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Battery module and battery pack including the same

Abstract

A battery module includes a battery cell stack in which a plurality of battery cells are stacked; a module frame for housing the battery cell stack; end plates located on one side and the other side of the battery cell stack and having a connector opening formed therein; and a module connector exposed through the connector opening, wherein the module connector comprise a body part and an interrupting part surrounding the outer peripheral surface of the body part, and the interrupting part is movable toward the connector opening.

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References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
2011/0300424	12/2010	Kim et al.	N/A	N/A
2019/0355959	12/2018	Ro	N/A	N/A
2020/0176739	12/2019	You et al.	N/A	N/A
2020/0292626	12/2019	Hemnani	N/A	G01R 31/006
2021/0151804	12/2020	You	N/A	H01M 50/211
2021/0167466	12/2020	Choi et al.	N/A	N/A
2021/0320385	12/2020	Kim	N/A	H01M 50/284
2025/0079574	12/2024	Wang	N/A	H01M 50/249
2025/0087848	12/2024	Li	N/A	H01M 50/516

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
2014-175329	12/2013	JP	N/A
10-1146363	12/2011	KR	N/A
10-2018-0090572	12/2017	KR	N/A
10-2067711	12/2019	KR	N/A
10-2020-0067587	12/2019	KR	N/A
10-2020-0068593	12/2019	KR	N/A
10-2020-0080074	12/2019	KR	N/A
WO-2020138869	12/2019	WO	H01M 10/0413

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Background/Summary

TECHNICAL FIELD

(1) The present disclosure relates to a battery module and a battery pack including the same, and more particularly, to a battery module that can suppress the propagation of thermal runaway

phenomenon, and a battery pack including the same.

BACKGROUND

(2) In modern society, as portable devices such as a mobile phone, a notebook computer, a camcorder and a digital camera has been daily used, the development of technologies in the fields related to mobile devices as described above has been activated. In addition, chargeable/dischargeable secondary batteries are used as a power source for an electric vehicle (EV), a hybrid electric vehicle (HEV), a plug-in hybrid electric vehicle (P-HEV) and the like, in an attempt to solve air pollution and the like caused by existing gasoline vehicles using fossil fuel. Therefore, there is a growing need for development of the secondary battery.

(3) Currently commercialized secondary batteries include a nickel cadmium battery, a nickel hydrogen battery, a nickel zinc battery, a lithium secondary battery, and the like. Among them, the lithium secondary battery has come into the spotlight because they have advantages, for example, hardly exhibiting memory effects compared to nickel-based secondary batteries and thus being freely charged and discharged, and having very low self-discharge rate and high energy density.

(4) Such lithium secondary battery mainly uses a lithium-based oxide and a carbonaceous material as a positive electrode active material and a negative electrode active material, respectively. The lithium secondary battery includes an electrode assembly in which a positive electrode plate and a negative electrode plate each coated with the positive electrode active material and the negative electrode active material are disposed with a separator being interposed between them, and a battery case that seals and houses the electrode assembly together with an electrolyte solution.

(5) Generally, the lithium secondary battery may be classified based on the shape of the exterior material into a can type secondary battery in which the electrode assembly is mounted in a metal can, and a pouch-type secondary battery in which the electrode assembly is mounted in a pouch of an aluminum laminate sheet.

(6) In the case of a secondary battery used for small-sized devices, two to three battery cells are disposed, but in the case of a secondary battery used for a middle or large-sized device such as an automobile, a battery module in which a large number of battery cells are electrically connected is used. In such a battery module, a large number of battery cells are connected to each other in series or in parallel to form a cell stack, thereby improving capacity and output. In addition, one or more battery modules may be mounted together with various control and protection systems such as BMS (battery management system) and a cooling system to form a battery pack.

(7) A battery pack configured to gather a plurality of battery modules can add up heat generated from the large number of battery cells in a narrow space, so that the temperature can rise more quickly and excessively. In other words, a battery module in which a large number of battery cells are stacked, and a battery pack equipped with such a battery module can obtain high output, but it is not easy to remove heat generated from the battery cells during charging and discharging. When the heat dissipation of the battery cell is not properly performed, deterioration of the battery cells is accelerated, the lifespan is shortened, and the possibility of explosion or ignition increases.

(8) Moreover, in the case of a battery module included in a vehicle battery pack, it is frequently exposed to direct sunlight and can be subjected to high-temperature conditions such as summer or desert areas. Further, since a plurality of battery modules are concentratedly arranged to increase the mileage of the vehicle, a thermal runaway phenomenon generated in one battery module can easily propagate to an adjacent battery module, which may eventually lead to ignition or explosion of the battery pack itself.

(9) Therefore, there is a need to design a model that does not lead to a fire or explosion of the battery pack itself, even if a thermal runaway phenomenon occurs in any one battery module.

DETAILED DESCRIPTION OF THE INVENTION

Technical Problem

(10) It is an object of the present disclosure to provide a battery module that can suppress high-temperature gas and flame from being ejected when a thermal runaway phenomenon occurs within

the battery module, and a battery pack including the same.

(11) The objects of the present disclosure are not limited to the aforementioned objects, and other objects which are not described herein should be clearly understood by those skilled in the art from the following detailed description and the accompanying drawings.

Technical Solution

(12) According to one embodiment of the present disclosure, there is provided a battery module comprising: a battery cell stack comprising a plurality of stacked battery cells; a module frame for housing the battery cell stack; end plates located on respective sides of the battery cell stack, a connector opening formed in a first end plate of the end plates; and a module connector exposed through the connector opening, wherein the module connector comprises a body part and an interrupting part surrounding an outer peripheral surface of the body part, and the interrupting part is movable toward the connector opening.

(13) The module connector may be located inside the connector opening.

(14) An insertion hole is formed in the interrupting part, and the body part may be inserted into the insertion hole.

(15) The interrupting part may be movable along the outer peripheral surface of the body part.

(16) The interrupting part may move toward an inner side of the connector opening upon a rise of internal pressure of the module frame.

(17) The battery module may further include a busbar frame located between the battery cell stack and the first end plate.

(18) The battery module may further include an insulation cover located between the busbar frame and the end plate, and a connector opening hole may be in a portion of the insulation cover corresponding to the connector opening.

(19) The interrupting part may be in contact with an inner side of the connector opening hole upon the rise of internal pressure of the module frame.

(20) The connector opening hole may be opened in an upward direction.

(21) The interrupting part may be spaced apart from the connector opening hole in a first position, and the interrupting part may move in an upward direction to a second position to close a gap between the body part and the connector opening hole upon a rise of internal pressure of the module frame.

(22) The battery module may further include a connection cable connected to the module connector, and a joining member for connecting the connection cable and the electrode lead of the battery cell.

(23) The connector opening may be opened in an upward direction.

Advantageous Effects

(24) According to embodiments of the present disclosure, when a thermal runaway phenomenon occurs within the battery module, the pressure inside the battery module rises, which allows the interrupting part of the module connector to move to close a gap formed in the battery module. That is, the gap through which the high-temperature gas and the flame can be ejected can be offset by utilizing the pressure rise inside the battery module.

(25) The effects of the present disclosure are not limited to the effects mentioned above and additional other effects not described above will be clearly understood from the description of the appended claims by those skilled in the art.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. 1 is a perspective view of a battery module according to an embodiment of the present disclosure;

- (2) FIG. 2 is an exploded perspective view of the battery module of FIG. 1;
- (3) FIG. 3 is a perspective view showing a state in which an end plate and an insulating cover are removed from the battery module according to an embodiment of the present disclosure;
- (4) FIG. 4 is a perspective view showing a sensing assembly according to an embodiment of the present disclosure;
- (5) FIGS. 5(a) and (b) are perspective views showing a module connector according to an embodiment of the present disclosure;
- (6) FIG. 6 is a perspective view showing a state where the module connector according to an embodiment of the present disclosure is disassembled;
- (7) FIG. 7 is a perspective view showing an end plate and an insulation cover according to an embodiment of the present disclosure; and
- (8) FIGS. 8 and 9 are partial cross-sectional views showing a cross-section taken along the cutting line A-N of FIG. 1.

Detailed Description of the Embodiments

- (9) 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 carry out them. The present disclosure may be modified in various different ways, and is not limited to the embodiments set forth herein.
- (10) Portions 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.
- (11) Further, in the drawings, the size and thickness of each element are arbitrarily illustrated for convenience of the description, and the present disclosure is not necessarily limited to those illustrated in the drawings. In the drawings, the thickness of layers, regions, etc. are exaggerated for clarity. In the drawings, for convenience of the description, the thicknesses of some layers and regions are exaggerated.
- (12) 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” or “above” the reference portion toward the opposite direction of gravity.
- (13) Further, throughout the specification, when a portion is referred to as “including” a certain component, it means that the portion can further include other components, without excluding the other components, unless otherwise stated.
- (14) Further, throughout the specification, when referred to as “planar”, it means when a target portion is viewed from the upper side, and when referred to as “cross-sectional”, it means when a target portion is viewed from the side of a cross section cut vertically.
- (15) FIG. 1 is a perspective view of a battery module according to an embodiment of the present disclosure. FIG. 2 is an exploded perspective view of the battery module of FIG. 1.
- (16) Referring to FIGS. 1 and 2, the battery module **100** according to an embodiment of the present disclosure includes a battery cell stack **120** in which a plurality of battery cells **110** are stacked; a module frame **200** for housing the battery cell stack **120**; and end plates **400** located on one side and the other side of the battery cell stack **120**.
- (17) First, the battery cell **110** is preferably a pouch-type battery cell. Such a battery cell **110** may be formed in a rectangular sheet-like structure. For example, the battery cell **110** according to the present embodiment has a structure in which the two electrode leads **111** face each other and protrude on one side and the other side, respectively. More specifically, the electrode leads **111** are connected to an electrode assembly (not shown) and are protruded from the electrode assembly (not shown) to the outside of the battery cell **110**.

(18) Meanwhile, the battery cell **110** may be manufactured by thermally fusing the outer periphery of the pouch-type cell case in a state in which an electrode assembly (not shown) is housed in the pouch-type cell case. The pouch-type cell case may be formed of a laminate sheet including a resin layer and a metal layer.

(19) Meanwhile, only the battery cell **110** having a structure in which the electrode lead **111** protrudes in both directions on one side and the other side has been described, but it goes without saying that in another embodiment of the present disclosure, a unidirectional pouch-type battery cell in which electrode leads protrude together in one direction is also possible.

(20) The battery cell **110** may be configured by a plurality of numbers, and the plurality of battery cells **110** may be stacked along one direction so as to be electrically connected to each other, thereby forming a battery cell stack **120**. For example, as shown in FIG. 2, a plurality of battery cells **110** may be stacked along a direction parallel to the x-axis. The pouch-type cell case is generally formed of a laminate structure of a resin layer/metallic thin film layer/resin layer. For example, a surface of the pouch-type cell case formed of an O(oriented)-nylon layer tends to slide easily by an external impact when a plurality of battery cells are stacked to form a medium or large-sized battery module. Therefore, in order to prevent this sliding and maintain a stable stacked structure of the battery cells, an adhesive member, for example, a sticky adhesive such as a double-sided tape or a chemical adhesive coupled by a chemical reaction upon adhesion can be attached to the surface of the battery case to form the battery cell stack **120**.

(21) The battery cell stack **120** is housed in the module frame **200**. The module frame **200** may be a metal frame of which both surfaces are opened. More specifically, the module frame **200** may be opened in both directions in which the electrode leads **111** protrude with reference to the battery cell stack **120**. However, the module frame **200** shown in FIG. 2 is an exemplary structure, and the form thereof is not particularly limited as long as it can house the battery cell stack **120**. The module frame **200** of FIG. 2 is shown as a mono frame in the form of a metal plate in which the upper surface, the lower surface and both side surfaces are integrated, but a form in which an upper cover is joined to a U-shaped frame with an open upper part, a form in which a U-shaped frame and an inverted U-shaped frame are coupled with each other, or the like are possible.

(22) End plates **400** are located on one side and the other side of the battery cell stack **120**. That is, the end plates **400** may be located on the opened both surfaces of the module frame **200**.

(23) The module frame **200** and the end plate **400** can be joined by welding or the like in a state in which the corresponding corner portions are in contact with each other. However, this is an exemplary method, and bolt fastening, hook fastening, or the like can be applied as a mechanical coupling form. The battery cell stack **120** is housed in the space formed by the module frame **200** and the end plate **400**, thereby capable of physically protecting the battery cell stack **120**. For this purpose, the module frame **200** and the end plate **400** may include a metal material having a predetermined strength such as aluminum or a plastic material.

(24) Meanwhile, the battery module **100** according to the present embodiment may include a busbar frame **300** located between the battery cell stack **120** and the end plate **400**, and an insulation cover **600** located between the busbar frame **300** and the end plate **400**. That is, the busbar frame **300**, the insulation cover **600**, and the end plate **400** may be sequentially located from the battery cell stack **120** to the outside. Similarly to the end plate **400**, the busbar frame **300** and the insulation cover **600** may each be configured by a plurality of numbers.

(25) Next, a connector opening formed in the busbar frame, the module connector, and the end plate according to the present embodiment will be described in detail with reference to FIGS. 3 to 7, and the like.

(26) FIG. 3 is a perspective view showing a state in which an end plate and an insulating cover are removed from the battery module according to an embodiment of the present disclosure. FIG. 4 is a perspective view showing a sensing assembly according to an embodiment of the present disclosure.

(27) First, referring to FIGS. 2 to 4, the battery module **100** according to an embodiment of the present disclosure includes a module connector **510**. Further, a connector opening **420H** is formed in the end plate **400**, and the module connector **510** is exposed through the connector opening **420H**.

(28) Specifically, the battery module **100** according to the present embodiment may include a sensing assembly **500** for sensing connection of the battery module **100**. Here, the sensing assembly **500** is for connecting LV (Low voltage), wherein the LV connection means a sensing connection for sensing and controlling the voltage and temperature of the battery cell. The voltage information and temperature information of the battery cell **110** can be measured through the sensing assembly **500** and transmitted to an external BMS (battery management system). The sensing assembly **500** according to the present embodiment may include a module connector **510**, a connection cable **520**, and a joining member **530**.

(29) Meanwhile, the battery module **100** according to the present embodiment may include a busbar **310** and a terminal busbar **320**. The busbar **310** and the terminal busbar **320** may be mounted on the busbar frame **300**.

(30) The busbar **310** and the terminal busbar **320** may be joined to the electrode lead **111** of the battery cells **110** in order to electrically connect the plurality of battery cells **110**. Specifically, the busbar frame **300** on which the busbar **310** and the terminal busbar **320** are mounted may be located on one side (y-axis direction) and the other side (−y-axis direction) of the battery cell stack **120**, respectively. The one side (y-axis direction) and the other side (−y-axis direction) of the battery cell stack **120** correspond to the direction in which the electrode lead **111** of the battery cells **110** protrudes. That is, as described above, any one busbar frame **300** may be located between any one of the end plates **400** and the battery cell stack **120**.

(31) A lead slit may be formed at the busbar frame **300**, and the electrode leads **111** can be bent after passing through the lead slit, and joined to the busbar **310** or the terminal busbar **320**. As long as physical and electrical connection is possible, the joining method is not particularly limited, and weld-joining can be performed as an example. The electrode leads **111** can be electrically connected via the busbar **310**.

(32) Meanwhile, a portion of the terminal busbar **320** is exposed to the outside of the battery module **100**. Specifically, an opening **410H** is formed in the end plate **400**, and a portion of the terminal busbar **320** is exposed through the opening **410H**.

(33) A portion of the terminal bus bar **320** exposed to the outside of the battery module **100** can be connected to another battery module or a BDU (battery disconnect unit) or the like to form a high voltage (HV) connection. Here, the HV connection is a connection that plays a role of a power source for supplying electric power, and refers to a connection between battery cells or a connection between battery modules. That is, the battery module **100** may be electrically connected to other adjacent battery modules via the terminal bus bar **320**.

(34) Next, the sensing assembly **500** according to the present embodiment will be described in detail with reference to FIGS. 4 to 7. FIGS. 5(a) and (b) are perspective views showing a module connector according to an embodiment of the present disclosure. FIG. 6 is a perspective view showing a state where the module connector according to an embodiment of the present disclosure is disassembled. FIG. 7 is a perspective view showing an end plate and an insulation cover according to an embodiment of the present disclosure.

(35) Referring to FIGS. 4 to 7, the module connector **510** is configured to transmit/receive signals to and from an external control device. A connector opening **420H** is formed in the end plate **400**, and the module connector **510** is exposed to the outside of the battery module **100** through this connector opening **420H**, and the module connector **510** can be connected to an external BMS.

(36) A portion in which the module connector **510** can be seated may be provided at an upper portion of the busbar frame **300**. That is, the module connector **510** as well as the busbar **310** and the terminal busbar **320** may be mounted on the busbar frame **300**.

(37) The connection cable **520** is a configuration that connects the module connector **510** and the joining member **530**, and may be a flexible printed circuit board (FPCB) or a flexible flat cable (FFC). The module connector **510** and the connection cable **520** may be located at the upper end of the busbar frame **300**.

(38) The joining member **530** may be connected to one end of the connection cable **520**, and the joining member **530** can electrically connect the connection cable **520** and the electrode lead **111** of the battery cells **110**. Specifically, the electrode lead **111** may be joined to one portion of the busbar **310**, and the joining member **530** may be joined to another portion of the busbar **310**. A weld joining can be utilized for the joining.

(39) Voltage information on the plurality of battery cells **110** passes through the joining member **530**, the connection cable **520**, and the module connector **510** in sequence, and is transmitted to an external BMS (Battery Management System).

(40) Although not specifically shown in the figure, a temperature sensor may be provided on a part of the connection cable **520**. Temperature information inside the battery module **100** through such a temperature sensor may pass through a connection cable **520** and a module connector **510** in sequence and may be transmitted to an external BMS (Battery Management System).

(41) In this manner, the sensing assembly **500** may detect and control phenomena such as overvoltage, overcurrent, and overheating of each battery cell **110**.

(42) Meanwhile, as described above, the battery module **100** according to the present embodiment may include an insulation cover **600** located between the busbar frame **300** and the end plate **400**. The insulation cover **600** is preferably formed by a plurality of numbers. Insulation cover **600** may include a material having electrical insulation, and interrupts the busbar **310** or the terminal busbar **320** from contacting with the end plate **400**.

(43) Referring to FIGS. 3 and 7 together, a connector opening hole **620H** may be formed in a portion of the insulation cover **600** corresponding to the connector opening **420H** of the end plate **400**. Also, an opening hole **610H** may be formed in a portion of the insulation cover **600** corresponding to the opening **410H** of the end plate **400**.

(44) The module connector **510** according to the present embodiment may be exposed to the outside of the battery module **100** through the connector opening hole **620H** of the insulation cover **600** and the connector opening **420H** of the end plate **400**. Further, the terminal busbar **320** may be exposed to the outside of the battery module **100** through the opening **610H** of the insulation cover **600** and the opening **410H** of the end plate **400**.

(45) Meanwhile, the terminal busbar **320** is configured by a plurality of numbers, one of which may function as a positive electrode terminal of the battery module **100**, and the other one may function as a negative electrode terminal of the battery module **100**. Thereby, each of the opening **410H** and the opening hole **610H** may be configured by a plurality of numbers.

(46) Referring to FIGS. 5 and 6, the module connector **510** according to the present embodiment includes a body part **511** and an interrupting part **512** surrounding the outer peripheral surface of the body part **511**.

(47) The body part **511** is a configuration into which a connection member (not shown) connected to an external BMS is inserted, and can be connected to the connection cable **520** through a pin **511P** provided on the lower surface. However, the case where the pin **511P** is formed is one example, and other module connectors in which the pin **511P** is not formed are also applicable.

(48) The interrupting part **512** is a structure separate from the body part **511**, and is not a structure fixed to the body part **511**. That is, the insertion hole **512H** may be formed in the interrupting part **512**, and the body part **511** may be inserted into the insertion hole **512H**. Therefore, the interrupting part **512** is movable along the outer peripheral surface of the body part **511**.

(49) In the battery module **100** provided with the module connector **510**, the interrupting part **512** is movable toward the connector opening **420H** of the end plate **400**.

(50) Next, the function of the module connector according to an embodiment of the present

disclosure will be described in detail with reference to FIGS. 5 to 9.

(51) FIGS. 8 and 9 are partial cross-sectional views showing a cross-section taken along the cutting line A-A' of FIG. 1. Particularly, FIG. 8 is a cross-sectional view showing a battery module in a normal time, and FIG. 9 is a cross-sectional view showing a state in which a thermal runaway phenomenon occurs in a battery module.

(52) Referring to FIGS. 5 to 9, the interrupting part 512 according to the present embodiment moves to interrupt the connector opening 420H upon the rise of internal pressure of the module frame 200. The internal pressure of the module frame 200 means the air pressure of the inner space of the module frame 200 in which the battery cell stack 120 is housed. The internal pressure rise of the module frame 200 means that a large amount of gas is generated in the inner space of the module frame 200.

(53) Specifically, the module connector 510 may be located inside the connector opening 420H, and the interrupting part 512 that is not fixed to the body part 511 is movable toward the connector opening 420H of the module connector 510. The interrupting part 512 may move toward the inner side of the connector opening 420H upon the rise of internal pressure of the module frame 200.

(54) In particular, the connector opening 420H may be opened in an upward direction. As shown in FIG. 8, the interrupting part 512 of the module connector 510 is spaced apart from the connector opening 420H in a normal time. As shown in FIG. 9, when the internal pressure of the module frame 200 rises due to a thermal runaway phenomenon, or the like, the interrupting part 512 of the module connector 510 may move in an upward direction to close the connector opening 420H.

(55) A thermal runaway phenomenon may occur in the battery cells 110 inside the battery module 100. One example of a thermal runaway phenomenon is as follows. The physical, thermal, and electrical damage to the battery cell 110 including overcharging may occur, thereby increasing the internal pressure of the battery cell 110. When the fusion strength limit value of the pouch-type cell case of the battery cell 110 is exceeded, high-temperature heat, venting gas, and the like generated in the battery cell 110 may be ejected to the outside of the battery cell 110.

(56) The thermal runaway phenomenon generated in any one battery cell can be extended to other battery cells by the convection effect, and eventually, high-temperature gas and flame may be generated inside the battery module 100. The generated high-temperature gas and flame may be ejected to the outside through the connector opening 420H of the end plate 400, and it may damage adjacent battery modules or cause another thermal runaway phenomenon of the adjacent battery module. Ultimately, the thermal runaway phenomenon may propagate to a plurality of battery modules, which may cause explosion and ignition of the battery pack.

(57) Thus, the battery module 100 according to the present embodiment is configured such that the interrupting part 512 can move in accordance with an increase in the internal pressure of the module frame 200. As shown in FIG. 9, when a thermal runaway occurs, gas is ejected from the battery cells, and the internal pressure of the module frame 200 is increased. Due to this increased internal pressure P, the interrupting part 512 moves toward the connector opening 420H, and eventually, the gap of the connector opening 420H may be closed.

(58) Therefore, it is possible to suppress the high temperature gas or flame from being ejected to the outside of the battery module 100. That is, the gap through which high-temperature gas and flame may be ejected may be offset by increasing the internal pressure of the battery module 100. Ultimately, it is possible to prevent the thermal runaway phenomenon generated in one battery module from propagating to other battery module.

(59) As described above, a connector opening hole 620H may be formed in a portion of the insulation cover 600 corresponding to the connector opening 420H. The connector opening hole 620H may be opened in an upward direction. In this case, the inner side of the connector opening hole 620H may be located closer to the module connector 510 than the inner side of the connector opening 420H to ensure insulation. The interrupting part 512 may be in close contact with the inner side of the connector opening hole 620H upon the rise of internal pressure of the module frame

200.

(60) In other words, the interrupting part **512** may be spaced apart from the connector opening hole **620H** in a normal time, and when the internal pressure of the module frame **200** rises due to the thermal runaway phenomenon, the interrupting part **512** moves in an upward direction and is in close contact with the inner side of the connector opening hole **620H** to close the gap between the body part **511** and the connector opening hole **620H**. By the operating principle of the module connector **510**, it is possible to prevent high-temperature gas or flame from being ejected to the outside of the battery module **100**.

(61) Even though the terms indicating directions such as front, rear, left, right, upper and lower directions are used herein, it is obvious to those skilled in the art that these merely represent relative positions for convenience in explanation and may vary depending on a position of an observer, a position of an object, or the like.

(62) The one or more battery modules according to the present embodiment as described above can be mounted together with various control and protection systems such as a battery management system (BMS) and a cooling system to form a battery pack.

(63) The battery module or the battery pack can be applied to various devices. Specifically, these devices can be applied to vehicle means 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 secondary battery.

(64) 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 can be designed by those skilled in the art using the basic concepts of the present disclosure defined in the following claims, which also falls within the spirit and scope of the present disclosure.

DESCRIPTION OF REFERENCE NUMERALS

(65) **100**: battery module **120**: battery cell stack **200**: module frame **300**: busbar frame **400**: end plate **420H**: connector opening **510**: module connector

Claims

1. A battery module comprising: a battery cell stack comprising a plurality of stacked battery cells; a module frame for housing the battery cell stack; end plates located on respective sides of the battery cell stack; a connector opening formed in a first end plate of the end plates; and a module connector exposed through the connector opening, wherein the module connector comprises a body part and an interrupting part surrounding an outer peripheral surface of the body part, wherein the interrupting part is movable toward the connector opening, and wherein the interrupting part moves toward an inner side of the connector opening upon a rise of internal pressure of the module frame.
2. The battery module according to claim 1, wherein the module connector is located inside the connector opening.
3. The battery module according to claim 2, wherein an insertion hole is formed in the interrupting part, and the body part is inserted into the insertion hole.
4. The battery module according to claim 1, wherein the interrupting part is movable along the outer peripheral surface of the body part.
5. The battery module according to claim 1, further comprising a busbar frame located between the battery cell stack and the first end plate.
6. A battery module comprising: a battery cell stack comprising a plurality of stacked battery cells; a module frame for housing the battery cell stack; end plates located on respective sides of the battery cell stack; a connector opening formed in a first end plate of the end plates; a module connector exposed through the connector opening; a busbar frame located between the battery cell stack and the first end plate; an insulation cover located between the busbar frame and the first end

- plate; and a connector opening hole in a portion of the insulation cover corresponding to the connector opening, wherein the module connector comprises a body part and an interrupting part surrounding an outer peripheral surface of the body part, and wherein the interrupting part is movable toward the connector opening.
7. The battery module according to claim 6, wherein the interrupting part is in contact with an inner side of the connector opening hole upon a rise of internal pressure of the module frame.
8. The battery module according to claim 6, wherein the connector opening hole is opened in an upward direction.
9. The battery module according to claim 6, wherein the interrupting part is spaced apart from the connector opening hole in a first position, and wherein the interrupting part moves in an upward direction to a second position to close a gap between the body part and the connector opening hole upon a rise of internal pressure of the module frame.
10. The battery module according to claim 9, wherein an inner side of the connector opening hole is located closer to the module connector than the inner side of the connector opening.
11. The battery module according to claim 1, further comprising a connection cable connected to the module connector, and a joining member for connecting the connection cable and an electrode lead of a battery cell of the battery cell stack.
12. The battery module according to claim 11, wherein a temperature sensor is provided on a part of the connection cable.
13. The battery module according to claim 1, wherein the connector opening is opened in an upward direction.
14. The battery module according to claim 1, wherein the connector opening has a bottom edge, and wherein the interrupting part has a first position spaced from the bottom edge of the connector opening and a second position having a top surface of the interrupting part contacting the bottom edge of the connector opening.
15. A battery pack comprising the battery module as set forth in claim 1.
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