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BATTERY CELL INCLUDING CASE, BATTERY DEVICE COMPRISING THE SAME, AND CASE MANUFACTURING PROCESS

Abstract

A battery cell includes a case including a first edge forming an opening and a joining portion positioned perpendicular to the first edge, an electrode assembly accommodated within the case, and a cap assembly coupled to the case and sealing the opening. The case includes a center area facing the electrode assembly, an end area surrounding at least a portion of the cap assembly, and a groove extending from the end area and accommodating a welding bead formed in the joining portion.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This patent document claims the priority and benefits of Korean Patent Application No. 10-2024-0021155 filed on Feb. 14, 2024, the disclosure of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The disclosure and implementations disclosed in this patent document generally relate to a battery cell including a case, a battery device including the same, and a case manufacturing process.

BACKGROUND

[0003] Secondary batteries, unlike primary batteries, may be charged and discharged, and may be applied to devices within various fields such as digital cameras, mobile phones, laptops, hybrid cars, electric cars, and energy storage systems (ESS). Secondary batteries may be lithium-ion batteries, nickel-cadmium: nickel-metal hydride batteries, or nickel-hydrogen batteries.

[0004] Secondary batteries are manufactured as flexible pouch-type battery cells or rigid prismatic or cylindrical can-type battery cells. A plurality of battery cells may be formed into a cell assembly in a stacked form.

SUMMARY

[0005] The present disclosure may be implemented in some embodiments to provide a battery cell including an electrode assembly, a case housing the electrode assembly, and a cap assembly sealing an opening of the case and electrically connected to the electrode assembly.

[0006] The case may be manufactured using a pressurizing process. For example, the case may be manufactured by folding at least a portion of a plate. Edges (for example, joints) of the plate may be joined to each other, thereby forming the case in a closed curve shape and forming an opening.

[0007] However, a welding bead may be formed by joining the edges of the plate. A portion of the welding bead may protrude toward the cap assembly and contact a portion (for example, a cap plate) of the cap assembly. In the case in which the welding bead contacts the cap assembly (for example, the cap plate), a gap may be formed between the cap assembly and the case, and the bonding force between the cap assembly and the case may be reduced.

[0008] The present disclosure may be implemented in some embodiments to provide a battery cell that may reduce a bonding failure of a cap assembly to a case.

[0009] The present disclosure may be implemented in some embodiments to provide a battery cell in which a gap between a cap assembly and a case is prevented.

[0010] The present disclosure may be implemented in some embodiments to provide a battery cell and a battery device that may be widely applied to green technology fields such as electric vehicles, battery charging stations, and solar power generation and wind power generation using batteries. In addition, the battery cell and the battery device may be used in eco-friendly electric vehicles and hybrid vehicles to ameliorate the effects of climate change by suppressing air pollution and greenhouse gas emissions.

[0011] In some embodiments of the present disclosure, a battery cell includes a case including a first edge forming an opening and a joining portion positioned perpendicular to the first edge, an electrode assembly accommodated within the case, and a cap assembly coupled to the case and sealing the opening. The case includes a center area facing the electrode assembly, an end area

surrounding at least a portion of the cap assembly, and a groove extending from the end area and accommodating a welding bead formed in the joining portion.
[0012] The opening may include a first opening formed in one side of the battery cell and a second opening formed on the other side of the battery cell. The cap assembly may include a first cap assembly sealing the first opening and a second cap assembly sealing the second opening.
[0013] The end area may include a first end area forming the first opening and a second end area forming the second opening. The joining portion may extend from the first end area to the second end area by passing the center area.
[0014] The groove may include a first groove extending from the first end area and facing at least a portion of the first cap assembly, and a second groove extending from the second end area and facing at least a portion of the second cap assembly.
[0015] A second thickness of the end area may be thinner than a first thickness of the center area.
[0016] The joining portion may be formed in a first direction. The case may include a plurality of bending portions folded based on a direction, parallel to the first direction.
[0017] The groove may be located between the end area and the center area.
[0018] The case may include an outer surface facing an outside of the battery cell and an inner surface opposite to the outer surface. The welding bead may be located on the inner surface of the case.
[0019] The case may include at least one of aluminum or stainless steel.
[0020] The end area and the groove may be formed using forging.
[0021] The case may include a plurality of second edges perpendicular to the first edge. The joining portion may be formed by welding the plurality of second edges.
[0022] In some embodiments of the present disclosure, a battery device includes a cell assembly including a plurality of battery cells, and a frame including the cell assembly. The plurality of battery cells each include a case including a first edge forming an opening and a joining portion positioned perpendicular to the first edge, an electrode assembly accommodated within the case, and a cap assembly coupled to the case and sealing the opening. The case includes a center area facing the electrode assembly, an end area surrounding at least a portion of the cap assembly, and a groove extending from the end area and receiving a welding bead formed in the joining portion.
[0023] In some embodiments of the present disclosure, a case manufacturing process includes a preparatory process of preparing a plate including a plurality of first edges and a plurality of second edges perpendicular to the plurality of first edges, a punching process of forming a through-hole in the plate, a pressurizing process of forming an end area in the plurality of first edges of the plate and a groove in a portion of the plurality of second edges, a bending process of bending at least a portion of the plate, and a joining process of joining the plurality of second edges.
[0024] The plate may include a center area surrounded by the plurality of first edges and the plurality of second edges, and the groove may be located between the end area and the center area.
[0025] The joining process may form a welding bead on an inner surface of the case. The groove may receive at least a portion of the welding bead.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0026] Certain aspects, features, and advantages of the present disclosure are illustrated by the following detailed description with reference to the accompanying drawings.
[0027] FIG. **1** is a perspective view of a battery cell according to an embodiment.
[0028] FIG. **2** is an exploded perspective view of a battery cell according to an embodiment.
[0029] FIG. **3** is a perspective view of a case according to an embodiment.
[0030] FIG. **4**A is a perspective view of a case according to an embodiment, and FIG. **4**B is a

perspective view of a case according to another embodiment.
[0031] FIG. **5** is a schematic diagram of a battery cell illustrating the coupling of a case and a cap assembly according to an embodiment.
[0032] FIG. **6** is a cross-sectional perspective view of a battery cell including a case and a cap assembly according to an embodiment.
[0033] FIGS. **7**A, **7**B, **7**C, **7**D, and **7**E are a schematic diagram illustrating a case manufacturing process according to an embodiment.
[0034] FIG. **8** is a flowchart of a case manufacturing process according to an embodiment.
[0035] FIG. **9** is an exploded perspective view of a battery device according to an embodiment.

DETAILED DESCRIPTION

[0036] Features of the present disclosure disclosed in this patent document are described by example embodiments with reference to the accompanying drawings.
[0037] Hereinafter, the present disclosure will be described in detail with reference to the attached drawings. However, this is merely illustrative and the present disclosure is not limited to the detailed embodiments described as examples.
[0038] Terms or words used in the present specification and claims described below are not to be construed as limited to their conventional or dictionary meanings. The inventor will interpret the terms in the sense and concept that are consistent with the technical idea of the present disclosure based on the principle that the inventor may appropriately define the concept of the term in order to explain his or her own invention in the best way.
[0039] Therefore, it will be understood that the embodiments described in this specification and the configurations depicted in the drawings are only the most illustrative embodiments of the present disclosure and do not represent all of the technical idea of the present disclosure, and that there may be various equivalents and modified examples that may replace the embodiments and configurations at the time of this application.
[0040] Detailed descriptions of known functions and configurations that may obscure the gist of the present disclosure are omitted. In the attached drawings, some components are exaggerated, or omitted, schematically illustrated, and the size of each component does not entirely reflect the actual size thereof.
[0041] FIG. **1** is a perspective view of a battery cell according to an embodiment. FIG. **2** is an exploded perspective view of a battery cell according to an embodiment.
[0042] Referring to FIG. **1** and/or FIG. **2**, a battery cell **100** may include an electrode assembly **110**, a case **120**, a venting portion **130**, cap assemblies **140** and **150**, and/or an insulating bag **160**. The battery cell **100** may be a secondary battery. For example, the battery cell **100** may be a lithium ion battery, but is not limited thereto. For example, the battery cell **100** may be a nickel-cadmium battery, a nickel-metal hydride battery, or a nickel-hydrogen battery capable of being charged and discharged.
[0043] The electrode assembly **110** may include at least one positive electrode plate, at least one negative electrode plate, and at least one separator. The separator may prevent contact between the positive electrode plate and the negative electrode plate. Those skilled in the art will appreciate that the electrode assembly **110** may be manufactured using a variety of methods. In example embodiments, the positive electrode, the negative electrode, and the separator may be repeatedly disposed to form the electrode assembly. In some embodiments, the electrode assembly may be a winding type, a stacking type, a z-folding type, or a stack-folding type.
[0044] The case **120** forms at least a portion of the exterior of the battery cell **100** and may accommodate the electrode assembly **110**. For example, the case **120** may provide a space in which the electrode assembly **110** and the electrolyte are accommodated. In an embodiment, the case **120** may include aluminum. The case **120** may be referred to as a can or a housing. The case **120** may have a substantially rectangular shape that is partially open. For example, the case **120** may include a first side **120***a* and a second side **120***b* having a width greater than that of the first side **120***a*. The

first side **120***a* may be referred to as a narrow side, and the second side **120***b* may be referred to as a wide side.

[0045] According to an embodiment, the case **120** may include a first opening **121** formed in one side (+Y direction) of the battery cell **100**, and a second opening **122** formed in the other side (−Y direction) of the battery cell **100**, in the longitudinal direction (Y-axis direction) of the battery cell, and a through-hole **123** formed in the height direction (Z-axis direction) of the battery cell **100**. The first opening **121**, the second opening **122**, and the through-hole **123** may each be an empty space connected in the internal space of the case **120**. For example, the first opening **121** may be an empty space extending from the second opening **122**.

[0046] The venting portion **130** may provide a path for releasing gas generated inside the case **120** to the outside of the case **120**. For example, the venting portion **130** may include a notch portion **131** configured to be ruptured at a specified pressure or higher, and a base **132** coupled to the case **120**.

[0047] According to an embodiment, the venting portion **130** may be located on a first side **120***a* of the case **120** where a relatively large stress value appears among the remaining surfaces of the case **120** excluding the portion where the cap assemblies **140** and **150** are coupled. The venting portion **130** may be located between the first cap assembly **140** and the second cap assembly **150**. According to an embodiment, at least a portion of the venting portion **130** may be positioned within a through-hole **123** formed in the first side **120***a*.

[0048] In a battery cell **100** including a plurality of cap assemblies **140** and **150** positioned on both sides of the length direction of the case **120** as in an embodiment, the space available for one cap assembly **140**, **150** may be reduced. Since the venting portion **130** is formed on the case **120**, the design freedom of the venting portion **130** is improved, and the discharge of gas inside the case **120** may be improved. In this document, the venting portion **130** formed on the first side **120***a* of the case **120** is illustrated, but this is illustrative. For example, in another embodiment, the venting portion **130** may be positioned on the cap assemblies **140** and **150**.

[0049] According to an embodiment, the base **132** may be welded and joined to the case **120** along the edge portion. The base **132** may be a plate including aluminum.

[0050] According to an embodiment, the notch portion **131** may be a recess, groove, and/or hole formed in the base **132**. The notch portion **131** may be a portion of the venting portion **130** that is ruptured earlier than other portions when the pressure inside the case **120** is a predetermined pressure or more. The thickness of at least a portion of the notch portion **131** may be thinner than the thickness of the base **132**. Since at least a portion of the gas generated inside the case **120** is discharged through the empty space of the venting portion **130** formed as the notch portion **131** is ruptured, the gas discharge direction may be controlled from the perspective of the battery cell **100**.

[0051] The cap assemblies **140** and **150** may be respectively coupled to both sides of the longitudinal direction (for example, Y-axis direction) of the case **120**. For example, the cap assemblies **140** and **150** may accommodate the electrode assembly **110** and the electrolyte together with the case **120**. The cap assemblies **140** and **150** may include a first cap assembly **140** coupled to an end of one side (for example, +Y direction) of the case **120** and a second cap assembly **150** coupled to an end of the other side (for example, −Y direction) of the case **120**. The first cap assembly **140** may seal a first opening **121** of the case **120**. The second cap assembly **150** may seal a second opening **122** of the case **120**.

[0052] The cap assemblies **140** and **150** may include a plurality of components.

[0053] In an embodiment, the cap assemblies **140** and **150** may include cap plates **142** and **152** that are coupled to the case **120** to seal the case **120**. For example, the cap plates **142** and **152** may be formed of aluminum or a material including aluminum. The cap plates **142** and **152** may be laser welded to the case **120** along the edge portion. When the cap plates **142** and **152** are coupled to the case **120**, the interior of the case **120** is sealed, and thus, at least one of the cap plates **142** and **152** may include an electrolyte injection port **148** through which an electrolyte is injected into the

interior of the case **120**. The electrolyte injection port **148** may be sealed with a stopper or the like after the electrolyte is injected.

[0054] The cap assemblies **140** and **150** may include terminal plates **141** and **151**. The terminal plates **141** and **151** may be joined to one side of the cap plates **142** and **152**. One side of the cap plates **142** and **152** may be the opposite side of the side facing the inside of the case **120**. When configuring a module or pack, the battery cells **100** may be electrically connected to adjacently disposed battery cells **100** through the terminal plates **141** and **151**.

[0055] The terminal plates **141** and **151** may have positive electrode or negative electrode polarity. For example, based on the drawings, the first terminal plate **141** disposed on one side of the case **120** (for example, in the +Y direction) may have negative electrode polarity, and the second terminal plate **151** disposed on the other side of the case **120** (for example, in the −Y direction) may have positive electrode polarity. For example, the terminal plates **141** and **151** may respectively be electrically connected to the electrode assembly **110** through electrode tabs.

[0056] The cap assemblies **140** and **150** may include current collector plates **143** and **153** disposed on the other surfaces of the cap plates **142** and **152**. The current collector plates **143** and **153** may be connected to the negative electrode plate or the positive electrode plate of the electrode assembly **110**, respectively, and may have a negative electrode or positive electrode polarity. In addition, insulating plates (inner insulating plates) **144***a*, **144***b*, **154***a* and **154***b*) may be disposed between the cap plates **142** and **152** and the current collector plates **143** and **153** and between the current collector plates **143** and **153** and the inner space of the case **120**, respectively. In an embodiment, at least some of the insulating plates **144***a*, **144***b*, **154***a* and **154***b* may be replaced with a resistance plate.

[0057] In an embodiment, the cap assemblies **140** and **150** may include rivet terminals **145** and **155** that pass in the thickness direction from the terminal plates **141** and **151** to the current collector plates **143** and **153**. To this end, the cap plates **142** and **152**, the terminal plates **141** and **151**, the current collector plates **143** and **153**, and some insulating plates **144***a* and **154***a* may include holes into which rivet terminals **145** and **155** are inserted, and gaskets **147** and **157** may be fitted between the holes and the rivet terminals **145** and **155**.

[0058] According to an embodiment, some (for example, the first cap assembly **140**) of the cap assemblies **140** and **150** may include an insulating plate **146** (for example, an outer insulating plate) disposed between the first terminal plate **141** and the first cap plate **142**.

[0059] The components of the cap assemblies **140** and **150** described above are only examples, and thus, some of the components of the cap assemblies **140** and **150** may be omitted or other configurations not described may be added.

[0060] The insulating bag **160** may be used to insulate the case **120** of the battery cell **100**. For example, the insulating bag **160** may include an insulating material. The insulating bag **160** may be referred to as a tape, a protective film, a protective member, a protective tape, an insulating film, an insulating member, and/or an insulating tape. According to an embodiment, the insulating bag **160** may include an adhesive material for bonding with the case **120** and the venting portion **130**.

[0061] The insulating bag **160** may cover at least a portion of the case **120**. In this document, the insulating bag **160** is illustrated as covering the entirety of the case **120**, but the location where the insulating bag **160** covers the case **120** may be changed depending on the design. For example, in an embodiment, one side **160***a* of the insulating bag **160** may cover at least a portion of the venting portion **130** and the first side **120***a* of the case **120**. According to an embodiment, at least a portion of the insulating bag **160** may be folded so as to overlap.

[0062] In an embodiment, the cover area **162** of the insulating bag **160** may cover the venting portion **130**. At least a portion (for example, cover area **162**) of the insulating bag **160** may come into contact with at least a portion of the venting gas that has passed through the notch portion **131** of the venting portion **130** after the notch portion **131** of the venting portion **130** is broken, and may be melted.

[0063] In this document, a structure in which the battery cell **100** is a prismatic battery cell with open sides in both directions is illustrated, but this is illustrative. For example, in an embodiment not illustrated, the battery cell **100** may be a prismatic battery cell with open sides in one direction.
[0064] FIG. **3** is a perspective view of a case according to an embodiment. FIG. **4**A is a perspective view of a case according to an embodiment. FIG. **4**B is a perspective view of a case according to another embodiment. FIG. **5** is a schematic diagram of a battery cell illustrating the combination of a case and a cap assembly according to an embodiment. FIG. **6** is a cross-sectional perspective view of a battery cell including a case and a cap assembly according to an embodiment.
[0065] Referring to FIGS. **3**, **4**A, **4**B, **5**, and/or **6**, a battery
[0066] cell **100** may include an electrode assembly **110**, cap assemblies **140** and **150**, and a case **200**. The case **200** may include a center area **210**, an end area **220**, a joining portion **230**, a groove **240**, and a bending portion **260**. At least some of the descriptions of the battery cell **100**, the electrode assembly **110**, the case **120**, and the cap assemblies **140** and **150** of FIGS. **1** and/or **2** may be applied to a battery cell **100**, an electrode assembly **110**, a case **200**, and cap assemblies **140** and **150** of FIGS. **3**, **4**A, **4**B, **5**, and/or **6**.
[0067] The case **200** may accommodate at least some of the components of the battery cell (for example, the battery cell **100** of FIG. **1**). For example, the case **200** may include a center area **210** surrounding at least some of the electrode assembly (for example, the electrode assembly **110** of FIG. **2**) and an end area **220** extending from the center area **210**. The end area **220** may form an end of the case **200**.
[0068] The end area **220** may be connected to a cap assembly (for example, the cap assemblies **140** and **150** of FIG. **2**). The cap assemblies **140** and **150** may be coupled to the end area **220** of the case **200**. The end area **220** may surround at least a portion of the cap assemblies **140** and **150**. The end area **220** may include a mounting surface **220***a* that contacts the cap assemblies **140** and **150**. The mounting surface **220***a* may be formed in a shape corresponding to the cap plates **142** and **152**.
[0069] The end area **220** may include a first end area **221** connected to the first cap assembly **140** and a second end area **222** connected to the second cap assembly **150**. The center area **210** may be located between the first end area **221** and the second end area **222**.
[0070] The case **200** may be formed in a shape in which the cap assemblies **140** and **150** may be mounted. For example, the case **200** may have different thicknesses for respective sections. A second thickness T**2** of the end area **220** may be thinner than a first thickness T**1** of the center area **210**. By forming the second thickness T**2** of the end area **220** thinner than the first thickness T**1** of the center area **210**, unintended movement of the cap assemblies **140** and **150** may be prevented. For example, the end area **220** may be in contact with the cap assemblies **140** and **150**, and movement of the cap assemblies **140** and **150** into the case **200** may be prevented. In an embodiment, the sum of a depth T**3** of the groove **240** and the second thickness T**2** of the end area **220** may be substantially equal to the first thickness T**1** of the center area **210**.
[0071] The case **200** may be formed by the plate **209** being folded multiple times. For example, the case **200** may include a plurality of bending portions **260**. The plate **209** may be a metal having a substantially rectangular shape. For example, the case **200** may be the plate **209** folded such that an opening **201** (for example, the first opening **121** and/or the second opening **122** of FIG. **2**) is formed. In an embodiment, the plate **209** may be folded based on a direction parallel to the joining portion **230**. For example, the plate **209** may be folded multiple times along the first direction (for example, the Y-axis direction). The case **200** may include a plurality of bending portions **260** folded based on a direction, parallel to the first direction (the Y-axis direction). The plate **209** may include a first edge **207** and a second edge **208** perpendicular to the first edge **207**. The first edge **207** may be at least a portion of the end area **220**. For example, the end area **220** may form the first edge **207**. The first edges **207** may be provided in multiple numbers. For example, the first edge **207** may include a first-first edge **207***a* located in the first end area **221** and a first-second edge **207***b* located in the second end area **222**. The second edge **208** may include a second-first edge **208***a* and a

second-second edge **208***b* parallel to the second-first edge **208***a*. In an embodiment, the joining portion **230** may be formed on a narrow surface (for example, the first side **120***a* of FIG. **1**) of the case **120**.

[0072] The case **200** may be formed by welding a folded plate **209**. The case **200** may include a joining portion **230**. The joining portion **230** may be formed by welding a plurality of second edges **208***a* and **208***b*. The joining portion **230** may extend from the first end area **221** through the center area **210** to the second end area **222**. For example, the joining portion **230** may be a joint formed along the first direction (Y-axis direction). The joining portion **230** may be joined by a welding line formed along the first direction (Y-axis direction).

[0073] The joining portion **230** may be formed to be substantially perpendicular to the end area **220**. For example, the case **200** may include an end area **220** located at an end in a first direction (Y-axis direction) and joining areas **231**, **232** located at an end in a second direction (X-axis direction) perpendicular to the first direction (Y-axis direction). The joining areas **231**, **232** may form at least a portion of an end in the X-axis direction of the plate **209**. The joining portion **230** may be formed by welding the first joining area **231** and the second joining area **232**.

[0074] The case **200** may be manufactured from a material that allows a welding process and a bending process. For example, the case **200** may be formed of a metal having rigidity of a specified degree or more. In an embodiment, the case **200** may include at least one of aluminum or stainless steel.

[0075] The case **200** may include a joining portion **230** and/or a welding bead **250** formed around the joining portion **230**. The welding bead **250** may be a portion of the plate **209** formed when the molten parent material (for example, the plate **209**) is solidified when the second edges **208***a* and **208***b* of the case **200** are joined by welding. For example, the welding bead **250** may be a plurality of protrusions or a plurality of projections formed during the welding process of the joining portion **230**. The welding bead **250** may form an irregular surface on the inner surface **200***b* of the case **200**. The case **200** may include an outer surface **200***a* facing the outside of the battery cell **100** and an inner surface **200***b* opposite to the outer surface **200***b*. The welding bead **250** may be formed on the inner surface **200***b* of the case **200**. For example, the welding bead **250** may be formed on the inner surface **200***b* of the case **200** where the joining portion **230** is located. When the welding bead **250** comes into contact with the cap plates **142** and **152**, the bonding force between the cap plates **142** and **152** and the case **200** may be reduced. For example, the welding bead **250** may reduce the contact area between the cap plates **142** and **152** and the end area **220** of the case **200**.

[0076] The case **200** may include a groove **240**. The groove **240** may accommodate at least a portion of the welding bead **250** formed on the joining portion **230**. As the groove **240** accommodates at least a portion of the welding bead **250**, direct contact between the welding bead **250** and the cap assemblies **140** and **150** may be prevented. For example, at least a portion of the welding bead **250** may be located within the groove **240**. For example, the end area **220** may surround at least portions of the edges of the cap plates **142** and **152** of the cap assemblies **140** and **150** and come into contact with the cap plates **142** and **152**. By preventing direct contact between the welding bead **250** and the cap assemblies **140** and **150**, the bonding force of the cap assemblies **140** and **150** to the case **200** and the assembly position accuracy of the cap assemblies **140** and **150** may be increased. By accommodating the welding bead **250** in the groove **240**, the occurrence of a gap between the cap assemblies **140** and **150** and the case **200** may be prevented. The groove **240** may extend from the end area **220**. For example, the groove **240** may be a hollow space (for example, a recess) extending from the end area **220** toward the inside of the case **200**. The groove **240** may be located between the end area **220** and the center area **210**.

[0077] The groove **240** may face at least portions of the cap assemblies **140** and **150**. For example, the groove **240** may face portions of the edges of the cap plates **142** and **152**. Since the groove **240** accommodates the welding bead **250**, contact between the cap plates **142** and **152** and the welding bead **250** may be prevented. For example, in a joining process (for example, joining process **350** of

FIG. **8**), contact between the welding bead **250** and the cap plates **142** and **152** may be prevented since a portion of the molten plate **209** flows into the inside of the groove **240**. The groove **240** may be a groove formed toward the inside of the case **200** on the mounting surface **220***a*.

[0078] The shape of the groove **240** may be selectively designed. For example, the structure of the groove **240** is not limited to a structure formed in the first joining region **231** and/or the second joining region **232** in order to accommodate the welding bead **250** formed in the joining portion **230**. According to an embodiment (for example, see FIG. **4**A), the groove **240** may have a substantially triangular cross-sectional shape. For example, the groove **240** may include a first surface **240***a* substantially perpendicular to the mounting surface **220***a*, and a second surface **240***b* at least a portion of which is substantially perpendicular to the first surface **240***a* and substantially parallel to the mounting surface **220***a*. According to an embodiment (for example, see FIG. **4**B), the groove **240** may have a substantially triangular cross-sectional shape. For example, the groove **240** may include a third surface **240***c* that is inclined with respect to the mounting surface **220***a*.

[0079] The groove **240** may include a first groove **241** extending from the first end area **221** and a second groove **242** extending from the second end area **222**.

[0080] The first groove **241** may face at least a portion of the first cap assembly **140** (for example, the first cap plate **142**). The first groove **241** may prevent contact between the welding bead **250** and the first cap plate **142** and increase a contact area between the first cap plate **142** and the first end area **221**. The second groove **242** may face at least a portion of the second cap assembly **150** (for example, the second cap plate **152**). The second groove **242** may prevent contact between the welding bead **250** and the second cap plate **152** and increase the contact area between the second cap plate **152** and the second end area **222**.

[0081] FIGS. **7**A, **7**B, **7**C, **7**D, and **7**E are a schematic diagram illustrating a case manufacturing process according to an embodiment. FIG. **8** is a flowchart of a case manufacturing process according to an embodiment.

[0082] Referring to FIGS. **7**A, **7**B, **7**C, **7**D, and **7**E, and/or FIG. **8**, the case manufacturing process **300** may include a process **310** for preparing a plate **209**, a punching process **320** for forming a through-hole **209***a*, a pressurizing process **330** for forming an end area **220** and a groove **240**, a bending process **340** for bending the plate, and a joining process **350**.

[0083] The description of the case **200** of FIG. **3** to FIG. **6** may be applied to the case **200** of FIGS. **7**A, **7**B, **7**C, **7**D, and **7**E. For example, the case manufacturing process **300** of FIGS. **7**A, **7**B, **7**C, **7**D, and **7**E and **8** may be a manufacturing process for manufacturing the case **200** of FIGS. **3** to **6**.

[0084] In the process **310** of preparing the plate **209** (for example, FIG. **7**A), the plate **209** may be substantially a metal plate or a metal sheet. The plate **209** may include a metal (for example, aluminum and/or stainless steel) that is capable of welding and pressurizing processes. The plate **209** may include a plurality of first edges **207** and a plurality of second edges **208** perpendicular to the plurality of first edges **207**. The first edges **207** may include a first-first edge **207***a* and a first-second edge **207***b* parallel to the first-first edge **207***a*.

[0085] In the punching process **320** (for example, FIG. **7**B), a through-hole **209***a* may be formed in the plate **209**. In an embodiment, the through-hole **209***a* may accommodate a venting portion (for example, the venting portion **130** of FIG. **1**). In another embodiment, the through-hole **209***a* may be a notch for venting gas discharge.

[0086] In the pressurizing process **330** (for example, FIG. **7**C), at least a portion of the end area **220** and the groove **240** may be formed. For example, the pressurizing process **330** may be a forging process that pressurizes portions of the plate **209** to form the end area **220** and the groove **240**. The end area **220** may be formed adjacent to the opening **201** of the plate **209**. For example, the end area **220** may be formed on the first edge **207** of the plate **209**. The groove **240** may be formed adjacent to the vertex of the plate **209**. For example, the groove **240** may extend from the end area **220** adjacent to the second edge **208**. In an embodiment, the groove **240** may be formed on each of the plurality of second edges **208**.

[0087] In an embodiment, the end area **220** and the groove **240** may be formed using a single pressurizing device. For example, the pressurizing device may be formed in a shape corresponding to the end area **220** and the groove **240** and may provide pressure to the plate **209**. In another embodiment, the end area **220** and the groove **240** may be formed using different pressurizing devices, respectively.

[0088] At least a portion of the plate **209** may be bent using the bending process **340** (for example, FIGS. **7**D and **7**E). For example, the bending process **340** may include a first bending process for bending a portion of the plate **209** where the second edge **208** is positioned. The case **200** may include a first bending portion **261** formed adjacent to the groove **240**. The first bending portion **261** may be a portion of the case **200** formed by the first bending process.

[0089] The bending process **340** may include a second bending process for forming a second bending portion **262** spaced apart from the first bending portion **261**. The case **200** may be formed as a closed curve with an opening **201** formed by the second bending process. The case **200** including the first bending portion **261** and the second bending portion **262** may include an opening **201**. The first edge **207** may form the opening **201**. For example, at least a portion of the opening **201** may be a hollow space surrounded by the first edge **207**. In the bending process **340**, the plate **209** may be bent along a direction substantially the same as the direction in which the second edge **208** extends. By forming the case **200** by the bending process **340**, an end area **220** and a groove **240** may be formed on the inner surface **200***b* of the case **200**.

[0090] The joining process **350** (for example, FIG. **7**E) may join the edges (for example, a plurality of second edges **208**) of the plate **209**. For example, by the joining process **350**, the plurality of second edges **208***a* and **208***b* may be welded to each other to form a joining portion **230**. After the bending process **340**, the plurality of second edges **208** may be joined to each other.

[0091] By the joining process **350**, a welding bead (for example, a welding bead **250** in FIG. **5**) may be generated on the inner surface **200***b* of the case **200**. The groove **240** may accommodate at least a portion of the welding bead **250** formed by the joining process **350**.

[0092] FIG. **9** is a perspective view of a battery device according to an embodiment.

[0093] Referring to FIG. **9**, the battery device **400** may include a plurality of cell assemblies **101** and a frame **410** that accommodates the plurality of cell assemblies **101**.

[0094] The plurality of cell assemblies **101** may each include a plurality of battery cells **100**. The plurality of battery cells **100** may each be prismatic battery cells that include a case **200**. For example, the descriptions of the battery cells **100** and/or the cases **120** and **200** described in FIGS. **1** to **6** may be applied to the battery cells **100** of FIG. **9**.

[0095] The battery device **400** may be referred to as a battery module or a battery pack.

[0096] The frame **410** may accommodate components of the battery device **400** (for example, cell assemblies **101**). The frame **410** may include a bottom member **411** supporting the battery cells **100**, a cover member **412** covering the cell assemblies **101**, and a side wall **413** surrounding at least a portion of the bottom member **411** and the cover member **412**.

[0097] The frame **410** may include a partition wall **420** that crosses at least a portion of the plurality of cell assemblies **101**. For example, the receiving space of the frame **410** may be divided into a plurality of spaces by the partition wall **420**. The partition wall **420** may be installed across the receiving space to reinforce the rigidity of the frame **410**. In an embodiment, the partition wall **420** may include a first partition wall **420***a* that crosses the plurality of cell assemblies **101** and a plurality of second partition walls **420***b* that are substantially perpendicular to the first partition wall **420***a*.

[0098] In an embodiment, the battery device **400** may include a duct member **430**. The duct member **430** may include an exhaust space for providing a path for gases and/or flames discharged from the battery cells **100**. The duct member **430** may be disposed within the frame **410**. The duct member **430** may surround at least a portion of the cell assembly **101**. For example, gases and/or flames generated from the battery cells of the cell assembly **101** (for example, the battery cells **100**

of FIG. **1**) may pass through the exhaust space of the duct member **430** to the exterior of the battery device **400**. In the present disclosure, the duct member **430** may be referred to as an exhaust duct, or an exhaust member.
[0099] The battery device **400** may include a battery control unit **490** for controlling the battery cells **100**. The battery control unit **490** may be placed within the frame **410**. The battery control unit **490** may include a battery management system (BMS). The configuration of the battery control unit **490** is known in various forms, so a detailed description thereof will be omitted. In an embodiment, the battery control unit **490** may be referred to as a processor.
[0100] The structure of the battery device **400** of FIG. **9** is illustrative. For example, the number of battery cells **100** included in the battery device **400**, the structure of the frame **410** and/or the duct member **430** may be selectively designed.
[0101] As set forth above, according to an embodiment, a bonding failure of a cap assembly to a case may be reduced.
[0102] According to an embodiment, occurrence of a gap between a cap assembly and a case may be prevented.
[0103] The above description is merely an example of applying the principles of the present disclosure, and other configurations may be further included without departing from the scope of the present disclosure.
[0104] Only specific examples of implementations of certain embodiments are described. Variations, improvements and enhancements of the disclosed embodiments and other embodiments may be made based on the disclosure of this patent document. For example, the present disclosure may be implemented by deleting some of the components in the above-described embodiments, and the respective embodiments may be implemented in combination with each other.

Claims

1. A battery cell comprising: a case including a first edge forming an opening and a joining portion positioned perpendicular to the first edge; an electrode assembly accommodated within the case; and a cap assembly coupled to the case and sealing the opening, wherein the case includes a center area facing the electrode assembly, an end area surrounding at least a portion of the cap assembly, and a groove extending from the end area and accommodating a welding bead formed in the joining portion.
2. The battery cell of claim 1, wherein the opening includes a first opening formed in one side of the battery cell and a second opening formed in the other side of the battery cell, and the cap assembly includes a first cap assembly sealing the first opening and a second cap assembly sealing the second opening.
3. The battery cell of claim 2, wherein the end area includes a first end area forming the first opening and a second end area forming the second opening, and the joining portion extends from the first end area to the second end area by passing the center area.
4. The battery cell of claim 3, wherein the groove includes a first groove extending from the first end area and facing at least a portion of the first cap assembly, and a second groove extending from the second end area and facing at least a portion of the second cap assembly.
5. The battery cell of claim 1, wherein a second thickness of the end area is thinner than a first thickness of the center area.
6. The battery cell of claim 1, wherein the joining portion is formed in a first direction, and the case includes a plurality of bending portions folded based on a direction, parallel to the first direction.
7. The battery cell of claim 1, wherein the groove is located between the end area and the center area.
8. The battery cell of claim 1, wherein the case includes an outer surface facing an outside of the battery cell and an inner surface opposite to the outer surface, and the welding bead is located on

the inner surface of the case.
9. The battery cell of claim 1, wherein the case includes at least one of aluminum or stainless steel.
10. The battery cell of claim 1, wherein the end area and the groove are formed using forging.
11. The battery cell of claim 1, wherein the case includes a plurality of second edges perpendicular to the first edge, and the joining portion is formed by welding the plurality of second edges.
12. A battery device comprising: a cell assembly including a plurality of battery cells; and a frame including the cell assembly, wherein the plurality of battery cells each include, a case including a first edge forming an opening and a joining portion positioned perpendicular to the first edge, an electrode assembly accommodated within the case, and a cap assembly coupled to the case and sealing the opening, and the case includes a center area facing the electrode assembly, an end area surrounding at least a portion of the cap assembly, and a groove extending from the end area and receiving a welding bead formed in the joining portion.
13. A case manufacturing process comprising: a preparatory process of preparing a plate including a plurality of first edges and a plurality of second edges perpendicular to the plurality of first edges; a punching process of forming a through-hole in the plate; a pressurizing process of forming an end area in the plurality of first edges of the plate and a groove in a portion of the plurality of second edges; a bending process of bending at least a portion of the plate; and a joining process of joining the plurality of second edges.
14. The case manufacturing process of claim 13, wherein the plate includes a center area surrounded by the plurality of first edges and the plurality of second edges, and the groove is located between the end area and the center area.
15. The case manufacturing process of claim 13, wherein the joining process forms a welding bead on an inner surface of the case, and the groove receives at least a portion of the welding bead.