US Patent & Trademark Office
Patent Public Search | Text View

United States Patent	12388139
Kind Code	B2
Date of Patent	August 12, 2025
Inventor(s)	Lee; Youngho et al.

Battery module and battery pack including the same

Abstract

A battery module according to an embodiment of the present disclosure includes: a battery cell stack in which a plurality of battery cells are stacked; a module frame accommodating the battery cell stack and having an open upper part; and an upper plate covering the battery cell stack over the open upper part of the module frame. The module frame includes a bottom part and two side parts opposite to each other. The bottom part of the module frame includes a first region and a second region, the first region being located along an edge of the bottom part extending along at least one of the side parts of the module frame, and the second region being located inside the first region. The thickness of the bottom part of the module frame is smaller in the second region than in the first region.

Inventors:	**Lee; Youngho (Daejeon, KR), Kim; Soo Youl (Daejeon, KR), Baek; Seung Ryul (Daejeon, KR), Yoon; Han Ki (Daejeon, KR)**
Applicant:	**LG Energy Solution, Ltd.** (Seoul, KR)
Family ID:	**1000008749089**
Assignee:	**LG Energy Solution, Ltd. (Seoul, KR)**
Appl. No.:	**17/430224**
Filed (or PCT Filed):	**July 06, 2020**
PCT No.:	**PCT/KR2020/008790**
PCT Pub. No.:	**WO2021/107312**
PCT Pub. Date:	June 03, 2021

Prior Publication Data

Document Identifier	**Publication Date**
US 20220166100 A1	May. 26, 2022

Foreign Application Priority Data

KR	10-2019-0152654	Nov. 25, 2019

Publication Classification

Int. Cl.: **H01M10/65** (20140101); **H01M10/653** (20140101); **H01M10/655** (20140101); **H01M50/207** (20210101); **H01M50/211** (20210101); **H01M50/505** (20210101)

U.S. Cl.:

CPC **H01M50/211** (20210101); **H01M10/653** (20150401); **H01M10/655** (20150401); **H01M50/207** (20210101); **H01M50/505** (20210101); H01M2220/20 (20130101)

Field of Classification Search

CPC: H01M (50/211); H01M (50/207); H01M (50/505); H01M (50/233)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
2012/0225339	12/2011	Nakaguchi et al.	N/A	N/A
2015/0099146	12/2014	Kim et al.	N/A	N/A
2016/0093862	12/2015	DeKeuster	429/121	H01M 50/209
2017/0025719	12/2016	Yamada et al.	N/A	N/A
2017/0069887	12/2016	Lee et al.	N/A	N/A
2018/0138565	12/2017	Lee	N/A	H01M 10/6554
2019/0131596	12/2018	Yang	N/A	H01M 50/224
2019/0173065	12/2018	Millon	N/A	H01M 50/278
2019/0198952	12/2018	Choi	N/A	H01M 50/20
2019/0280265	12/2018	Jansen et al.	N/A	N/A
2019/0305261	12/2018	Kim	N/A	H01M 10/6554
2020/0168864	12/2019	Seo et al.	N/A	N/A

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
110505325	12/2018	CN	B32B 9/005
20130126159	12/2012	KR	N/A
20170030667	12/2016	KR	N/A
101792751	12/2016	KR	N/A
20190078521	12/2018	KR	N/A
20190078841	12/2018	KR	N/A
2011114625	12/2010	WO	N/A
2015151884	12/2014	WO	N/A
2018022907	12/2017	WO	N/A
2019088625	12/2018	WO	N/A

OTHER PUBLICATIONS

International Search Report for Application No. PCT/KR2020/008790 mailed Oct. 29, 2020, pp. 1-3. cited by applicant

---

Primary Examiner: Smith; Nicholas A

Assistant Examiner: Lu; Ziheng

Attorney, Agent or Firm: Lerner David LLP

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

(1) This application is a national phase entry under 35 U.S.C. § 371 of International Application No. PCT/KR2020/008790 filed Jul. 6, 2020, which claims priority from Korean Patent Application No. 10-2019-0152654 filed on Nov. 25, 2019, the disclosure of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

(2) The present disclosure relates to a battery module and a battery pack including the same, and more particularly, to a battery module that improves space utilization rate and minimizes the amount of thermally conductive resin used, and a battery pack including the same.

BACKGROUND ART

(3) Secondary batteries, which are easily applied to various product groups and have electrical characteristics such as high energy density, are universally applied not only for a portable device but also for an electric vehicle or a hybrid electric vehicle, an energy storage system or the like, which is driven by an electric driving source. Such secondary batteries are attracting attention as a new environmentally-friendly energy source for improving energy efficiency since they provide a primary advantage of remarkably reducing the use of fossil fuels and also do not generate by-products from the use of energy at all.

(4) Small-sized mobile devices use one or several battery cells for each device, whereas middle- or large-sized devices such as vehicles require high power and large capacity. Therefore, a middle- or large-sized battery module having a plurality of battery cells electrically connected to one another is used.

(5) Preferably, the middle- or large-sized battery module is manufactured so as to have as small a size and weight as possible. Consequently, a prismatic battery or a pouch-shaped battery, which can be stacked with high integration and has a small weight to capacity ratio, is usually used as a battery cell of the middle- or large-sized battery module. Meanwhile, in order to protect the cell stack from external shock, heat, or vibration, the battery module may include a frame member whose front and back surfaces are opened so as to accommodate the battery cell stack in an internal space.

(6) FIG. **1** is a perspective view illustrating a battery module having a mono frame according to the related art.

(7) Referring to FIG. **1**, the battery module may include a battery cell stack **12** formed by stacking a plurality of battery cells **11**, a mono frame **20** whose front and rear surfaces are opened to cover the battery cell stack **12**, and end plates **60** covering the front and rear surfaces of the mono frame **20**. In order to form such a battery module, it is necessary to horizontally assemble the components such that the battery cell stack **12** is inserted into the opened front or rear surfaces of the mono

frame **20** along the X-axis direction as shown by the arrow in FIG. **1**. However, in order to stabilize such a horizontal assembly, sufficient clearance must be secured between the battery cell stack **12** and the mono frame **20**. Herein, the clearance refers to a gap generated by press-fitting or the like.
(8) A thermally conductive resin layer (not illustrated) may be formed between the battery cell stack **12** and the mono frame **20**. The thermally conductive resin layer may serve to transfer heat generated from the battery cell stack to the outside of the battery module, and fix the battery cell stack in the battery module. When a tolerance increases, the amount of the thermally conductive resin layer used may increase more than necessary.
(9) In addition, the height of the mono frame **20** should be designed to be large in consideration of the maximum height of the battery cell stack **12**, the assembling tolerance in the insertion process, and the like, and accordingly, an unnecessarily wasted space may occur.
DETAILED DESCRIPTION OF THE INVENTION
Technical Problem
(10) It is an object of the present disclosure to provide a battery module that improves space utilization rate and minimizes the amount of thermally conductive resin used, by modifying a structure of a frame member surrounding a battery cell stack, and a battery pack including the same.
(11) However, the problem to be solved by the embodiments of the present disclosure is not limited to the above-described problems, and can be variously expanded within the scope of the technical idea included in the present disclosure.
Technical Solution
(12) A battery module according to an embodiment of the present disclosure includes: a battery cell stack in which a plurality of battery cells are stacked; a module frame accommodating the battery cell stack and having opened upper part; and an upper plate covering the battery cell stack on the opened upper part of the module frame, wherein the module frame includes a bottom part and two side surface parts opposite to each other, the bottom part includes a first portion and a second portion, the first portion is located at an edge based on the thickness direction of the battery cell, the second portion is located inside the first portion, and the thickness of the second portion located along the thickness direction of the battery cell is smaller than the thickness of the first portion.
(13) The battery module may further include a pad part located between the bottom part and the battery cell stack, in which the pad part may be in close contact with a connecting part between the side surface part and the first portion of the bottom part.
(14) The second portion of the bottom part may be located further outside the first portion in the longitudinal direction of the battery cell stack, and the thickness of the second portion located along the longitudinal direction of the battery cell stack may be smaller than the thickness of the first portion.
(15) The battery module may further include a bus bar frame connected to the battery cell stack, in which the module frame may be opened at both sides opposite to each other based on a direction in which an electrode lead of the battery cell stack protrudes, and the bus bar frame is connected to the battery cell stack on both the opened sides of the module frame, the bus bar frame may include a main frame disposed perpendicular to the direction in which the electrode lead protrudes, and a bent part extending from a lower portion of the main frame, and the bent part is located above the second portion of the bottom part.
(16) The total thickness of the thickness of the bent part and the thickness of the second portion may be smaller than the thickness of the first portion.
(17) The battery cell may include a protrusion part formed in the width direction, and the protrusion part may be located on the bent part.
(18) The pad part may be located between the first portion and the battery cell stack.
(19) The battery module may further include a thermally conductive resin layer located between the first portion and the batter cell stack, in which the pad part is located between the thermally

conductive resin layer and the second portion.
(20) The battery module may further include end plates coupled to both of the opened sides of the module frame, respectively, in which both of the opened sides of the module frame may be opposite to each other based on a direction in which an electrode lead of the battery cell stack protrudes.
(21) A battery pack according to another embodiment of the present disclosure includes the above-described battery module.
Advantageous Effects
(22) According to the embodiments, by implementing the U-shaped frame, a clearance between a battery cell stack and the frame can be reduced compared to the related art, thereby improving a space utilization rate.
(23) Further, by utilizing an overflow prevention structure, a thermally conductive resin can be prevented from flowing to an unintended space when the battery cell stack is inserted.
(24) Further, by forming the overflow prevention structure on the module frame, the formability of the bus bar frame itself can be increased, as compared to a case where the overflow prevention structure is formed in the bus bar frame according to the related art.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is an exploded perspective view illustrating a battery module having a mono frame according to the related art.
(2) FIG. **2** is an exploded perspective view illustrating a battery module according to an embodiment of the present disclosure.
(3) FIG. **3** is a perspective view illustrating a state in which components of the battery module of FIG. **2** are coupled to each other.
(4) FIG. **4** is a perspective view illustrating one battery cell included in a battery cell stack of FIG. **2**.
(5) FIG. **5** is a perspective view illustrating a U-shaped frame in the battery module of FIG. **2**.
(6) FIG. **6** is a perspective view illustrating a bus bar frame in the battery module of FIG. **2**.
(7) FIG. **7** is a cross-sectional view taken along the YZ plane, which is the width direction of the battery cell stack in FIG. **3**.
(8) FIG. **8** is a cross-sectional view of a battery module corresponding to a comparative example to FIG. **7**.
(9) FIG. **9** is a sectional view taken along the XZ plane, which is the longitudinal direction of the battery cell stack in FIG. **3**.
(10) FIG. **10** is a sectional view of a battery module corresponding to a comparative example to FIG. **9**.
DETAILED DESCRIPTION OF THE EMBODIMENTS
(11) Hereinafter, various embodiments of the present disclosure will be described in detail with reference to the accompanying drawings so that those skilled in the art can easily implement them. The present disclosure may be modified in various different ways, and is not limited to the embodiments set forth herein.
(12) Parts that are irrelevant to the description will be omitted to clearly describe the present disclosure, and like reference numerals designate like elements throughout the specification.
(13) Further, the size and thickness of each element shown in the figures are arbitrarily illustrated for convenience of description, and the present disclosure is not necessarily limited to those illustrated in the drawings. In the figures, the thickness of layers, regions, etc. are exaggerated for clarity. In the figures, for convenience of description, the thicknesses of some layers and regions

are shown to be exaggerated.
(14) In addition, it will be understood that when an element such as a layer, film, region, or plate is referred to as being “on” or “above” another element, it can be directly on the other element or intervening elements may also be present. In contrast, when an element is referred to as being “directly on” another element, it means that other intervening elements are not present. Further, the word “on” or “above” means disposed on or below a reference portion, and does not necessarily mean being disposed on the upper end of the reference portion toward the opposite direction of gravity.
(15) Further, throughout the specification, when a part is referred to as “including” or “comprising” a certain component, it means that it can further include other components, without excluding the other components, unless otherwise stated.
(16) Further, throughout the specification, when referred to as “planar”, it means when a target portion is viewed from the top, and when referred to as “cross-sectional”, it means when a target portion is viewed from the side of a cross section cut vertically.
(17) FIG. **2** is an exploded perspective view illustrating a battery module according to an embodiment of the present disclosure. FIG. **3** is a perspective view illustrating a state in which components of the battery module of FIG. **2** are coupled to each other. FIG. **4** is a perspective view illustrating one battery cell included in a battery cell stack of FIG. **2**.
(18) Referring to FIGS. **2** and **3**, a battery module **100** according to the present embodiment includes: a battery cell stack **120** including a plurality of battery cells **110**; a U-shaped frame **300** (i.e., module frame) of which the upper surface, the front surface, and the rear surface are opened; an upper plate **400** that covers an upper portion of the battery cell stack **120**; end plates **150** that are located on the front surface and the rear surface of the battery cell stack **120**, respectively; and bus bar frames **130** that are located between the battery cell stack **120** and the end plates **150**. Further, the battery module **100** includes a thermally conductive resin layer **310** located between the U-shaped frame **300** and the battery cell stack **120**. The thermally conductive resin layer **310**, which is a type of heat dissipation layer, may be formed by applying a material having a heat dissipation function.
(19) When opened both sides of the U-shaped frame **300** are referred to as a first side and a second side, respectively, the U-shaped frame **300** has a plate-shaped structure that is bent to continuously surround the front surface, the lower surface, and the rear surface adjacent to each other among the other outer surfaces except surfaces of the battery cell stack **120** corresponding to the first side and the second side. The upper surface corresponding and opposite to the lower surface of the U-shaped frame **300** is opened.
(20) The upper plate **400** has one plate-shaped structure surrounding the upper surface of the remainder excluding the front, lower and rear surfaces which are surrounded by the U-shaped frame **300**. The U-shaped frame **300** and the upper plate **400** may be coupled by welding or the like in a state in which the corresponding corner areas are in contact with each other, thereby forming a structure surrounding the battery cell stack **120**. That is, the U-shaped frame **300** and the upper plate **400** may have a coupling portion CP formed along edges corresponding to each other by a coupling method such as welding.
(21) The battery cell stack **120** may include a plurality of battery cells **110** stacked in one direction, and the plurality of battery cells **110** may be stacked in a Y-axis direction, as illustrated in FIG. **2**. In other words, a direction in which the plurality of battery cells **110** are stacked may be identical to a direction in which two side surface parts of the U-shaped frame **300** are opposite to each other.
(22) It is preferable that the battery cell **110** is a pouch-type battery cell. For example, referring to FIG. **4**, the battery cell **110** according to the present embodiment has a structure in which two electrode leads **111** and **112** are opposite to each other, and respectively protrude from one end **114*a*** and the other end **114*b*** of a battery body **113**. The battery cell **110** may be manufactured by bonding both ends **114*a*** and **114*b*** of a case **114** and both side surfaces **114**c connecting them in a

state in which an electrode assembly (not illustrated) is accommodated in the battery case **114**. In other words, the battery cell **110** according to the present embodiment has a total of three sealing parts **114***sa*, **114***sb*, and **114***sc*, the sealing parts **114***sa*, **114***sb*, and **114***sc* have a structure in which the sealing parts **114***sa*, **114***sb*, and **114***sc* are sealed by a method such as thermal fusion, and the other side surface part may be formed by a connecting portion **115**. A direction between the both ends **114***a* and **114***b* of the battery case **114** may be defined as a longitudinal direction of the battery cell **110**, and a direction between the connecting portion **115** and the side surface part **114**c connecting the both ends **114***a* and **114***b* of the battery case **114** may be defined as a width direction of the battery cell **110**.
(23) The connecting portion **115** may be an area extending longitudinally along one edge of the battery cell **110**, and a protrusion part **110***p* of the battery cell **110** may be formed at an end part of the connecting portion **115**. The protrusion part **110***p* may be formed at at least one of both ends of the connecting portion **115**, and may protrude in a direction perpendicular to a direction in which the connecting portion **115** extends. The protrusion part **110***p* may be located between the connecting portion **115** and one of the sealing parts **114***sa* and **114***sb* of each end **114***a* and **114***b* of the battery case **114**.
(24) The battery case **114** generally has a laminate structure of a resin layer/metal thin film layer/resin layer. For example, in the case where the surface of the battery case is made of O (oriented)-nylon layer, if the surfaces of battery cells are stacked to form a medium-sized or large-sized battery module, the battery cells tend to easily slide due to external impact. Thus, in order to prevent the sliding and maintain a stable stack structure of the battery cells, the battery cell stack **120** may be formed by attaching, to the surface of the battery case, an adhesive member such as an adhesion adhesive such as a double-sided tape and a chemical adhesive providing bonding by a chemical reaction during adhesion. In the present embodiment, the battery cell stack **120** may be stacked in the Y-axis direction, may be accommodated inside the U-shaped frame **300** in the Z-axis direction, and may be cooled by a thermally conductive resin layer, which will be described below. As a comparative example, there is a case in which the battery cells are formed as cartridge-type components, and fixing between the battery cells may thus be made by assembling a battery module frame. In such a comparative example, due to the presence of the cartridge-type components, there may be little cooling action or the cooling action may be progressed in the plane direction of the battery cells, the cooling action hardly proceeds or may proceed in a surface direction of the battery cell, and cooling is not well performed in a height direction of the battery module.
(25) FIG. **5** is a perspective view illustrating a U-shaped frame in the battery module of FIG. **2**.
(26) Referring to FIG. **5**, the U-shaped frame **300** according to the present embodiment includes a bottom part **300***a* and two side surface parts **300***b* opposite to each other. Before the battery cell stack **120** described in FIG. **2** is mounted on the bottom part **300***a* of the U-shaped frame **300**, a thermally conductive resin is applied to the bottom part **300***a* of the U-shaped frame **300**, and the thermally conductive resin is cured, thereby forming the thermally conductive resin layer **310**.
(27) Before the thermally conductive resin layer **310** is formed, that is, before the applied thermally conductive resin is cured, the battery cell stack **120** may be mounted on the bottom part **300***a* of the U-shaped frame **300** while moving along a direction perpendicular to the bottom part **300***a* of the U-shaped frame **300**. Thereafter, the thermally conductive resin layer **310** formed by curing the thermally conductive resin is located between the bottom part **300***a* of the U-shaped frame **300** and the battery cell stack **120**. The thermally conductive resin layer **310** may serve to transfer heat generated by the battery cells **110** to the bottom of the battery module **100**, and fix the battery cell stack **120**.
(28) The battery module according to the present embodiment may further include a pad part **320** formed on the bottom part **300***a* of the U-shaped frame **300**. The pad part **320** may guide the application position of the thermally conductive resin or prevent the thermally conductive resin

from overflowing to the outside of the bottom part **300***a*, and at least one pad part **320** may be formed. Further, when there is no pad part **320** according to the present embodiment, if the thermally conductive resin excessively overflows, is thus formed in an unnecessary part, and is then cured, an unintended failure mode may also be formed. Although it is illustrated in FIG. **5** that one pad part **320** is formed at each of both ends of the bottom part **300***a* based on the X-axis direction, the size, the position, and the number of the pad part **320** may be modified and designed in consideration of the amount of the thermally conductive resin applied. The pad part **320** may be formed of an insulation film. At this time, the pad part **320** may be formed of a material such as polyurethane (PU) foam or rubber such that the thermally conductive resin may be compressed by bringing the battery cells **110** into contact with an upper portion of the bottom part **300***a*.

(29) According to the present embodiment, the thermally conductive resin layer **310** includes a plurality of application lines extending longitudinally along a direction perpendicular to the direction in which the plurality of battery cells **110** are stacked. The plurality of application lines may form two groups, and an insulation film **330** may be formed between the two groups. The insulation film **330** may function to maintain the insulation performance between the battery cells **110** and the U-shaped frame **300**, and the thermally conductive resin may be at least partially applied onto the insulation film **330**.

(30) Referring back to FIGS. **2** and **3**, the width of the side surface parts **300***b* of the U-shaped frame **300** according to the present embodiment may be identical to that of the upper plate **400**. In other words, edge portions of the upper plate **400** along the X-axis direction and edge portions of the side surface parts **300***b* of the U-shaped frame **300** along the X-axis direction may be in direct contact with each other and coupled to each other through a method such as welding.

(31) FIG. **6** is a perspective view illustrating a bus bar frame in the battery module of FIG. **2**.

(32) Referring to FIG. **6**, the bus bar frame **130** according to the present embodiment includes a main frame **130***a* disposed perpendicular to the direction in which the electrode leads **111** and **112** described in FIG. **4** protrude and a bent part **130***b* extending from a lower portion of the main frame **130***a*. As illustrated in FIGS. **2** and **3**, the bus bar frame **130** is connected to the battery cell stack **120**. A structure in which the electrode leads pass through slits and are coupled to bus bars may be formed in the main frame **130***a*. The bent part **130***b* may be bent so as to be oriented about 90 degrees relative to the main frame **130***a* and may be located on the bottom part **300***a* of the U-shaped frame **300**. The bent part **130***b* and peripheral configurations will be additionally described with reference to FIGS. **7** and **9**.

(33) FIG. **7** is a cross-sectional view taken along the YZ plane, which is in the width direction of the battery cell stack in FIG. **3**. FIG. **8** is a sectional view of a battery module corresponding to a comparative example to FIG. **7**.

(34) Referring to FIGS. **5** and **7**, the bottom part **300***a* of the U-shaped frame **300** according to the present embodiment includes a first portion **300***a***1** and a second portion **300***a***2**, the first portion **300***a***1** is located along an edge of the bottom part **300***a* in the thickness direction of the battery cells **110**, and the second portion **300***a***2** is located inside the first portion **300***a***1**. The thickness direction of the battery cells **110** is identical to the Y-axis direction illustrated in FIG. **2**. At this time, the thickness of the second portion **300***a***2** is smaller than the thickness of the first portion **300***a***1**. By differently forming the thickness of the U-shaped frame **300** at different portions of the bottom part **300***a* in the Y-axis direction, the size of the battery module **100** according to the present embodiment may be reduced simultaneously while the rigidity of a portion where the bottom part **300***a* and the side surface parts **300***b* are connected to each other is improved, so that the energy density may be increased.

(35) The U-shaped frame **300** according to the present embodiment includes a connecting part **300***c* where the side surface part **300***b* and the first portion **300***a***1** of the bottom part **300***a* are in contact with each other. The pad part **320** located between the bottom part **300***a* and the battery cell stack **120** may be in close contact with the connecting part **300***c*. In this way, the possibility that the

thermally conductive resin forming the thermally conductive resin layer **310** described in FIG. **5** is diffused to a portion other than the application portion despite the fact that the pad part **320** is formed can be prevented due to the structure in which the pad part **320** and the U-shaped frame **300** are in close contact with each other.
(36) The battery module according to the present embodiment may further include a compression pad **160** located between the outermost battery cell **110** and the side surface part **300***b* of the U-shaped frame **300**. The compression pad **160** may be formed of a polyurethane-based material. The compression pad **160** may absorb a change in the thickness due to swelling of the battery cell **110** and a change of the battery cell **110** due to external impact. At least one compression pad **160** may be formed also between the adjacent battery cells **110** as well as between the outermost battery cell **110** and the side surface part of the U-shaped frame **300**.
(37) Referring to FIG. **8**, unlike the embodiment of FIG. **7**, a pad part **320**′ is formed on a bent part **130***b*′ of the bus bar frame **130**. In such a structure, since the pad part **320**′ is difficult to position in close contact with a module frame **300**′, and a hole H is formed between the bent part **130***b*′, the module frame **300**′, and the pad part **320**′, the thermally conductive resin may overflow.
(38) FIG. **9** is a sectional view taken along the XZ plane, which is in the longitudinal direction of the battery cell stack in FIG. **3**. FIG. **10** is a sectional view of a battery module corresponding to a comparative example to FIG. **9**.
(39) Referring to FIG. **9**, the battery cell **110** according to the present embodiment includes a protrusion part **110***p* formed in the width direction, and the protrusion part **110***p* is located on the bent part **130***b*. Here, the width direction of the battery cell **110** may be a Z-axis direction of FIG. **9**. The bottom part **300***a* of the U-shaped frame according to the present embodiment further includes a second portion **300***a***2** located on the outer side of the first portion **300***a***1** in the longitudinal direction of the battery cell stack **120**. In other words, the second portion **300***a***2** is located along an edge of the bottom part **300***a* in the longitudinal direction of the battery cell **110**, and the first portion **300***a***1** is located inside the second portion **300***a***2**. At this time, it is preferable that the thickness of the second portion **300***a***2** is smaller than the thickness of the first portion **300***a***1**. Here, the longitudinal direction of the battery cell **110** may be the X-axis direction of FIG. **9**.
(40) Referring to FIGS. **6** and **9**, the bent part **130***b* of the bus bar frame **130** according to the present embodiment is located above the second portion **300***a***2** of the bottom part **300***a* of the U-shaped frame. At this time, it is preferable that the total thickness of the thickness of the bent part **130***b* and the thickness of the second portion **300***a***2** is smaller than the thickness of the first portion **300***a***1**. This is because the protrusion part **110***p* of the battery cell **110** is caught by a step between the second portion **300***a***2** and the first portion **300***a***1**, and the battery cell **110** may thus be prevented from moving due to external impact. In addition, a gap between the battery cell **110** and the U-shaped frame may be reduced through the processing of the bottom part **300***a* of the U-shaped frame, and this gap reduction effect may cause synergy with a gap reduction effect that may be obtained through height-direction assembling, thereby maximizing the overall space efficiency. In the processing of the bottom part **300***a* of the U-shaped frame, a step of the bottom part **300***a* may be formed simultaneously while the structure of the U-shaped frame is formed. Press forming, numerical control work (NC) processing, or the like may be used in order to form such a step.
(41) The pad part **320** is located between the first portion **300***a***1** of the bottom part **300***a* and the battery cell **110**, and the thermally conductive resin layer **310** is located inside the pad part **320**. That is, the pad part **320** may be located between the thermally conductive resin layer **310** and the second portion **300***a***2** of the bottom part **300***a* to define a position where the thermally conductive resin layer **310** is formed.
(42) Referring to FIG. **10**, as compared with the embodiment of FIG. **9**, the thickness of a bottom part **300***a*′ of the module frame is uniform. When a battery cell **110**′ having the same size as the battery cell **110** described in FIG. **9** and a protrusion part **110***p*′ are mounted on the bottom part **300***a*′ of the module frame, the heights of the thermally conductive resin layer **310**′ and the pad part

320′ may increase as there is no step as in the bottom part **300***a* of FIG. **9**. Thus, as compared to the comparative example of FIG. **10**, by reducing a tolerance between the battery cell **110** and the frame, as in the embodiment of FIG. **9**, the space utilization may be improved, and by reducing the thickness of the thermally conductive resin layer **310**, also as in the embodiment of FIG. **9**, the amount of the thermally conductive resin used to form the thermally conductive resin layer **310** may be reduced.

(43) In addition, in the case of the comparative example of FIG. **10**, since the pad part **320**′ is attached onto the bent part **130***b*′ of the bus bar frame, when the bus bar frame is formed, a thin injection material should be formed longer than that of the embodiment of FIG. **9**. Thus, when the bus bar frame is formed, the formability may deteriorate.

(44) Meanwhile, one or more battery modules according to an exemplary embodiment of the present disclosure may be packaged in a pack case to form a battery pack.

(45) The above-mentioned battery module and a battery pack including the same may be applied to various devices. These devices may be applied to vehicles such as an electric bicycle, an electric vehicle, a hybrid vehicle, but the present disclosure is not limited thereto and can be applied to various devices that can use the battery module and the battery pack including the same, which also belongs to the scope of the present disclosure.

(46) Although the preferred embodiments of the present disclosure have been described in detail above, the scope of the present disclosure is not limited thereto, and various modifications and improvements of those skilled in the art using the basic concepts of the present disclosure defined in the following claims also belong to the scope of rights.

DESCRIPTION OF REFERENCE NUMERALS

(47) **110***p:* protrusion part **130***a:* main frame **130***b:* bent part **150**: end plate **160**: compression pad **300**: U-shaped frame **310**: thermally conductive resin layer **320**: pad part **400**: upper plate

Claims

1. A battery module comprising: a battery cell stack in which a plurality of battery cells are stacked; a module frame accommodating the battery cell stack therein and having open upper part; and an upper plate covering the battery cell stack over the open upper part of the module frame, wherein the module frame includes a bottom part and two side parts positioned opposite to one other across the bottom part by a predetermined distance, and wherein the bottom part includes a first portion and a second portion, wherein the first portion is located along a first edge of the bottom part extending along at least one of the side parts, wherein the second portion has a reduced thickness portion, wherein terminal ends of the reduced thickness portion are spaced away from respective planes of each of the two side parts, so as to be spaced away from the first portion, the respective planes extending parallel to an outer surface of each the two side parts, wherein the reduced thickness portion is thinner than a thickness of the first portion and extends continuously across a majority of the predetermined distance.

2. The battery module according to claim 1, further comprising: a pad part located between the bottom part and the battery cell stack, wherein the pad part is in close contact with a connecting part connecting one of the side surface parts and to the bottom part at the first portion.

3. The battery module according to claim 2, wherein the second portion of the bottom part includes a second portion extending along a second edge of the bottom part extending orthogonally to the first edge, and the thickness of bottom part of the module frame is smaller in the second portion of the second portion than in the first portion.

4. The battery module according to claim 3, further comprising: a bus bar frame connected to the battery cell stack, wherein the module frame is open along two sides opposite to each other in a direction in which an electrode lead of the battery cell stack protrudes, and the bus bar frame is connected to the battery cell stack along each of the open sides of the module frame, the bus bar

frame includes a main frame disposed perpendicular to the direction in which the electrode lead protrudes, and a bent part extending from a lower portion of the main frame, and the bent part is positioned above the second portion of the bottom part.

5. The battery module according to claim 4, wherein a total thickness of the bent part and the bottom part of the module frame in the second portion is smaller than the thickness of bottom part of the module frame in the first portion.

6. The battery module according to claim 5, wherein at least one of the plurality of battery cells includes a protrusion part protruding along a width direction of the battery cells, and the protrusion part is positioned on the bent part.

7. The battery module according to claim 2, wherein the pad part is located between the battery cell stack and the bottom part of the module frame in the first portion.

8. The battery module according to claim 7, further comprising: a thermally conductive resin layer located between the battery cell stack and the bottom part of the module frame in the first portion, wherein the pad part is located between the thermally conductive resin layer and the second portion of the module frame.

9. The battery module according to claim 1, wherein the module frame is open along two sides opposite to each other in a direction in which an electrode lead of the battery cell stack protrudes, the battery module further comprising: end plates covering each of the open sides of the module frame.

10. A battery pack comprising the battery module according to claim 1.

11. The battery module according to claim 1, wherein the reduced thickness portion has a continuous thickness.

12. The battery module according to claim 8, wherein the pad part extends along the predetermined distance.