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BATTERY

Abstract

Disclosed is a battery capable of improving connectivity between a terminal and a current collector part while improving structural efficiency around the terminal and the current collector part. The battery of the present disclosure includes an electrode laminate, a current collector part, and a terminal. The current collector part protrudes from the electrode laminate. The terminal has a contact surface with the current collector part. The contact surface has a curved surface. The curved surface bulges toward a side opposite the current collector part.

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Background/Summary

FIELD
[0001] The present disclosure relates to a battery.
BACKGROUND
[0002] Patent Literature 1 discloses a battery, wherein an electrode laminate and a lid terminal are electrically connected via a current collector part, an exterior body is adhered to an outer periphery of the lid terminal, and the current collector part and the electrode laminate are housed inside the exterior body.
CITATION LIST
Patent Literature
[0003] [PTL 1] Japanese Unexamined Patent Publication No. 2023-084066
SUMMARY
Technical Problem
[0004] Conventional batteries have room for improvement in terms of improving structural efficiency around the terminal and the current collector part, and improving connectivity between the terminal and current collector part.
Solution to Problem
[0005] The present disclosure provides, as means for achieving the object described above, the following multiple aspects.
<Aspect 1>
[0006] A battery, comprising an electrode laminate, a current collector part, and a terminal, wherein
[0007] the current collector part protrudes from the electrode laminate, [0008] the terminal has a contact surface with the current collector part, [0009] the contact surface has a curved surface, and [0010] the curved surface bulges toward a side opposite the current collector part.
<Aspect 2>
[0011] The battery according to Aspect 1, wherein [0012] the electrode laminate and the current collector part are housed in an exterior body, [0013] the terminal has the contact surface on an interior of the exterior body, and [0014] the terminal has an exposed surface facing an outside of the exterior body.
<Aspect 3>
[0015] The battery according to Aspect 1 or 2, wherein [0016] the terminal comprises a base and a protrusion, [0017] the base has a first surface and a second surface opposite the first surface, [0018] the protrusion protrudes from the base toward the electrode laminate, [0019] the protrusion comprises a first protrusion and a second protrusion, [0020] the first protrusion has a third surface facing the second protrusion and a fourth surface opposite the third surface, [0021] the second protrusion has a fifth surface facing the first protrusion and a sixth surface opposite the fifth surface, and [0022] at least one of the first surface, the third surface, and the fifth surface has the contact surface.
<Aspect 4>
[0023] The battery according to Aspect 3, wherein [0024] the electrode laminate and the current collector part are housed in an exterior body, [0025] the first surface, the third surface, and the fifth surface face an interior of the exterior body, [0026] the second surface faces an exterior of the exterior body, and [0027] the fourth surface and the sixth surface are adhered to the exterior body.
<Aspect 5>
[0028] The battery according to any one of Aspect 3 or 4, wherein [0029] a planar shape of the base

is a rectangle, [0030] the protrusion comprises a third protrusion and a fourth protrusion, [0031] the rectangle comprises a first side and a second side facing each other and a third side and a fourth side facing each other, [0032] the first protrusion protrudes from the first side, [0033] the second protrusion protrudes from the second side, [0034] the third protrusion protrudes from the third side, and [0035] the fourth protrusion protrudes from the fourth side.

Effects

[0036] According to the battery of the present disclosure, structural efficiency around the terminal and the current collector part can easily be improved (space can easily be saved), and connectivity between the terminal and the current collector part can easily be improved.

Description

BRIEF DESCRIPTION OF DRAWINGS

[0037] FIG. **1** schematically shows an example of the external configuration of a battery.

[0038] FIG. **2** schematically shows an example of the configuration of the cross section taken along line II-II of FIG. **1**.

[0039] FIG. **3** schematically shows an example of the configuration of the cross section taken along line III-III of FIG. **1**.

[0040] FIG. **4** schematically shows an example of the configuration of the cross section taken along line IV-IV of FIG. **1**.

[0041] FIG. **5** schematically shows an example of the external shape of a terminal.

[0042] FIG. **6** schematically shows an example of the cross section of a terminal.

[0043] FIG. **7** schematically shows an example of the cross section of a terminal.

[0044] FIG. **8** schematically shows an example of the cross section of a terminal.

[0045] FIG. **9** schematically shows an example of the cross section of a terminal.

[0046] FIG. **10** schematically shows an example of an adherence state between a terminal and an exterior body. The current collector part and electrode laminate are omitted.

[0047] FIG. **11** is a view detailing problems of a battery of the prior art.

DESCRIPTION OF EMBODIMENTS

[0048] An embodiment of the battery and battery production method of the present disclosure will be described below, but the battery and battery production method of the present disclosure is not limited to the following embodiment.

1. Problems of Battery of Prior Art

[0049] FIG. **11** shows an example of the cross-sectional configuration of a battery of the prior art. As shown in FIG. **11**, in the battery of the prior art, the current collector part protruding from the electrode laminate is bent so as to connect the current collector part to the terminal while ensuring structural efficiency around the terminal and the current collector part. In this case, as shown in FIG. **11**, there are concerns regarding deterioration of the current collector part due to the curvature R of the current collector part becoming excessively small, and deterioration of the exterior body due to the current collector part coming into contact with the exterior body. Furthermore, in the battery of the prior art, the contact area between the terminal and the current collector part is small, and there is room for improvement regarding connectivity between the terminal and the current collector part.

2. Battery of Present Disclosure

[0050] In light of the problems described above, the present application discloses a battery which can improve connectivity between a terminal and a current collector part while improving structural efficiency around the terminal and the current collector part. As shown in FIGS. **1** to **7**, a battery **100** according to an embodiment comprises an electrode laminate **10**, a current collector part **20**, and a terminal **30**. The current collector part **20** protrudes from the electrode laminate **10**.

As shown in FIGS. **5** and **6**, the terminal **30** has a contact surface **30***a* with the current collector part **20**. The contact surface **30***a* has a curved surface **30***ax*. The curved surface **30***ax* bulges toward the side opposite the current collector part **20**.

2.1 Electrode Laminate

[0051] The battery **100** supplies the power generated by the electrode laminate **10** to external devices and the like via the current collector part **20** and the terminal **30**. Specifically, the electrode laminate **10** functions as a power generating element of the battery **100**.

[0052] As shown in FIGS. **2** and **4**, the electrode laminate **10** may be formed by stacking a plurality of electrode bodies. Each electrode body can comprise, for example, a layer composed of a positive electrode current collector, a positive electrode active material layer, an electrolyte layer, a negative electrode active material layer, and a layer composed of a negative electrode current collector. The positive electrode current collector, the positive electrode active material layer, the electrolyte layer, the negative electrode active material layer, and the negative electrode current collector may be publicly known components. The electrode laminate **10** may contain a solid electrolyte, a liquid electrolyte, or a solid electrolyte and a liquid electrolyte. When the electrode laminate **10** contains at least a solid electrolyte, a battery **100** having excellent mechanical properties, output properties, etc., can easily be obtained. The shape of the lamination surface of the layers constituting the electrode laminate **10** may be, for example, rectangular.

[0053] The number of electrode bodies stacked in the electrode laminate **10** is not particularly limited. In the electrode laminate **10**, the plurality of electrode bodies may be connected to each other in series or in parallel. The electrode laminate **10** may have a bipolar structure. In the electrode laminate **10**, the lamination surfaces of the electrode bodies may be insulated from each other by providing an insulating layer between one electrode body and another electrode body. As shown in FIG. **2**, in the battery **100**, the plurality of electrode bodies can be electrically connected to each other by the current collector part **20**. For example, the plurality of electrode bodies can be electrically connected to each other in parallel by the current collector part **20**.

[0054] As shown in FIGS. **2** to **4**, the electrode laminate **10** may have an end surface **10***x* at one end in the lamination direction of each of the layers, an end surface **10***y* at the other end in the lamination direction of each of the layers, and side surfaces **10***z* each connecting the end surface **10***x* and the end surface **10***y*. Each side surface **10***z* may be formed by the outer edges of the layers constituting the electrode laminate **10**. In the electrode laminate **10**, the lamination areas of the layers may differ so that the side surfaces **10***z* may have concavities and convexities or gaps. Each side surface **10***z* may have a surface along the lamination direction of the layers in the electrode laminate **10**. The current collector part **20**, which is described later, can protrude from the side surface **10***z* of the electrode laminate **10** to the terminal **30**. The electrode laminate **10** may be, for example, in the shape of a plate or a rectangular parallelepiped as a whole.

[0055] As shown in FIGS. **2** and **4**, the electrode laminate **10** can have a thickness T.sub.10 along the lamination direction. The thickness T.sub.10 of the electrode laminate **10** is not particularly limited. The thickness T.sub.10 of the electrode laminate **10** may be, for example, 5 mm or more and 100 mm or less, or 10 mm or more and 50 mm or less.

[0056] As shown in FIGS. **3** and **4**, the electrode laminate **10** can have a width W.sub.10 along the lamination surface at the side surface **10***z* where the current collector part **20** protrudes. The width W.sub.10 of the electrode laminate **10** is not particularly limited. The width W.sub.10 of the electrode laminate **10** may be, for example, 10 mm or more and 500 mm or less, or 50 mm or more and 200 mm or less.

2.2 Current Collector Part

[0057] The current collector part **20** protrudes from the electrode laminate **10**, is connected to the contact surface **30***a* of the terminal **30**, and electrically connects the electrode laminate **10** and the terminal **30**.

[0058] As shown in FIGS. **2** and **3**, the current collector part **20** may be, for example, a bundle of a

plurality of current collectors protruding from the side surface **10***z* of the electrode laminate **10** toward the terminal **30**. The number of current collectors protruding in the same direction from the electrode laminate **10** is not particularly limited, and may be, for example, 2 to 500, or 30 to 100. In the battery **100**, the current collector part **20** may be a bundle of a plurality of positive electrode current collectors, or a bundle of a plurality of negative electrode current collectors. In the battery **100**, the plurality of current collectors protruding from the side surface **10***z* of the electrode laminate **10** toward the terminal **30** may be grouped to form one bundle, or may be grouped to form a plurality of bundles.

[0059] The current collector constituting the current collector part **20** may be, for example, a metal foil or a metal mesh. From the viewpoint of excellent handling, the current collector part **20** may comprise a plurality of metal foils. Examples of the metal constituting the current collector include Cu, Ni, Cr, Au, Pt, Ag, Al, Fe, Ti, Zn, Co, and stainless steel. The current collector may have some type of coating layer on the surface thereof for the purpose of adjusting the resistance, etc. Furthermore, when the current collector part **20** is composed of a plurality of metal foils, some type of layer may be present between the plurality of metal foils. The thickness of each current collector is not particularly limited. For example, it may be 0.1 μm or more, it may be 1 μm or more, it may be 1 mm or less, and it may be 100 μm or less.

[0060] As shown in FIG. **3**, the current collector part **20** can have a width W.sub.20 in a direction perpendicular to the protrusion direction of the current collector part **20** from the electrode laminate **10** and along the lamination surface of the electrode laminate **10**. The width W.sub.20 of the current collector part **20** is not particularly limited. The width W.sub.20 of the current collector part may be, for example, 5 mm or more and 450 mm or less, or 20 mm or more and 190 mm or less.

2.3 Terminal

[0061] As shown in FIGS. **2**, **3**, and **5** to **7**, the terminal **30** has a contact surface **30***a* with the current collector part **20**. The contact surface **30***a* has a curved surface **30***ax*. The curved surface **30***ax* bulges toward the side opposite the current collector part **20**. "The curved surface bulges toward the side opposite the current collector part" means that the curved surface **30***ax* is a concave surface. By including the curved surface **30***ax* in the contact surface **30***a* of the terminal **30** with the current collector part **20**, the current collector part **20** can be connected to the terminal **30** while being aligned with the contact surface **30***a*. Specifically, the contact area between the contact surface **30***a* and the current collector part **20** is increased, whereby connectivity of the current collector part **20** with the terminal **30** is improved. Furthermore, since the contact surface **30***a* is a concave surface, a part of the current collector part **20** can be housed in the space formed by the concave surface, whereby structural efficiency around the terminal **30** can be improved.

2.3.1 Contact Surface

[0062] As described above, the contact surface **30***a* of the terminal **30** has a curved surface **30***ax* which bulges toward the side opposite the current collector part **20**. In the battery **100**, the current collector part **20** contacts the contact surface **30***a* along the contact surface **30***a* including the curved surface **30***ax*, whereby the connection between the current collector part **20** and the terminal **30** is secured. The radius of curvature of the curved surface **30***ax* can be appropriately determined in accordance with the bundle shape of the current collector part **20**, the size of the terminal **30**, etc. For example, the contact surface **30***a* may have a curved surface **30***ax* having a radius of curvature of 0.5 mm or more and 50 mm or less. The contact surface **30***a* may have the curved surface **30***ax* in only a part thereof, or the entire contact surface **30***a* may be constituted by the curved surface **30***ax*. The contact surface **30***a* may be a combination of a flat surface **30***ay* and a curved surface **30***ax* as shown in the drawings, or may be a combination of a plurality of curved surfaces **30***ax* having different radii of curvature.

2.3.2 Surfaces Other than Contact Surface

[0063] The terminal **30** can have a surface other than the contact surface **30***a*. The surface other than the contact surface **30***a* is not particularly limited. For example, as shown in FIGS. **2**, **3**, and **5**

to **7**, when the electrode laminate **10** and the current collector part **20** are housed in the exterior body **40**, the terminal **30** may have the contact surface **30***a* inside the exterior body **40**, and the terminal **30** may have an exposed surface (for example, a second surface **31***y*, which will be described later) which faces the exterior of the exterior body **40**. Furthermore, as shown in FIGS. **2** and **3**, the terminal **30** may have an adhesive surface with the exterior body **40** (for example, a fourth surface **32***ay* or a sixth surface **32***by*, which will be described later).

2.3.3 Specific Examples of Shape of Terminal

[0064] Specific examples of the shape of terminal **30** will be described below, but the shape of terminal **30** is not limited to the specific shapes described below. As shown in FIGS. **2**, **3**, and **5** to **7**, the terminal **30** may comprise a base **31** and a protrusion **32**. The base **31** may have a first surface **31***x* and a second surface **31***y* opposite the first surface **31***x*. The protrusion **32** may protrude from the base **31** toward the electrode laminate **10**. The protrusion **32** may comprise a first protrusion **32***a* and a second protrusion **32***b*. The first protrusion **32***a* may have a third surface **32***ax* facing the second protrusion **32***b* and a fourth surface **32***ay* opposite the third surface **32***ax*. The second protrusion **32***b* may have a fifth surface **32***bx* facing the first protrusion **32***a* and a sixth surface **32***by* opposite the fifth surface **32***bx*. In this case, at least one of the first surface **31***x*, the third surface **32***ax*, and the fifth surface **32***bx* may have the contact surface **30***a* described above. When the terminal **30** has such a shape, structural efficiency around the terminal **30** can easily be further improved.

[0065] As shown in FIGS. **2** and **3**, when the electrode laminate **10** and the current collector part **20** are housed in the exterior body **40**, the first surface **31***x*, the third surface **32***ax*, and the fifth surface **32***bx* may face the interior of the exterior body **40**, the second surface **31***y* may face the exterior of the exterior body **40**, and the fourth surface **32***ay* and the sixth surface **32***by* may be adhered to the exterior body **40**. When the electrode laminate **10**, the current collector part **20**, the terminal **30**, and the exterior body **40** satisfy such a positional relationship, structural efficiency around the terminal **30** can easily be further improved.

2.3.3.1 Base

[0066] As shown in FIGS. **2**, **3**, and **5** to **7**, the base **31** can have a first surface **31***x* facing the electrode laminate **10** and a second surface **31***y* facing the side opposite the electrode laminate **10**. The base **31** may correspond to, for example, the bottom of a vessel-shaped terminal **30**. As shown in FIGS. **2** and **3**, the first surface **31***x* may be in contact with the current collector part **20**, and may have a joint **25** with the current collector part **20**. The second surface **31***y* may face the outside of the battery **100**. The first surface **31***x* and the second surface **31***y* of the base **31** may be, for example, flat surfaces as shown in the drawings, or may have concavities and convexities. Furthermore, the first surface **31***x* may constitute the contact surface **30***a* having the curved surface **30***ax* as described above. The planar shapes of the first surface **31***x* and the second surface **31***y* (referring to the planar shape when the first surface and the second surface are projected) is not particularly limited. Though the planar shapes of the illustrated first surface **31***x* and second surface **31***y* are elongated rectangles, the planar shapes may be square, quadrangles other than rectangles (elongated rectangles and squares), other polygonal shapes, circles, ellipses, or other shapes. In particular, when the first surface **31***x* and second surface **31***y* are rectangular, and especially when they are elongated rectangles, case of handling and mechanical strength are likely to be improved. Note that the terms “polygon”, “quadrangle”, “rectangle”, and “elongated rectangle” in the present description each include concepts including shapes with chamfered corners and shapes with rounded corners.

[0067] As shown in FIGS. **6** and **7**, the base **31** can have a thickness T.sub.31 (minimum thickness from the first surface **31***x* to the second surface **31***y*). The thickness T.sub.31 of the base **31** is not particularly limited. In particular, when the thickness T.sub.31 of the base **31** is 0.1 mm or more and 10 mm or less or 0.2 mm or more and 3 mm or less, the structural efficiency around the terminal **30** and the strength of the terminal **30** tend to be well balanced.

[0068] As shown in FIG. **6**, the base **31** can have a length (height) L.sub.31x along the lamination direction in the electrode laminate **10** in the inner dimension of the first surface **31***x* (from the inner surface of the first protrusion **32***a* to the inner surface of the second protrusion **32***b*). As shown in FIG. **6**, the length L.sub.31x in the inner dimension of the first surface **31***x* of the base **31** may be the same as the height H.sub.33 of the opening **33** of the terminal **30**, which will be described later. Alternatively, the length L.sub.31x in the inner dimension of the first surface **31***x* of the base **31** may be smaller or larger than the height H.sub.33. The length L.sub.31x in the inner dimension of the first surface **31***x* of the base **31** is not particularly limited, and may be 4.8 mm or more and 99.8 mm or less or 9.8 mm or more and 49.8 mm or less.
[0069] As shown in FIG. **6**, the base **31** can have a length (height) L.sub.31y at the second surface **31***y* along the lamination direction in the electrode laminate **10**. As shown in FIGS. **2** and **6**, the length L.sub.31y at the second surface **31***y* of the base **31** may be the same as the thickness T.sub.30 of the terminal **30** (the length from the fourth surface **32***ay* of the first protrusion **32***a* to the sixth surface **32***by* of the second protrusion **32***b*). Alternatively, the length L.sub.31y at the second surface **31***y* of the base **31** may be greater than the thickness T.sub.30 of the terminal **30**. Specifically, as shown in FIG. **8**, the first protrusion **32***a* and the second protrusion **32***b* may protrude from inside the outer edge of the first surface **31***x* of the base **31** toward the electrode laminate **10**. The length L.sub.31y of the second surface **31***y* of the base **31** is not particularly limited, and may be 4.9 mm or more and 99.9 mm or less or 9.9 mm or more and 49.9 mm or less.
[0070] As shown in FIG. **7**, the base **31** can have a width W.sub.31x along the lamination surface of the electrode laminate **10** in the inner dimension of the first surface **31***x*. As shown in FIG. **7**, the width W.sub.31x in the inner dimension of the first surface **31***x* of the base **31** may be the same as the width W.sub.33 of the opening **33** of the terminal **30**, which will be described later. Alternatively, the width W.sub.31x in the inner dimension of the first surface **31***x* of the base **31** may be smaller than the width W.sub.33. The width W.sub.31x in the inner dimension of the first surface **31***x* of the base **31** is not particularly limited, and may be 7.5 mm or more and 475 mm or less or 30 mm or more and 195 mm or less.
[0071] As shown in FIG. **7**, the base **31** can have a width W.sub.31y at the second surface **31***y* along the lamination surface of the electrode laminate **10**. As shown in FIG. **7**, the width W.sub.31y of the second surface **31***y* of the base **31** may be the same as the sum of the width W.sub.33 of the opening **33**, the thickness T.sub.32c of the third protrusion **32***c*, and the thickness T.sub.32d of the fourth protrusion **32***d*, of the terminal **30**, which will be described later. Alternatively, the width W.sub.31y of the second surface **31***y* of the base **31** may be larger than the sum of the width W.sub.33, the thickness T.sub.32c, and the thickness T.sub.32d. The width W.sub.31y of the second surface **31***y* of the base **31** is not particularly limited, and may be 8.1 mm or more and 475.1 mm or less or 30.1 mm or more and 195.1 mm or less.
[0072] The ratio L.sub.31x/W.sub.31x of the length (height) L.sub.31x to the width W.sub.31x of the first surface **31***x* of the base **31** is not particularly limited. In particular, when the ratio L.sub.31x/W.sub.31x is 0.01 or more and 13.3 or less or 0.05 or more and 1.66 or less, the connectivity of the current collector part **20** to the terminal **30** and the strength of the terminal are easily secured.
[0073] The ratio L.sub.31y/W.sub.31y of the length (height) L.sub.31y to the width W.sub.31y of the second surface **31***y* of the base **31** is not particularly limited. In particular, when the ratio L.sub.31y/W.sub.31y is 0.01 or more and 13.3 or less or 0.05 or more and 1.66 or less, the connectivity of the current collector part **20** to the terminal **30** and the strength of the terminal are easily secured.
2.3.3.2 Protrusion
[0074] The protrusion **32** protrudes from the base **31** toward the electrode laminate **10**. As shown in FIGS. **2**, **3**, and **5** to **7**, the protrusion **32**, excluding the portion on which the curved surface **30***ax* described above is formed, may protrude linearly from the base **31** toward the electrode laminate

10 while having a thickness. As shown in FIG. **2**, the protrusion **32** can comprise a first protrusion **32***a* and a second protrusion **32***b* in one cross section. The first protrusion **32***a* has a third surface **32***ax* facing the second protrusion **32***b* and a fourth surface **32***ay* opposite the third surface **32***ax*. The second protrusion **32***b* has a fifth surface **32***bx* facing the first protrusion **32***a* and a sixth surface **32***by* opposite the fifth surface **32***bx*. Furthermore, as shown in FIG. **3**, the protrusion **32** may have a third protrusion **32***c* and a fourth protrusion **32***d* in a cross section perpendicular to the one cross section. In this case, the third protrusion **32***c* may have a seventh surface **32***cx* facing the fourth protrusion **32***d* and an eighth surface **32***cy* opposite the seventh surface **32***cx*. The fourth protrusion **32***d* may have a ninth surface **32***dx* facing the third protrusion **32***c* and a tenth surface **32***dy* opposite the ninth surface **32***dx*.

[0075] In the battery **100**, the thickness T.sub.32 of the protrusion **32** (for example, T.sub.32a to T.sub.32d in FIGS. **6** and **7**) is not particularly limited. In particular, when the thickness T.sub.32 of the protrusion **32** is 0.1 mm or more and 10 mm or less or 0.2 mm or more and 3 mm or less, connectivity of the current collector part **20** to the terminal **30** and the strength of the terminal are easily secured. Note that the "thickness of the protrusion" in the present description is measured at the end surface of the protrusion on the electrode laminate side.

[0076] As shown in FIGS. **6** and **7**, the protrusion **32** can have a protrusion length L.sub.32 from the first surface **31***x* of the base **31** toward the electrode laminate **10**. The protrusion length L.sub.32 of the protrusion **32** is not particularly limited and may be 3 mm or more and 50 mm or less or 5 mm or more and 30 mm or less. The protrusion **32** may have the same protrusion length L.sub.32 as a whole. Specifically, the first protrusion **32***a*, the second protrusion **32***b*, the third protrusion **32***c*, and the fourth protrusion **32***d* may be flush with each other at the end surfaces on the electrode laminate **10** side. Alternatively, the protrusion length of a part of the protrusion **32** may be different from the protrusion length of the other parts of the protrusion **32**.

[0077] As shown in FIGS. **6** and **7**, the thickness T.sub.31 of the base **31** may be smaller than the protrusion length L.sub.32 of the protrusion **32**. By making the thickness T.sub.31 of the base **31** relatively thin, the space for inserting the current collector part **20** is increased. The ratio T.sub.31/L.sub.32 of the thickness T.sub.31 of the base **31** to the protrusion length L.sub.32 of the protrusion **32** may be, for example, more than 0 and less than 1.0, 0.02 or more and 0.5 or less, or 0.05 or more and 0.25 or less.

[0078] As shown in FIGS. **2**, **3**, and **5** to **7**, in the terminal **30**, the protrusion **32** may protrude from the outer edge of the base **31**. Specifically, the planar shape of the second surface **31***y* of the base **31** may coincide with the shape defined by the outer periphery of the protrusion **32**. Alternatively, as shown in FIG. **9**, the protrusion **32** may protrude from inside the outer edge of the first surface **31***x* of the base **31**. Specifically, the planar shape of the second surface **31***y* of the base **31** may be larger than the shape defined by the outer periphery of the protrusion **32**.

[0079] When the protrusion **32** protrudes from the outer edge of the base **31**, the shape defined by the outer periphery of the protrusion **32** corresponds to the planar shape of the second surface **31***y* of the base **31**. For example, when the planar shape of the base **31** (planar shape of the second surface **31***y*) is rectangular, the rectangle has a first side and a second side facing each other and a third side and a fourth side facing each other, and the protrusion **32** comprises the first protrusion **32***a*, the second protrusion **32***b*, the third protrusion **32***c*, and the fourth protrusion **32***d*, the first protrusion **32***a* may protrude from the first side, the second protrusion **32***b* may protrude from the second side, the third protrusion **32***c* may protrude from the third side, and the fourth protrusion **32***d* may protrude from the fourth side. By adopting a configuration in which the protrusion **32** protrudes from the outer edge of the rectangular base **31** in this manner, the structural efficiency around the terminal and the strength of the terminal can easily be secured.

[0080] For example, when the planar shape of the base **31** (planar shape of the second surface **31***y*) is an elongated rectangle, the first protrusion **32***a* may protrude from one long side of the elongated rectangle, the second protrusion **32***b* may protrude from the other long side of the elongated

rectangle, the third protrusion **32***c* may protrude from one short side of the elongated rectangle, and the fourth protrusion **32***d* may protrude from the other short side of the elongated rectangle. Since the protrusion **32** protrudes from the outer edge of the elongated rectangular base **31** in this manner, the structural efficiency around the terminal and the strength of the terminal can easily be secured. Furthermore, by forming the contact surface **30***a* with the current collector part **20** on the long side, the connectivity between the current collector part **20** and the terminal **30** can easily be further improved.

[0081] Furthermore, when the planar shape of the base **31** (planar shape of the second surface **31***y*) is an elongated rectangle, the lamination direction in the electrode laminate **10** may be along the short sides of the elongated rectangle, and the width direction of the electrode laminate **10** may be along the long sides of the elongated rectangle. As a result, a large space for inserting the current collector part **20** can easily be secured, connectivity between the terminal **30** and the current collector part **20** can be improved, and an excellent balance of structural efficiency and strength around the terminal **30** and the current collector part **20** can easily be achieved.

[0082] The first protrusion **32***a* may have a third surface **32***ax* facing the second protrusion **32***b* and a fourth surface **32***ay* opposite the third surface **32***ax*. As shown in FIG. **2**, the third surface **32***ax* may contact the current collector part **20**. The third surface **32***ax* may have a joint with the current collector part **20**. Conversely, as shown in FIG. **2**, the fourth surface **32***ay* may be an adhesive surface with the exterior body **40**. The third surface **32***ax* and the fourth surface **32***ay* of the first protrusion **32***a* may have flat surfaces as shown in the drawing, or may have concavities and convexities. Furthermore, as described above, the third surface **32***ax* may constitute the contact surface **30***a* having the curved surface **30***ax*. The planar shapes of the third surface **32***ax* and the fourth surface **32***ay* (referring to the planar shapes when the third surface and the fourth surface are projected) are not particularly limited. In particular, when the third surface **32***ax* and the fourth surface **32***ay* have rectangular planar shapes, the structural efficiency around the terminal **30** is likely to be improved, and the connectivity of the current collector part **20** to the terminal **30** and the strength of the terminal **30** are likely to be improved.

[0083] The second protrusion **32***b* may have a fifth surface **32***bx* facing the first protrusion **32***a* and a sixth surface **32***by* opposite the fifth surface **32***bx*. The fifth surface **32***bx* may or may not have the contact surface **30***a* with the current collector part **20**. Conversely, as shown in FIG. **2**, the sixth surface **32***by* may be an adhesive surface with the exterior body **40**. The fifth surface **32***bx* and the sixth surface **32***by* of the second protrusion **32***b* may be, for example, flat surfaces as shown in the drawing, or may have concavities and convexities. Furthermore, as described above, the fifth surface **32***bx* may constitute the contact surface **30***a* having the curved surface **30***ax*. The planar shapes of the fifth surface **32***bx* and the sixth surface **32***by* (referring to the planar shapes when the fifth surface and the sixth surface are projected) are not particularly limited. In particular, when the fifth surface **32***bx* and the sixth surface **32***by* have rectangular planar shapes, the structural efficiency around the terminal **30** is likely to be improved, and the connectivity of the current collector part **20** to the terminal **30** and the strength of the terminal **30** are likely to be improved.

[0084] The third protrusion **32***c* may have a seventh surface **32***cx* facing the fourth protrusion **32***d* and an eighth surface **32***cy* opposite the seventh surface **32***cx*. As shown in FIG. **3**, the seventh surface **32***cx* need not contact the current collector part **20**. Conversely, as shown in FIG. **3**, the eighth surface **32***cy* may be an adhesive surface with the exterior body **40**. The seventh surface **32***cx* and the eighth surface **32***cy* of the third protrusion **32***c* may be, for example, flat surfaces as shown in the drawing, or may have concavities and convexities. The planar shapes of the seventh surface **32***cx* and the eighth surface **32***cy* (referring to the planar shapes when the seventh surface and the eighth surface are projected) are not particularly limited. In particular, when the seventh surface **32***cx* and the eighth surface **32***cy* have rectangular planar shapes, the structural efficiency around the terminal **30** is likely to be improved, and the connectivity of the current collector part **20** to the terminal **30** and the strength of the terminal **30** are likely to be improved.

[0085] The fourth protrusion **32***d* may have a ninth surface **32***dx* facing the third protrusion **32***c* and a tenth surface **32***dy* opposite the ninth surface **32***dx*. As shown in FIG. **3**, the ninth surface **32***dx* need not contact the current collector part **20**. Conversely, as shown in FIG. **3**, the tenth surface **32***dy* may be an adhesive surface with the exterior body **40**. The ninth surface **32***dx* and the tenth surface **32***dy* of the fourth protrusion **32***d* may be, for example, a flat surface as shown in the drawing, or may have concavities and convexities. The planar shapes of the ninth surface **32***dx* and the tenth surface **32***dy* (referring to the planar shapes when the seventh surface and the eighth surface are projected) are not particularly limited. In particular, when the ninth surface **32***dx* and the tenth surface **32***dy* have rectangular planar shapes, the structural efficiency around the terminal **30** is likely to be improved, and the connectivity of the current collector part **20** to the terminal **30** and the strength of the terminal **30** are likely to be improved.

2.3.3.3 Opening

[0086] As shown in FIGS. **2**, **3**, and **5** to **7**, the terminal **30** may have an opening **33** on the electrode laminate **10** side. In this case, the current collector part **20** can be inserted into the opening **33** and connected to the terminal **30**. The shape of the opening **33** can be defined in accordance with the protrusion **32**. The shape of the opening **33** is not particularly limited. The shape of the opening **33** may be rectangular, circular, or elliptical, or may be another shape.

[0087] When the shape of the opening **33** is rectangular and the rectangle has a first side and a second side facing each other and a third side and a fourth side facing each other, the first protrusion **32***a* of the protrusion **32** may constitute the first side, the second protrusion **32***b* may constitute the second side, the third protrusion **32***c* may constitute the third side, and the fourth protrusion **32***d* may constitute the fourth side. When the shape of the opening **33** defined by the protrusion **32** is rectangular, it becomes easier to ensure the structural efficiency around the terminal and the strength of the terminal.

[0088] When the shape of the opening **33** is an elongated rectangle, the first protrusion **32***a* of the protrusion **32** may constitute one short side of the elongated rectangle, the second protrusion **32***b* may constitute the other short side of the elongated rectangle, the third protrusion **32***c* may constitute one long side of the elongated rectangle, and the fourth protrusion **32***d* may constitute the other long side of the elongated rectangle. In this case as well, the structural efficiency around the terminal and the strength of the terminal can easily be secured.

[0089] When the shape of the opening **33** is an elongated rectangle, the lamination direction in the electrode laminate **10** may be along the short sides of the elongated rectangle, and the width direction of the electrode laminate **10** may be along the long sides of the elongated rectangle. As a result, a large space for inserting the current collector part **20** can easily be secured, and an excellent balance of structural efficiency and strength around the terminal **30** and the current collector part **20** can easily be achieved.

[0090] As shown in FIG. **6**, the opening **33** can have a height H.sub.33 along the lamination direction in the electrode laminate **10**. The height H.sub.33 of the opening **33** is not particularly limited. In particular, when the height H.sub.33 of the opening **33** is 4.8 mm or more and 99.8 mm or less, or 9.8 mm or more and 49.8 mm or less, the strength of the terminal **30** is easily secured, and the current collector part **20** can more easily be inserted into the opening **33** and joined to the terminal **30**.

[0091] As shown in FIG. **7**, the opening **33** can have a width W.sub.33 along the lamination surface of the electrode laminate **10**. The width W.sub.33 of the opening **33** is not particularly limited. In particular, when the width W.sub.33 of the opening **33** is 7.5 mm or more and 475 mm or less, or 30 mm or more and 195 mm or less, the strength of the terminal **30** is easily secured, and the width W.sub.20 of the current collector part **20** is easily secured sufficiently.

[0092] The ratio H.sub.33/W.sub.33 of the height H.sub.33 to the width W.sub.33 of the opening **33** is not particularly limited. In particular, when the ratio H.sub.33/W.sub.33 is 0.01 or more and 13.3 or less, or 0.05 or more and 1.66 or less, the joinability of the current collector part **20** and the

strength of the terminal **30** are likely to be excellent.

2.3.4 Other Features Regarding Terminal

[0093] As described above, the base **31** can have a thickness T.sub.31, and the protrusion **32** can have a thickness T.sub.32. The relationship between the thickness T.sub.31 of the base **31** and the thicknesses T.sub.32a and T.sub.32b of the first protrusion **32***a* and second protrusion **32***b* is not particularly limited. In particular, when the base **31** is thicker than the first protrusion **32***a* and second protrusion **32***b*, the structural efficiency around the terminal and the strength of the terminal are likely to be improved.

[0094] The relationship of the thickness T.sub.31 of the base **31** with the thicknesses T.sub.32c and T.sub.32d of the third protrusion **32***c* and fourth protrusion **32***d* is not particularly limited. In particular, when the base **31** is thicker than the third protrusion **32***c* and fourth protrusion **32***d*, the structural efficiency around the terminal and the strength of the terminal are likely to be improved.

[0095] The terminal **30** can be easily produced by, for example, pressing a metal material with a punch or the like to form a desired concave shape, cutting a metal material to form a desired concave shape, or subjecting a metal material to electric discharge machining to form a desired concave shape. The material of the terminal **30** may be appropriately selected taking into consideration sufficient electrical conductivity, appropriate mechanical strength, etc. For example, the material of the terminal **30** may be aluminum, copper, iron, nickel, or an alloy thereof. The terminal **30** may be a base material plated with any of the above metals or alloys thereof.

[0096] An insulating layer may be provided between the terminal **30** and the electrode laminate **10**. As a result, short circuits in the battery **100** can more easily be suppressed. For example, as shown in FIG. **10**, the protrusion **32** of the terminal **30** may have an insulating layer **35** on the end surface on the electrode laminate **10** side. For example, the insulating layer **35** can be formed on the end surface by applying or transferring an insulating resin material (for example, an ultraviolet-curing resin such as acrylic monomer/oligomer; thermosetting resin such as epoxy resin or imide resin; or thermoplastic resin such as polypropylene or polyethylene) to the end surface of the protrusion **32** of the terminal **30**, or by forming a layer composed of a metal oxide (for example, aluminum oxide) on the end surface by anodization or the like. The thickness of the insulating layer **35** is not particularly limited. When the insulating layer **35** is composed of an insulating resin material, the thickness may be, for example, 0.1 mm or more and 1.0 mm or less. Furthermore, when the insulating layer **35** is composed of a metal oxide formed by anodization or the like, the thickness thereof may be, for example, 0.01 mm or more and less than 0.10 mm.

2.4 Supplementary Information Regarding Arrangement of Electrode Laminate, Current Collector Part, and Terminal

[0097] In the battery **100**, the arrangement of the electrode laminate **10**, the current collector part **20**, and the terminal **30** is not particularly limited as long as the current collector part **20** protruding from the electrode laminate **10** is electrically connected to a predetermined surface of the terminal **30**. Since a terminal **30** having the specific shape described above is adopted in the battery **100**, space around the terminal **30** and the current collector part **20** can easily be saved, and the connectivity of the current collector part **20** to the terminal **30** can easily be improved. An example of the arrangement of the electrode laminate **10**, the current collector part **20**, and the terminal **30** will be supplemented below.

2.4.1 Width of Terminal and Width of Current Collector Part

[0098] As described above, the current collector part **20** protruding from the electrode laminate **10** may be inserted into the opening **33** of the terminal **30** and connected to a predetermined surface of the terminal **30**. When a large current flows through the current collector part **20** and the terminal **30**, heat can be generated in the current collector part **20** and the terminal **30**. According to the knowledge of the present inventors, the heat generation temperature around the terminal **30** and the current collector part **20** varies depending on the width of the current collector part **20** relative to the width of the terminal **30**. As shown in FIG. **3**, for example, when the ratio W.sub.20/W.sub.33

of the width W.sub.20 of the current collector part **20** to the width W.sub.33 of the opening **33** of the terminal **30** is 0.9 or more, the heat generation around the terminal **30** and the current collector part **20** can be suppressed particularly remarkably. Alternatively, when the ratio W.sub.20/W.sub.31x of the width W.sub.20 of the current collector part **20** to the inner width W.sub.31x of the base **31** of the terminal **30** (the width at the inner dimension of the first surface **31***x*) is 0.9 or more, heat generation around the terminal **30** and the current collector part **20** can be suppressed particularly remarkably.

2.4.2 Thickness of Electrode Laminate and Thickness of Terminal

[0099] The thickness T.sub.30 of the terminal **30** may be thicker than, equal to, or thinner than the thickness T.sub.10 of the electrode laminate **10**. In particular, as shown in FIG. **2**, when the thickness T.sub.30 of the terminal **30** is thinner than the thickness of the electrode laminate **10**, it becomes easier to further improve the adhesion between the exterior body and the terminal **30** by, for example, arranging a resin **34** between the laminate exterior body and the terminal **30**.

2.4.3 Joint Form Between Current Collector Part and Terminal

[0100] As described above, the current collector part **20** contacts with the contact surface **30***a* of the terminal **30**. The current collector part **20** may be joined to a part of the contact surface **30***a* of the terminal **30** to form a joint **25**. In an embodiment, the current collector part **20** may be ultrasonically joined or laser joined to at least a part of the contact surface **30***a* of the terminal **30**.

2.5 Other Members

[0101] The battery **100** can have obvious structures as a battery in addition to the above-mentioned electrode laminate **10**, current collector part **20**, and terminal **30**. For example, various members such as those disclosed in Patent Literature 1 (Japanese Unexamined Patent Publication (Kokai) No. 2023-084066) can be adopted as other members. Examples of other members provided in the battery **100** will be described below.

2.5.1 Exterior Body

[0102] The battery **100** can comprise an exterior body **40** for housing the electrode laminate **10** and the current collector part **20**. The exterior body may be a laminate exterior body composed of a laminate film or may be composed of a metal case. As shown in the drawings, the electrode laminate **10** and the current collector part **20** may be housed in a laminate exterior body, and the laminate exterior body may be adhered to a fourth surface **32***ay* of the first protrusion **32***a* and a sixth surface **32***by* of the second protrusion **32***b*.

[0103] The exterior body **40** may be, for example, a cylindrical body having an opening. Specifically, as shown in FIGS. **2** and **3**, the electrode laminate **10** and the current collector part **20** can be housed inside the cylindrical exterior body **40**, and the outer surface of the protrusion **32** of the terminal **30** can be adhered and sealed to the vicinity of the opening of the exterior body **40**. In this case, as shown in FIGS. **2** and **3**, the vicinity of the opening of the exterior body **40** and the protrusion **32** of the terminal **30** can be adhered to each other so as to overlap each other when viewed in the lamination direction in the electrode laminate **10**. This can improve the structural efficiency around the terminal **30** while increasing the sealing performance of the battery **100**.

[0104] As shown in FIG. **10**, the length L.sub.41 between the electrode laminate **10** side end surface (or opening **33**) of the terminal **30** and the opening **41** of the exterior body **40** is not particularly limited. In particular, when the length L.sub.41 is 1.0 mm or more and 20 mm or less, or 3.0 mm or more and 15 mm or less, the balance between the sealing performance and the structural efficiency is likely to be suitable. Furthermore, the ratio L.sub.41/L.sub.32 of the length L.sub.41 to the protrusion length L.sub.32 of the protrusion **32** is not particularly limited. In particular, when the ratio L.sub.41/L.sub.32 is 0.1 or more and 1.0 or less, or 0.5 or more and 1.0 or less, the balance between the sealing performance and the structural efficiency is likely to be suitable. When the exterior body **40** is a laminate exterior body, the laminate exterior body may be adhered to the outer surface of the protrusion **32** by heat sealing or the like, for example. Furthermore, when the exterior body **40** is a metal case, the metal case can be adhered to the outer

circumferential surface of the protrusion **32** by, for example, welding or using an adhesive. As described above, the resin **34** may be arranged between the outer surface of the protrusion **32** and the exterior body **40**.

2.5.2 Busbar

[0105] The battery **100** may comprise a conductive member for connecting one battery to another. For example, in the battery **100**, a busbar may be connected to the terminal **30**. A plurality of batteries **100** may be combined to form a battery assembly.

3. Applications

[0106] There are many applications for the battery **100**. For example, the battery **100** can be suitably used in at least one type of vehicle selected from a hybrid electric vehicle (HEV), a plug-in hybrid electric vehicle (PHEV), and a battery electric vehicle (BEV). Specifically, an aspect of the technology of the present disclosure relates to a vehicle having the battery **100** of the present disclosure described above.

DESCRIPTION OF REFERENCE SIGNS

[0107] **100** battery [0108] **10** electrode laminate [0109] **20** current collector part [0110] **25** joint [0111] **30** terminal [0112] **30***a* contact surface [0113] **30***ax* curved surface [0114] **30***ay* flat surface [0115] **31** base [0116] **31***x* first surface [0117] **31***y* second surface [0118] **32** protrusion [0119] **32***a* first protrusion [0120] **32***ax* third surface [0121] **32***ay* fourth surface [0122] **32***b* second protrusion [0123] **32***bx* fifth surface [0124] **32***by* sixth surface [0125] **32***c* third protrusion [0126] **32***cx* seventh surface [0127] **32***cy* eighth surface [0128] **32***d* fourth protrusion [0129] **32***dx* ninth surface [0130] **32***dy* tenth surface [0131] **33** opening [0132] **34** resin [0133] **35** insulating layer [0134] **40** exterior body [0135] **41** opening

Claims

1. A battery, comprising an electrode laminate, a current collector part, and a terminal, wherein the current collector part protrudes from the electrode laminate, the terminal comprises a contact surface with the current collector part, the contact surface has a curved surface, and the curved surface bulges toward a side opposite the current collector part.

2. The battery according to claim 1, wherein the electrode laminate and the current collector part are housed in an exterior body, the terminal has the contact surface on an interior of the exterior body, and the terminal has an exposed surface facing an outside of the exterior body.

3. The battery according to claim 1, wherein the terminal comprises a base and a protrusion, the base has a first surface and a second surface opposite the first surface, the protrusion protrudes from the base toward the electrode laminate, the protrusion comprises a first protrusion and a second protrusion, the first protrusion has a third surface facing the second protrusion and a fourth surface opposite the third surface, the second protrusion has a fifth surface facing the first protrusion and a sixth surface opposite the fifth surface, and at least one of the first surface, the third surface, and the fifth surface has the contact surface.

4. The battery according to claim 3, wherein the electrode laminate and the current collector part are housed in an exterior body, the first surface, the third surface, and the fifth surface face an interior of the exterior body, the second surface faces an exterior of the exterior body, and the fourth surface and the sixth surface are adhered to the exterior body.

5. The battery according to claim 3, wherein a planar shape of the base is a rectangle, the protrusion comprises a third protrusion and a fourth protrusion, the rectangle comprises a first side and a second side facing each other and a third side and a fourth side facing each other, the first protrusion protrudes from the first side, the second protrusion protrudes from the second side, the third protrusion protrudes from the third side, and the fourth protrusion protrudes from the fourth side.

6. The battery according to claim 4, wherein a planar shape of the base is a rectangle, the protrusion

comprises a third protrusion and a fourth protrusion, the rectangle comprises a first side and a second side facing each other and a third side and a fourth side facing each other, the first protrusion protrudes from the first side, the second protrusion protrudes from the second side, the third protrusion protrudes from the third side, and the fourth protrusion protrudes from the fourth side.