylchloride, carboxylated polyvinyl chloride,



polyvinyl fluoride, an ethylene propylene copolymer, polystyrene, polyurethane, polytetrafluoroethylene, polyvinylidene fluoride, polyethylene, polypropylene, polyamideimide, polyimide, and/or a (e.g., any suitable) combination thereof.

[0092] The aqueous binder may be selected from among styrene-butadiene rubber, (meth)acrylated styrene-butadiene rubber, (meth)acrylonitrile-butadiene rubber, (meth)acrylic rubber, butyl rubber, a fluororubber, polyethylene oxide, polyvinylpyrrolidone, polyepichlorohydrin, polyphosphazene, poly(meth)acrylonitrile, an ethylene propylene diene copolymer, polyvinyl pyridine, chlorosulfonated polyethylene, latex, a polyester resin, a (meth)acrylic resin, a phenolic resin, an epoxy resin, polyvinyl alcohol, and/or a (e.g., any suitable) combination thereof.

[0093] When the aqueous binder is used as the positive electrode binder, a cellulose-based compound capable of imparting viscosity may be further included. As the cellulose-based compound, one or more of carboxymethyl cellulose, hydroxypropyl methyl cellulose, methyl cellulose, or alkali metal salts thereof may be used alone or in combination. As the alkali metal, Na, K, or Li may be used.

[0094] The dry binder may be a fibrous polymer material, and for example, polytetrafluoroethylene, polyvinylidene fluoride, a polyvinylidene fluoride-hexafluoropropylene copolymer, polyethylene oxide, and/or a (e.g., any suitable) combination thereof.

[0095] The negative electrode plate **213** may function as a negative electrode of the electrode assembly **20**. The negative electrode plate **213** may be formed in the form of a foil including a metal material such as copper, a copper alloy, nickel, or a nickel alloy. The negative electrode plate **213** may be arranged to face the positive electrode plate **211** at a certain distance from the positive electrode plate **211**.

[0096] The type, kind, size, shape, and/or the like of the negative electrode plate **213** are not particularly limited as long as the negative electrode plate **213** has conductivity (e.g., is a conductor) and does not cause chemical changes in the secondary battery.

[0097] A negative electrode active material layer **214** may be applied onto at least a part of the negative electrode plate **213**. The negative electrode plate **213** may include a second coated region **213a** onto which the negative electrode active material layer **214** is applied, and a second uncoated region **213b** onto which the negative electrode active material layer **214** is not applied. A plurality of second coated regions **213a** and a plurality of second uncoated regions **213b** may be provided. The second coated regions **213a** and the second uncoated regions **213b** may be alternately arranged in an extending direction of the negative electrode plate **213**.

[0098] The negative electrode active material layer **214** may be applied onto both surfaces (e.g., opposite surfaces) of the second coated region **213a**, or alternatively, may be applied onto only one surface of the second coated region **213a**.

[0099] The negative electrode active material layer **214** may include a negative electrode active material.

[0100] The negative electrode active material may be a material that reversibly intercalates/deintercalates lithium ions, a lithium metal, a lithium metal alloy, a material capable of doping and dedoping lithium, or a transition metal oxide.

[0101] The material that reversibly intercalates/deintercalates lithium ions may be a carbon-based negative electrode active material, and examples thereof may include crystalline carbon, amorphous carbon, and/or a (e.g., any suitable) combination thereof. Examples of the crystalline carbon may include graphite such as amorphous, plate-shaped (e.g., in the shape of plates), flake-shaped (e.g., in the shape of flakes), spherical-shaped (e.g., in the shape of spheres) or fiber-shaped (e.g., in the shape of fibers) natural graphite or artificial graphite. Examples of the amorphous carbon may include soft carbon or hard carbon, a mesophase pitch carbonized product, calcined coke, and/or the like.

[0102] The lithium metal alloy may be an alloy of lithium and a metal selected from among Na, K, Rb, Cs, Fr, Be, Mg, Ca, Sr, Si, Sb, Pb, In, Zn, Ba, Ra, Ge, Al, and Sn.

[0103] A Si-based negative electrode active material or a Sn-based negative electrode active material may be used as the material capable of doping/dedoping lithium. The Si-based negative electrode active material may include silicon, a silicon-carbon composite,  $\text{SiO}_x$  ( $0 < x \leq 2$ ), a Si-Q alloy (where, Q is selected from among an alkali metal, an alkaline-earth metal, a Group 13 element, a Group 14 element (excluding Si), a Group 15 element, a Group 16 element, a transition metal, a rare-earth element, and/or a (e.g., any suitable) combination thereof), and/or a (e.g., any suitable) combination thereof. The Sn-based negative electrode active material may include Sn,  $\text{SnO}_x$  ( $0 < x \leq 2$ ), a Sn-based alloy, and/or a (e.g., any suitable) combination thereof.

[0104] The silicon-carbon composite may be a composite of silicon and amorphous carbon.

According to one or more embodiments, the silicon-carbon composite may be in the form of silicon particles and amorphous carbon coated on the surface of the silicon particles. For example, the silicon-carbon composite may include a secondary particle (core) in which silicon primary particles are agglomerated and an amorphous carbon coating layer (shell) located on the surface of the secondary particle. The amorphous carbon may also be located between the silicon primary particles, such that, for example, the silicon primary particles are coated with amorphous carbon. The secondary particles may be dispersed in an amorphous carbon matrix.

[0105] The silicon-carbon composite may further include crystalline carbon. For example, the silicon-carbon composite may include a core including crystalline carbon and silicon particles and an amorphous carbon coating layer located on the surface of the core.

[0106] The Si-based negative electrode active material or the Sn-based negative electrode active material may be used by being mixed with a carbon-based negative electrode active material.

[0107] The negative electrode active material layer **214** may further include a negative electrode conductive material and a negative electrode binder.

[0108] The negative electrode conductive material is used to impart conductivity to the negative electrode active material layer **214**, and any electrically conductive material that does not cause a chemical change in the battery may be used. Examples of the negative electrode conductive material may include a carbon-based material such as natural graphite, artificial graphite, carbon black, acetylene black, ketjen black, carbon fiber, carbon nanofiber, carbon nanotubes, and/or the like; a metal-based material of a metal powder or metal fiber including copper, nickel, aluminum, silver, and/or the like; a conductive polymer such as a polyphenylene derivative; and/or a (e.g., any suitable) mixture thereof.

[0109] The negative electrode binder serves to adhere particles constituting the negative electrode active material to each other well, and to adhere the negative electrode active material to the negative electrode plate **213** well.

[0110] Examples of the negative electrode binder may include a non-aqueous binder, an aqueous binder, a dry binder, and/or a (e.g., any suitable) combination thereof.

[0111] The non-aqueous binder may include polyvinylchloride, carboxylated polyvinylchloride, polyvinyl fluoride, an ethylene propylene copolymer, polystyrene, polyurethane, polytetrafluoroethylene, polyvinylidene fluoride, polyethylene, polypropylene, polyamideimide, polyimide, and/or a (e.g., any suitable) combination thereof.

[0112] The aqueous binder may be selected from among styrene-butadiene rubber, (meth)acrylated styrene-butadiene rubber, (meth)acrylonitrile-butadiene rubber, (meth)acrylic rubber, butyl rubber, a fluororubber, polyethylene oxide, polyvinylpyrrolidone, polyepichlorohydrin, polyphosphazene, poly(meth)acrylonitrile, an ethylene propylene diene copolymer, polyvinyl pyridine, chlorosulfonated polyethylene, latex, a polyester resin, a (meth)acrylic resin, a phenolic resin, an epoxy resin, polyvinyl alcohol, and/or a (e.g., any suitable) combination thereof.

[0113] When the aqueous binder is used as the negative electrode binder, a cellulose-based compound capable of imparting viscosity may be further included. As the cellulose-based compound, one or more of carboxymethyl cellulose, hydroxypropyl methyl cellulose, methyl cellulose, or alkali metal salts thereof may be used alone or in combination. As the alkali metal, Na,

K, or Li may be used.

[0114] The dry binder may be a fibrous polymer material, and for example, polytetrafluoroethylene, polyvinylidene fluoride, polyvinylidene fluoride-hexafluoropropylene copolymer, polyethylene oxide, and/or a (e.g., any suitable) combination thereof.

[0115] The separator **220** may be arranged between the positive electrode plate **211** and the negative electrode plate **213**. The separator **220** may prevent or reduce a short circuit between the positive electrode plate **211** and the negative electrode plate **213** while allowing the movement of lithium ions between the positive electrode plate **211** and the negative electrode plate **213**.

[0116] The separator **220** may be made of polyethylene, polypropylene, polyvinylidene fluoride, or a multilayer film of two or more layers thereof, and may also be made of a mixed multilayer film, such as a polyethylene/polypropylene double-layered separator, a polyethylene/polypropylene/polyethylene three-layered separator, and a polypropylene/polyethylene/polypropylene three-layered separator.

[0117] The separator **220** may include a porous substrate, and a coating layer including an organic material, an inorganic material, and/or a (e.g., any suitable) combination thereof located on at least one surface (e.g., on one surface or on opposite surfaces) of the porous substrate.

[0118] The porous substrate may be a polymer film formed of a polymer, or a copolymer or mixture of two or more selected from among polyolefins such as polyethylene, polypropylene, and/or the like, a polyester such as polyethylene terephthalate, polybutylene terephthalate, and/or the like, polyacetal, polyamide, polyimide, polycarbonate, polyether ether ketone, polyaryl ether ketone, polyetherimide, polyamideimide, polybenzimidazole, polyether sulfone, polyphenylene oxide, a cyclic olefin copolymer, polyphenylene sulfide, polyethylene naphthalate, glass fiber, Teflon, and polytetrafluoroethylene.

[0119] The organic material may include a polyvinylidene fluoride-based polymer or a (meth)acrylic-based polymer.

[0120] The inorganic material may include inorganic particles selected from among Al.sub.2O.sub.3, SiO.sub.2, TiO.sub.2, SnO.sub.2, CeO.sub.2, MgO, NiO, CaO, GaO, ZnO, ZrO.sub.2, Y.sub.2O.sub.3, SrTiO.sub.3, BaTiO.sub.3, Mg(OH).sub.2, boehmite, and/or a (e.g., any suitable) combination thereof, but the present disclosure is not limited thereto.

[0121] The organic and inorganic materials may be present by being mixed in one coating layer or may be present in a form in which a coating layer including organic materials and a coating layer including inorganic materials are laminated.

[0122] The electrode assembly **200** may have a shape that is wound around a winding axis C.

[0123] More specifically, the positive electrode plate **211** and the negative electrode plate **213** may be wound clockwise or counterclockwise around the winding axis C while one surface of each of the positive electrode plate **211** and the negative electrode plate **213** are arranged to face each other. Accordingly, the electrode assembly **200** may have substantially a jelly roll shape. A cross-sectional shape of the electrode assembly **200** may be changed in design into one or more suitable shapes such as an elliptical shape, a polygonal shape, and/or the like, in addition to a circular shape as illustrated in FIG. 3. Here, the winding axis C may be a straight line passing through a center part of the electrode assembly **200** and arranged normal (e.g., perpendicular) to the open surface of the case **10**.

[0124] A pair of separators **220** may be provided. The pair of separators **220** may be arranged to face both surfaces of the positive electrode plate **211** or the negative electrode plate **213** (e.g., one separator **220** arranged to face a first surface of each of the positive electrode plate **211** and the negative electrode plate **213** and a second separator **220** arranged to face a second surface, opposite the first surface, of each of the positive electrode plate **211** and the negative electrode plate **213**). The pair of separators **220** may be wound around the winding axis C together with the positive electrode plate **211** and the negative electrode plate **213**.

[0125] The electrode assembly **200** may be arranged in the case, more specifically, inside the can

**110**. The winding axis C of the electrode assembly **200** may be arranged coaxially with a central axis of the can **110**. A lower end part and an upper end part of the electrode assembly **200** may be arranged to face the bottom part **111** and the beading part **140** of the can **110**, respectively.

[0126] A center pin **21** may be additionally installed inside the electrode assembly **20**. The center pin **21** may have the form of a hollow circular pipe. The center pin **21** may be coupled to approximately the center of the electrode assembly **20**, and a central axis thereof may be arranged to coincide with the winding axis C of the electrode assembly **20**. The center pin **21** may include at least one of materials such as steel, stainless steel, aluminum, an aluminum alloy, and/or polybutylene terephthalate, for example. The center pin **21** serves to suppress or reduce deformation of the electrode assembly **200** during charging and discharging of the battery, and serves as a moving path for a gas generated inside the secondary battery. Of course, in some cases, the center pin **21** may not be provided.

[0127] The electrode tab **30** may be connected to the electrode plate **210** of the electrode assembly **20**. The electrode tab **30** may function as a component that electrically connects the case **100** to the electrode assembly **200**. One side of the electrode tab **30** may be arranged inside the electrode assembly **200**, and the other side of the electrode tab **30** may protrude to the outside of the electrode assembly **200**.

[0128] A plurality of electrode tabs **30** may be provided. As an example, a pair of electrode tabs **30** may be provided. One electrode tab **30** of the pair of electrode tabs **30** may be arranged between the positive electrode plate **211** and the separator **220**, and both sides (e.g., opposite sides) thereof in a longitudinal direction may be connected to the positive electrode plate **211** and the cap assembly **120**. Both sides of the other electrode tab **30** of the pair of electrode tabs **30** may be arranged between the negative electrode plate **213** and the separator **220**, and both sides (e.g., opposite sides) of the other electrode tab **30** in the longitudinal direction may be connected to the negative electrode plate **213** and the can **110**.

[0129] FIG. **4** is an enlarged cross-sectional view schematically illustrating an installation state of the electrode tab according to one or more embodiments of the present disclosure, FIG. **5** is a perspective view schematically illustrating a configuration of the electrode tab according to one or more embodiments of the present disclosure, and FIG. **6** is a cross-sectional view schematically illustrating a configuration of the electrode tab according to one or more embodiments of the present disclosure.

[0130] Among the plurality of electrode tabs **30**, the electrode tab **30** connected to the positive electrode plate **211** is illustrated in FIGS. **4** and **5** as an example, but a detailed configuration of the electrode tab **30** to be described in more detail below may be equally applied to the electrode tab **30** connected to the negative electrode plate **213**.

[0131] Hereinafter, a case in which the longitudinal direction of the electrode tab **30** is arranged substantially parallel to the winding axis C of the electrode assembly **200** will be described as an example. However, the electrode tab **30** is not limited thereto, and the longitudinal direction thereof may also be arranged to intersect the winding axis C of the electrode assembly **200**.

[0132] Referring to FIGS. **4** to **6**, the electrode tab **30** according to one or more embodiments may include a first tab body **310**, a second tab body **320**, and a connection member **330**.

[0133] The first tab body **310** and the second tab body **320** may form the exterior on both sides (e.g., opposite sides) of the electrode tab **30**. The first tab body **310** and the second tab body **320** may be formed of an electrically conductive material such as copper, aluminum, nickel, and/or the like.

[0134] Longitudinal directions of the first tab body **310** and the second tab body **320** may be arranged substantially parallel to each other. When the electrode tab **30** is connected to the electrode plate **210** of the electrode assembly **20**, the longitudinal directions of the first tab body **310** and the second tab body **320** may be arranged substantially parallel to the winding axis C of the electrode assembly **20**.

[0135] The first tab body **310** and the second tab body **320** may be arranged to face each other (e.g., arranged opposite to each other) in a direction intersecting the longitudinal direction of the first tab body **310**. As an example, the first tab body **310** and the second tab body **320** may be arranged to face each other (e.g., arranged opposite to each other) in a width direction of the first tab body **310**.

[0136] The longitudinal direction of each of the first tab body **310** and the second tab body **320** described in more detail below may be a direction substantially parallel to an X-axis based on FIG. 5, and the width direction of each of the first tab body **310** and the second tab body **320** may be a direction substantially parallel to a Y-axis based on FIG. 5.

[0137] The first tab body **310** according to one or more embodiments may include a first center part **311**, a first inner end part **312**, and a first outer end part **313**.

[0138] The first center part **311** may form an exterior of a central region of the first tab body **310**.

[0139] The first inner end part **312** may extend from one side of the first center part **311** in the width direction of the first tab body **310**. For example, the first inner end part **312** may be a region at one end part of the first tab body **310**, which extends toward the second tab body **320**, of both end parts of the first tab body **310** spaced and/or apart (e.g., spaced apart or separated) from each other in the width direction of the first tab body **310**. The first inner end part **312** may be connected to the connection member **330** to be described in more detail below.

[0140] The first outer end part **313** may extend in the width direction of the first tab body **310** from the other side of the first center part **311**. The first outer end part **313** may be spaced and/or apart (e.g., spaced apart or separated) from the first inner end part **312**. For example, the first outer end part **313** may be a region on the other end part of the first tab body **310**, which extends in a direction away from the second tab body **320**, of both end parts of the first tab body **310** spaced and/or apart (e.g., spaced apart or separated) from each other in the width direction of the first tab body **310**.

[0141] A cross-sectional area of the first tab body **310** may decrease from the first center part **311** toward the first outer end part **313**. Here, the cross-sectional area of the first tab body **310** may be an area of the first tab body **310** on a plane (e.g., in a plan view) normal (e.g., perpendicular) to the Y-axis based on FIG. 5. In this case, cross-sectional area of first tab body **310** normal (e.g., perpendicular) to the X-axis, a surface of the first outer end part **313** may have a curved shape curved with a set or predetermined curvature. Accordingly, if (e.g., when) the electrode assembly **200** expands, the first outer end part **313** can prevent or reduce excessive stress from being applied to the electrode plate **210** due to its own curvature.

[0142] The cross-sectional area of the first tab body **310** may decrease from the first center part **311** toward the first inner end part **312**. Accordingly, if (e.g., when) curvature of the electrode plate **210** changes during the winding process of the electrode plate **210**, the first inner end part **312** can guide the first tab body **310** to more smoothly rotate around the connection member **330**.

[0143] As the cross-sectional area of the first tab body **310** is configured as described above, a cross-sectional shape of the first tab body **310** normal (e.g., perpendicular) to the X-axis may have a substantially circular or elliptical shape.

[0144] The second tab body **320** may include a second center part **321**, a second inner end part **322**, and a second outer end part **323**.

[0145] The second center part **321** may form an exterior of a central region of the second tab body **320**.

[0146] The second inner end part **322** may extend from one side of the second center part **321** in the width direction of the second tab body **320**. For example, the second inner end part **322** may be a region on one end part of the second tab body **320**, which extends toward the first tab body **310**, of both end parts of the second tab body **320** spaced and/or apart (e.g., spaced apart or separated) from each other in the width direction of the second tab body **320**. The second inner end part **322** may be connected to the connection member **330** to be described in more detail below.

[0147] The second outer end part **323** may extend from the other side of the second center part **321** in the width direction of the second tab body **320**. The second outer end part **323** may be spaced and/or apart (e.g., spaced apart or separated) from the second inner end part **322**. For example, the second outer end part **323** may be a region on the other end part of the second tab body **320**, which extends in a direction away from the first tab body **310**, of both end parts of the second tab body **320** spaced and/or apart (e.g., spaced apart or separated) from each other in the width direction of the second tab body **320**.

[0148] A cross-sectional area of the second tab body **320** may decrease from the second center part **321** toward the second outer end part **323**. Here, the cross-sectional area of the second tab body **320** may refer to a cross-sectional area of the second tab body **320** normal (e.g., perpendicular) to the Y-axis based on FIG. 5. In this case, in a cross-sectional area of the second tab body **320** normal (e.g., perpendicular) to the X-axis, a surface of the second outer end part **323** may have a curved shape curved with a set or predetermined curvature. Accordingly, if (e.g., when) the electrode assembly **200** expands, the second outer end part **323** can prevent or reduce excessive stress from being applied to the electrode plate **210** due to its own curvature.

[0149] The cross-sectional area of the second tab body **320** normal (e.g., perpendicular) to the Y-axis may decrease from the second center part **321** toward the second inner end part **322**. Accordingly, if (e.g., when) the curvature of the electrode plate **210** changes, the second inner end part **322** may guide the second tab body **320** to more smoothly rotate around the connection member **330**.

[0150] As the cross section of the second tab body **320** is configured as described above, a cross-sectional shape of the second tab body **320** normal (e.g., perpendicular) to the X-axis may have a substantially circular or elliptical shape.

[0151] The connection member **330** may be arranged between the first tab body **310** and the second tab body **320**. The connection member **330** may function as a component to mechanically and electrically interconnect the first tab body **310** and the second tab body **320**. The connection member **330** may be formed of the same material as the first tab body **310** and the second tab body **320**.

[0152] The connection member **330** according to one or more embodiments may be formed to have a band or strip shape that extends continuously in the longitudinal direction of the first tab body **310** and the second tab body **320**. The connection member **330** may be arranged between the first inner end part **312** of the first tab body **310** and the second inner end part **322** of the second tab body **320**. The first tab body **310**, the connection member **330**, and the second tab body **320** may be sequentially arranged in the width direction of the first tab body **310**. One side of the connection member **330** may be connected to the first inner end part **312** and another side of the connection member **330** may be connected to the second inner end part **322**. A cross-sectional shape of the connection member **330** is not limited to a circular shape illustrated in FIGS. 4 and 5, and one or more suitable design changes are possible within a technical concept of the shape interconnecting the first tab body **310** and the second tab body **320** between the first tab body **310** and the second tab body **320**.

[0153] The connection member **330** may be fixed to the electrode plate **210** of the electrode assembly **20**. As an example, the connection member **330** provided on one of the pair of electrode tabs **30** may be welded to the first uncoated region **211b** of the positive electrode plate **211**. In one or more embodiments, the connection member **330** provided on the other one of the pair of electrode tabs **30** may be arranged between the negative electrode plate **213** and the separator **220** and welded to the second uncoated region **213b** of the negative electrode plate **213**.

[0154] The first tab body **310** and the second tab body **320** may be separated from the electrode plate **210** of the electrode assembly **20**. More specifically, the first tab body **310** and the second tab body **320** are not directly coupled to the electrode plate **210** of the electrode assembly **20**, but may simply be in contact with the electrode plate **210**. As an example, the first tab body **310** and the

second tab body **320** provided on one of the pair of electrode tabs **30** may simply be in contact with the first uncoated region **211b** of the positive electrode plate **211**. In one or more embodiments, the first tab body **310** and the second tab body **320** provided on the other one of the pair of electrode tabs **30** may simply be in contact with the second uncoated region **213b** of the negative electrode plate **213**.

[0155] The first tab body **310** and the second tab body **320** may be rotatably connected about the connection member **330**. When the curvature of the electrode plate **210** changes, the first tab body **310** and the second tab body **320** rotate clockwise or counterclockwise around the connection member **330**, and an angle between the first tab body **310** and the second tab body **320** may be freely adjusted. Accordingly, if (e.g., when) the electrode assembly **200** expands or the electrode assembly **200** is wound, the first tab body **310** and the second tab body **320** may relieve pressure applied to the electrode plate **210** and prevent or reduce a crack phenomenon of the electrode plate **210** by adjusting the angle therebetween.

[0156] A buffer member **340**, as shown, for example, in FIG. 4, may be arranged inside at least one of the first tab body **310** and the second tab body **320**. The buffer member **340** may function as a component to vary a volume of the electrode tab **30** by externally applied pressure. Accordingly, if (e.g., when) the electrode assembly **200** expands, the electrode tab **30** can absorb a change in pressure applied between the electrode plate **210** and the separator **220** through its own volume change, and can prevent or reduce damage to the electrode plate **210**.

[0157] Hereinafter, a case in which the buffer member **340** is arranged in both the first tab body **310** and the second tab body **320** will be described as an example. However, the buffer member **340** is not limited thereto, and may be arranged in only one of the first tab body **310** or the second tab body **320**.

[0158] The buffer member **340** according to one or more embodiments may include a first chamber **341** arranged inside the first tab body **310**, and a second chamber **342** arranged inside the second tab body **320**.

[0159] The first chamber **341** and the second chamber **342** according to one or more embodiments may be empty spaces formed inside the first tab body **310** and the second tab body **320**, respectively. The first chamber **341** and the second chamber **342** may extend in (along) the longitudinal directions of the first tab body **310** and the second tab body **320**, respectively. The first chamber **341** may pass through both ends (e.g., opposite ends) of the first tab body **310** in the longitudinal direction of the first tab body **310** and communicate with an external space of the first tab body **310**, and the second chamber **342** may pass through both ends (e.g., opposite ends) of the second chamber **342** in the longitudinal direction of the second tab body **320** and communicate with an external space of the second tab body **320**.

[0160] In one or more embodiments, the first chamber **341** and the second chamber **342** may pass through the first outer end part **313** and the second outer end part **323** and communicate with the external spaces of the first tab body **310** and the second tab body **320**, respectively.

[0161] Cross-sectional shapes of the first chamber **341** and the second chamber **342** may be the same as the cross-sectional shapes of the first tab body **310** and the second tab body **320**, respectively. Accordingly, the first chamber **341** and the second chamber **342** can maintain constant thicknesses of the first tab body **310** and the second tab body **320** over the entire circumferences of the first tab body **310** and the second tab body **320**, respectively.

[0162] The case in which the first chamber **341** and the second chamber **342** form empty spaces inside the first tab body **310** and the second tab body **320**, respectively, has been described above as an example, but the first chamber **341** and the second chamber **342** are not limited thereto, and it is possible to fill inner spaces of the first tab body **310** and the second tab body **320** with an elastically deformable material such as silicone, rubber, and/or the like.

[0163] Hereinafter, a manufacturing process of the secondary battery according to one or more embodiments of the present disclosure will be described.

[0164] FIGS. 7 and 8 are each a schematic view illustrating a manufacturing process of the secondary battery according to one or more embodiments of the present disclosure.

[0165] Referring to FIGS. 7 and 8, a tab ring T in the form of a ring with a hollow interior is seated on the first uncoated region **211b** of the positive electrode plate **211**.

[0166] Subsequently, by using a welding device A, a central region W of the tab ring T is pressed toward the positive electrode plate **211**, and the central region W of the tab ring T is welded onto the first uncoated region **211b** of the positive electrode plate **211**. In this process, the central region W of the tab ring T may be fused and

[0167] bonded to the first uncoated region **211b** of the positive electrode plate **211** while in contact therewith by heat applied by the welding device A.

[0168] As both inner side surfaces of the central region W of the tab ring T are fused while in contact with each other, the connection member **330** may be formed in the central region W of the tab ring T. The connection member **330** may be arranged substantially parallel to a winding axis of the electrode plate **210**.

[0169] The first tab body **310** and the second tab body **320** may be formed on both sides (e.g., opposite sides) of the connection member **330**, and the first chamber **341** and the second chamber **342** may be formed inside the first tab body **310** and the second tab body **320**, respectively.

[0170] The same process may be performed on the negative electrode plate **213**.

[0171] After the bonding of electrode tabs **30** to the positive electrode plate **211** and the negative electrode plate **213** is completed, the positive electrode plate **211**, the negative electrode plate **213**, and the pair of separators **220** may be alternately stacked.

[0172] Thereafter, the electrode assembly **200** may be formed by winding the positive electrode plate **211**, the negative electrode plate **213**, and the pair of separators **220** around the winding axis C (e.g., winding the positive electrode plate **211**, a first separator **220**, the negative electrode plate **213**, and a second separator **220** around the winding axis).

[0173] Thereafter, the electrode assembly **200** may be inserted into the can **110**, and the cap assembly **120** may be coupled to an upper side of the can **110**.

[0174] In this case, the electrode tab **30** connected to the positive electrode plate **211** may be coupled to the cap assembly **120**, and the electrode tab **30** connected to the negative electrode plate **213** may be connected to the can **110**.

[0175] Hereinafter, an operation of the secondary battery according to one or more embodiments of the present disclosure will be described.

[0176] FIGS. 9 and 10 are each a cross-sectional view schematically illustrating an operation of the secondary battery according to one or more embodiments of the present disclosure.

[0177] Referring to FIG. 9, in the process in which the electrode plate **210** is wound around the winding axis, the first tab body **310** and the second tab body **320** may be rotated clockwise or counterclockwise around the connection member **330** according to a change in curvature of the electrode plate **210**, and an angle therebetween may be adjusted.

[0178] Referring to FIG. 10, as the electrode assembly **200** expands during a charging and discharging operation of the secondary battery, a compressive force may be applied onto the electrode tab **30** located between the positive electrode plate **211** and the separator **220** or between the negative electrode plate **213** and the separator **220**.

[0179] Such a compressive force may cause the buffer member **340** to vary the volume of the electrode tab **30**, thereby reducing the magnitude of pressure applied between the electrode assembly **200** and the electrode tabs **30**.

[0180] More specifically, the volume of the first tab body **310** may be reduced as the first chamber **341** arranged inside the first tab body **310** is compressed. In one or more embodiments, the volume of the second tab body **320** may be reduced as the second chamber **342** arranged inside the second tab body **320** is compressed.

[0181] As the volume of the first tab body **310** and/or the second tab body **320** is reduced, the



magnitude of pressure applied between the electrode tab **30** and the positive electrode plate **211** and/or between the electrode tab **30** and the negative electrode plate **213** can be reduced, and damage to the positive electrode plate **211** and/or the negative electrode plate **213** can be prevented or reduced.

[0182] In one or more embodiments, because the surfaces of the first outer end part **313** and the second outer end part **323** have curved shapes, stress applied from the first outer end part **313** and the second outer end part **323** to the positive electrode plate **211** or the negative electrode plate **213** may be relieved if (e.g., when) the electrode assembly **200** expands.

[0183] Hereinafter, a secondary battery according to one or more embodiments of the present disclosure will be described.

[0184] The secondary battery according to one or more embodiments may be configured to be different from the secondary battery according to the one or more embodiments of the present disclosure described above only in a detailed configuration of the connection member **330**.

Accordingly, in describing the secondary battery according to one or more embodiments, only the detailed configuration of the connection member **330**, which is different from that of the secondary battery according to previously described embodiments of the present disclosure, will be described.

[0185] FIG. **11** is a perspective view schematically illustrating a configuration of an electrode tab according to one or more embodiments of the present disclosure, and FIG. **12** is a plan view schematically illustrating a configuration of the electrode tab of FIG. **11**, according to one or more embodiments of the present disclosure.

[0186] Referring to FIGS. **11** and **12**, a connection member **330** according to one or more embodiments may include a plurality of connection beads **330a**.

[0187] The plurality of connection beads **330a** may be arranged in a row in the longitudinal direction of each of the first tab body **310** and the second tab body **320**.

[0188] Intervals between adjacent connection beads **330a** may be the same, or alternatively, the intervals may be formed differently from each other.

[0189] The number, shape, and/or the like of the connection beads **330a** are not limited to those illustrated in FIGS. **11** and **12**, and may be changed in design to one or more suitable numbers and/or shapes according to the lengths of the first tab body **310** and the second tab body **320** and the intervals between the connection beads **330a**.

[0190] The plurality of connection beads **330a** may be formed by a method of pressing and welding the central region W of the tab ring T a plurality of times with the welding device A.

[0191] Hereinafter, a secondary battery according to one or more embodiments of the present disclosure will be described.

[0192] The secondary battery according to one or more embodiments may be configured to be different from the secondary battery according to the one or more embodiments of the present disclosure described above only in a detailed configuration of the electrode tab **30**. Accordingly, in describing the secondary battery according to one or more embodiments, only the detailed configuration of the electrode tab **30**, which is different from that of the secondary battery according to previously described embodiments of the present disclosure, will be described.

[0193] FIG. **13** is a perspective view schematically illustrating a configuration of an electrode tab according to one or more embodiments of the present disclosure, and FIG. **14** is a cross-sectional view schematically illustrating a configuration of the electrode tab of FIG. **13**, according to the one or more embodiments of the present disclosure.

[0194] The electrode tab **30** according to one or more embodiments may further include a third tab body **350**.

[0195] The third tab body **350** may be arranged between the first tab body **310** and the second tab body **320**. The third tab body **350** may be formed of the same electrically conductive material as the first tab body **310** and the second tab body **320**.

[0196] A longitudinal direction of the third tab body **350** according to one or more embodiments

may be arranged substantially parallel to a longitudinal direction of the first tab body **310** (an X-axis direction based on FIG. **14**). The third tab body **350** may be arranged between the first inner end part **312** and the second inner end part **322** facing (e.g., opposite to) each other in a width direction of the first tab body **310**. For example, the first tab body **310**, the third tab body **350**, and the second tab body **320**, may be sequentially arranged in the width direction of the first tab body **310** (a Y-axis direction based on FIG. **14**).

[0197] The third tab body **350** may be formed such that a cross-sectional area in a direction perpendicular to the Y-axis thereof decreases toward the first tab body **310** and the second tab body **320**. A surface of the third tab body **350** may be formed to have a curved shape. Accordingly, if (e.g., when) the third tab body **350** comes into contact with the electrode plate **210**, localized stress concentration on the electrode plate **210** may be prevented or reduced.

[0198] The connection member **330** may include a first connection member **331** and a second connection member **332**.

[0199] The first connection member **331** may be arranged between the first tab body **310** and the third tab body **350**. The first connection member **331** according to one or more embodiments may be formed to have a band or strip shape that extends continuously in the longitudinal direction of the first tab body **310**. The first connection member **331** may be arranged between the first inner end part **312** of the first tab body **310** and one end part of the third tab body **350** arranged to face the first inner end part **312**. One side of the first connection member **331** may be integrally connected to the first inner end part **312** and another side of the first connection member **331** may be integrally connected to one end part of the third tab body **350**.

[0200] The first tab body **310** and the third tab body **350** may be rotatably connected about the first connection member **331**. When curvature of the electrode plate **210** changes, the first tab body **310** and the third tab body **350** rotate clockwise or counterclockwise around the first connection member **331**, and an angle between the first tab body **310** and the third tab body **350** may be freely adjusted.

[0201] The second connection member **332** may be arranged between the second tab body **320** and the third tab body **350**. The second connection member **332** according to one or more embodiments may be formed to have a band or strip shape that extends continuously in the longitudinal direction of the second tab body **320**. The second connection member **332** may be arranged between the second inner end part **322** of the second tab body **320** and the other end part of the third tab body **350** arranged to face the second inner end part **322**. One side of the second connection member **332** may be integrally connected to the second inner end part **322** and another side of the second connection member **332** may be integrally connected to the other end part of the third tab body **350**.

[0202] The second tab body **320** and the third tab body **350** may be rotatably connected about the second connection member **332**. When the curvature of the electrode plate **210** changes, the second tab body **320** and the third tab body **350** rotate clockwise or counterclockwise around the second connection member **332**, and an angle between the second tab body **320** and the third tab body **350** may be freely adjusted.

[0203] The buffer member **340** may further include a third chamber **343**.

[0204] The third chamber **343** according to one or more embodiments may be an empty space formed inside the third tab body **350**. The third chamber **343** may extend in (along) the longitudinal direction of the third tab body **350**. The third chamber **343** may pass through both ends (e.g., opposite ends) of the third tab body **350** in the longitudinal direction and communicate with an external space of the third tab body **350**.

[0205] A cross-sectional shape of the third tab body **350** normal (e.g., perpendicular) to the X-axis may be substantially the same as a cross-sectional shape of the second tab body **320** normal (e.g., perpendicular) to the X-axis.

[0206] The case in which the third chamber **343** forms an empty space inside the third tab body **350** has been described above as an example, but the third chamber **343** is not limited thereto, and it is

possible to fill the inner space of the third tab body **350** with an elastically deformable material, such as silicone, rubber, and/or the like.

[0207] Hereinafter, a secondary battery according to one or more embodiments of the present disclosure will be described.

[0208] The secondary battery according to one or more embodiments may be configured to be different from the secondary battery according to one or more embodiments of the present disclosure described above only in a detailed configuration of the connection member **330**.

Accordingly, in describing the secondary battery according to one or more embodiments, only the detailed configuration of the connection member **330**, which is different from that of the secondary battery according to previously described embodiments of the present disclosure, will be described.

[0209] FIG. **15** is a perspective view schematically illustrating a configuration of an electrode tab according to one or more embodiments of the present disclosure, and FIG. **16** is a plan view schematically illustrating a configuration of the electrode tab of FIG. **15**, according to one or more embodiments of the present disclosure.

[0210] Referring to FIGS. **15** and **16**, the first connection member **331** according to one or more embodiments may include a plurality of first connection beads **331a**, and the second connection member **332** may include a plurality of second connection beads **332a**.

[0211] The plurality of first connection beads **331a** are arranged between the first tab body **310** and the third tab body **350**, and may be arranged in a row in the longitudinal direction of each of the first tab body **310** and the third tab body **350**. Intervals between adjacent first connection beads **331a** may be the same, or alternatively, the intervals may be formed differently from each other.

[0212] The plurality of second connection beads **332a** are arranged between the second tab body **320** and the third tab body **350**, and may be arranged in a row in the longitudinal direction of the second tab body **320** and the third tab body **350**. Intervals between adjacent second connection beads **332a** may be the same, or alternatively, the intervals may be formed differently from each other.

[0213] The case in which both the first connection member **331** and the second connection member **332** include the plurality of first connection beads **331a** and the plurality of second connection beads **332a** has been described above as an example, but the first connection member **331** and the second connection member **332** are not limited thereto, and any one of the first connection member **331** and/or the second connection member **332** may be formed to have a band or strip shape that extends continuously in the longitudinal direction of the first tab body **310** as described with reference, for example, to FIGS. **13** and **14**.

[0214] Hereinafter, a secondary battery according to one or more embodiments of the present disclosure will be described.

[0215] The secondary battery according to one or more embodiments may be configured to be different from the secondary battery according to one or more embodiments of the present disclosure described above only in a detailed configuration of the third tab body **350** and the connection member **330**. Accordingly, in describing the secondary battery according to one or more embodiments, only the detailed configuration of the third tab body **350** and the connection member **330**, which is different from that of the secondary battery according to previously described embodiments of the present disclosure, will be described.

[0216] FIG. **17** is a perspective view schematically illustrating a configuration of an electrode tab according to one or more embodiments of the present disclosure, and FIG. **18** is a cross-sectional view schematically illustrating a configuration of the electrode tab of FIG. **17**, according to one or more embodiments of the present disclosure.

[0217] Referring to FIGS. **17** and **18**, the third tab body **350** according to one or more embodiments may be provided as a plurality of third tab bodies **350**.

[0218] A longitudinal direction of each of the plurality of third tab bodies **350** may be arranged parallel (substantially parallel) to the longitudinal direction of each of the first tab body **310** and the

second tab body **320**. The plurality of third tab bodies **350** may be arranged at set or predetermined intervals in the width direction of the first tab body **310** between the first tab body **310** and the second tab body **320**.

[0219] The first connection member **331** may be arranged between one of the plurality of third tab bodies **350**, which faces the first tab body **310**, and the first tab body **310**. In one or more embodiments, the second connection member **332** may be arranged between another one of the plurality of third tab bodies **350**, which faces the second tab body **320**, and the second tab body **320**.

[0220] The connection member **330** may further include a third connection member **333**.

[0221] The third connection member **333** may be arranged between the adjacent third tab bodies **350**. Hereinafter, the case in which the third connection member **333** is formed as a single piece as two third tab bodies **350** are formed as shown in FIGS. **17** and **18** will be described as an example. However, if (e.g., when) three or more third tab bodies **350** are formed, a plurality of third connection members **333** may be formed, and each of the third connection members **333** may be individually arranged between a pair of adjacent third tab bodies **350**.

[0222] The third connection member **333** may be formed to have a band or strip shape that extends continuously in the longitudinal direction of the third tab body **350**. The third connection member **333** may be arranged between end parts of the pair of third tab bodies **350** arranged adjacent to each other. One side of the third connection member **333** may be integrally connected to one end part of one of the pair of third tab bodies **350** and another side of the third connection member **333** may be integrally connected to one end part of the other of the pair of third tab bodies **350** that is adjacent to the first of the pair of the third tab bodies **350**.

[0223] Hereinafter, a secondary battery according to one or more embodiments of the present disclosure will be described.

[0224] The secondary battery according to one or more embodiments may be configured to be different from the secondary battery according to one or more embodiments of the present disclosure described above only in a detailed configuration of the connection member **330**.

Accordingly, in describing the secondary battery according to one or more embodiments, only the detailed configuration of the connection member **330**, which is different from that of the secondary battery according to previously described embodiments of the present disclosure, will be described.

[0225] FIG. **19** is a perspective view schematically illustrating a configuration of an electrode tab according to one or more embodiments of the present disclosure, and FIG. **20** is a plan view schematically illustrating a configuration of the electrode tab of FIG. **19**, according to one or more embodiments of the present disclosure.

[0226] Referring to FIGS. **19** and **20**, the first connection member **331** according to one or more embodiments may include a plurality of first connection beads **331a**, the second connection member **332** may include a plurality of second connection beads **332a**, and the third connection member **333** may include a plurality of third connection beads **333a**.

[0227] The plurality of first connection beads **331a** are arranged between the first tab body **310** and the third tab body **350**, and may be arranged in a row in the longitudinal direction of each of the first tab body **310** and the third tab body **350**. Intervals between adjacent first connection beads **331a** may be the same, or alternatively, the intervals may be formed differently from each other.

[0228] The plurality of second connection beads **332a** are arranged between the second tab body **320** and the third tab body **350**, and may be arranged in a row in the longitudinal direction of each of the second tab body **320** and the third tab body **350**. Intervals between adjacent second connection beads **332a** may be the same, or alternatively, the intervals may be formed differently from each other.

[0229] The plurality of third connection beads **333a** are arranged between the pair of third tab bodies **350** adjacent to each other, and may be arranged in a row in the longitudinal direction of the third tab body **350**. Intervals between adjacent third connection beads **333a** may be the same, or

alternatively, the intervals may be formed differently from each other.

[0230] The case in which the first connection member **331**, the second connection member **332**, and the third connection member **333** are each configured to include the plurality of first connection beads **331a**, the plurality of second connection beads **332a**, and the plurality of third connection beads **333a** has been described above as an example, but the first connection member **331**, the second connection member **332**, and the third connection member **333** are not limited thereto, and any one or all of the first connection member **331**, the second connection member **332**, and/or the third connection member **333** may be formed to have a band or strip shape that extends continuously in the longitudinal direction of the first tab body **310** as described with reference to FIGS. **17** and **18**.

[0231] According to one or more embodiments of the present disclosure, if (e.g., when) an electrode assembly expands, a pressure change applied between an electrode plate and a separator can be absorbed through a change in volume of the electrode tab itself, so that damage to the electrode plate can be prevented or reduced.

[0232] According to one or more embodiments of the present disclosure, a first tab body and a second tab body may be to rotate around a connection member if (e.g., when) curvature of an electrode plate changes, and thus an angle between the first tab body and the second tab body can be freely adjusted, so that, if (e.g., when) an electrode assembly expands or the electrode assembly is wound, pressure applied to the electrode plate can be relieved and a crack phenomenon of the electrode plate can be prevented or reduced.

[0233] According to one or more embodiments of the present disclosure, surfaces of a first outer end part and a second outer end part have curved shapes curved with a set or predetermined curvature, so that, if (e.g., when) an electrode assembly expands, excessive stress can be prevented or reduced from being applied to the electrode plate.

[0234] However, the effects obtainable through the present disclosure are not limited to the above effects, and other technical effects that are not mentioned will be understood by those skilled in the art from the above description of the present disclosure.

[0235] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the present disclosure belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and/or the present specification, and should not be interpreted in an idealized or overly formal sense, unless expressly so defined herein.

[0236] A portable device, vehicle, and/or the battery, e.g., a battery controller, and/or any other relevant devices or components according to embodiments of the present disclosure described herein may be implemented utilizing any suitable hardware, firmware (e.g., an application-specific integrated circuit), software, or a combination of software, firmware, and hardware. For example, the various components of the device may be formed on one integrated circuit (IC) chip or on separate IC chips. Further, the various components of the device may be implemented on a flexible printed circuit film, a tape carrier package (TCP), a printed circuit board (PCB), or formed on one substrate. Further, the various components of the device may be a process or thread, running on one or more processors, in one or more computing devices, executing computer program instructions and interacting with other system components for performing the various functionalities described herein. The computer program instructions are stored in a memory which may be implemented in a computing device using a standard memory device, such as, for example, a random access memory (RAM). The computer program instructions may also be stored in other non-transitory computer readable media such as, for example, a CD-ROM, flash drive, or the like. Also, a person of skill in the art should recognize that the functionality of various computing devices may be combined or integrated into a single computing device, or the functionality of a particular computing device may be distributed across one or more other computing devices without departing from the scope of the

embodiments of the present disclosure.

[0237] It will be understood that descriptions of features or aspects within each embodiment should typically be considered as available for other similar features or aspects in other embodiments, unless otherwise described. Thus, as would be apparent to one of ordinary skill in the art, features, characteristics, and/or elements described in connection with a particular embodiment may be used singly or in combination with features, characteristics, and/or elements described in connection with other embodiments unless otherwise specifically indicated. It is to be understood that the foregoing is an illustration of various example embodiments and is not to be construed as limited to the specific embodiments disclosed herein, and that various modifications to the disclosed embodiments, as well as other example embodiments, are intended to be included within the spirit and scope of the present disclosure as defined in the appended claims, and their equivalents.

## Claims

1. An electrode tab comprising: a first tab body; a second tab body facing the first tab body; a connection member between the first tab body and the second tab body; and a buffer member in at least one of the first tab body or the second tab body.
2. The electrode tab as claimed in claim 1, wherein the first tab body and the second tab body are rotatably connected about the connection member.
3. The electrode tab as claimed in claim 1, wherein the first tab body comprises: a first center part; a first inner end part extending from one side of the first center part and connected to the connection member; and a first outer end part extending from the other side of the first center part and spaced from the first inner end part, and the second tab body comprises: a second center part; a second inner end part extending from one side of the second center part and connected to the connection member; and a second outer end part extending from the other side of the second center part and spaced from the second inner end part.
4. The electrode tab as claimed in claim 3, wherein a cross-sectional area of the first tab body decreases from the first center part toward the first outer end part, and a cross-sectional area of the second tab body decreases from the second center part toward the second outer end part.
5. The electrode tab as claimed in claim 4, wherein a surface of each of the first outer end part and the second outer end part has a curved shape.
6. The electrode tab as claimed in claim 4, wherein the cross-sectional area of the first tab body decreases from the first center part toward the first inner end part, and the cross-sectional area of the second tab body decreases from the second center part toward the second inner end part.
7. The electrode tab as claimed in claim 6, wherein a cross-sectional shape of each of the first tab body and the second tab body is a circular shape or an elliptical shape.
8. The electrode tab as claimed in claim 1, wherein the connection member extends along a longitudinal direction of the first tab body and the second tab body.
9. The electrode tab as claimed in claim 1, wherein the connection member comprises a plurality of connection beads arranged in a longitudinal direction of the first tab body and the second tab body.
10. The electrode tab as claimed in claim 1, wherein the buffer member comprises: a first chamber inside the first tab body; and a second chamber inside the second tab body.
11. The electrode tab as claimed in claim 10, wherein the first chamber and the second chamber are separated from each other.
12. The electrode tab as claimed in claim 10, wherein cross-sectional shapes of the first chamber and the second chamber are the same as cross-sectional shapes of the first tab body and the second tab body, respectively.
13. The electrode tab as claimed in claim 10, wherein the first chamber and the second chamber extend along longitudinal directions of the first tab body and the second tab body, respectively.
14. The electrode tab as claimed in claim 10, wherein the first chamber and the second chamber

pass through the first tab body and the second tab body, respectively.

**15.** The electrode tab as claimed in claim 1, further comprising a third tab body between the first tab body and the second tab body, wherein the connection member comprises: a first connection member between the first tab body and the third tab body; and a second connection member between the second tab body and the third tab body.

**16.** The electrode tab as claimed in claim 15, wherein the buffer member comprises: a first chamber inside the first tab body; a second chamber inside the second tab body; and a third chamber inside the third tab body.

**17.** The electrode tab as claimed in claim 15, wherein the third tab body is provided as a plurality of third tab bodies, and the connection member further comprises one or more third connection members between the third tab bodies adjacent to each other.

**18.** A secondary battery comprising: a case; an electrode assembly in which an electrode plate and a separator are alternately stacked, the electrode assembly being inside the case; and an electrode tab connected to the electrode plate, wherein the electrode tab comprises: a first tab body; a second tab body facing the first tab body; a connection member between the first tab body and the second tab body; and a buffer member in at least one of the first tab body and the second tab body.

**19.** The secondary battery as claimed in claim 18, wherein the electrode assembly is wound around a winding axis, and a longitudinal direction of each of the first tab body and the second tab body is substantially parallel to the winding axis.

**20.** The secondary battery as claimed in claim 18, wherein the connection member is fixed to the electrode plate, and the first tab body and the second tab body are separated from the electrode plate.

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