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Terminal block protective cover and battery module including the same

Abstract

The battery module includes: a battery cell stack in which a plurality of battery cells are stacked; a terminal block electrically connected to the battery cell stack; a housing accommodating the battery cell stack in a form of an opened side surface on which the terminal block is formed; an insulating cover covering an opening of the housing, a terminal block through hole exposing the terminal block to the outside being formed on one side of the insulating cover; and a terminal block protective cover accommodating the terminal block exposed to the outside. A portion of the terminal block protective cover being melted in a situation of a certain temperature or higher to cover and insulate an outer surface of the terminal block, thereby insulating the terminal block and preventing the short circuit in a thermal runaway situation.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

(1) This application claims priority to Korean Patent Application No. 10-2020-0127070 filed Sep. 29, 2020, the disclosure of which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

(2) The following disclosure relates to a terminal block protective cover and a battery module

including the same, and more particularly, to a terminal block protective cover capable of preventing a short circuit in a thermal runaway situation and a battery module including the same.

Description of Related

(3) Among secondary batteries, in a battery pack used in a battery vehicle, one or more battery modules is constituted by connecting a plurality of battery cells in series or in parallel to obtain high output as illustrated in FIG. 1, and the respective battery modules are electrically connected through a bus bar. A pair of terminal blocks having different poles is provided in the battery module, and both ends of the bus bar are respectively connected to terminal blocks of different battery modules, so that the respective battery modules are electrically connected. At this time, since the terminal block and both ends of the bus bar are exposed to the outside and there is a risk of electric shock, the terminal block portion of the battery module is provided in a structure for preventing a touch by additionally mounting a terminal block protective cover made of a plastic material.

(4) When a temperature of the battery pack increases due to internal or external causes of the battery pack, the increase in temperature causes an increase in current, a thermal runaway, which is a chain reaction in which the increase in current causes the increase in temperature of the battery pack again, may occur, and in a thermal runaway situation, the temperature of the battery pack becomes high enough to approach 600 degrees Celsius. At this time, metals inside the battery pack are affected by a high-temperature environment to generate metal particles, and the generated metal particles are sprayed in all directions inside the battery pack. On the other hand, the terminal block protective cover made of the plastic material is also burned and melted in the high-temperature environment, so that contact portions between both ends of the bus bar and the terminal block are exposed to the outside, and when the metal particles are introduced into the exposed contact portions, a short may occur, which may cause a short circuit and a fire.

(5) Therefore, it is necessary to develop a terminal block protective cover and a battery module that can protect the contact portion between the terminal block and the bus bar even in the thermal runaway situation.

RELATED ART DOCUMENT

Patent Document

(6) (Patent Document 1) Korea Patent Laid-Open Publication No. 10-2016-0107583 (“cell cover for secondary battery and battery module including the same”)

SUMMARY OF THE INVENTION

(7) An embodiment of the present disclosure is to provide a terminal block protective cover and a battery module capable of preventing a short circuit phenomenon by protecting a contact portion between a terminal block and a bus bar in a thermal runaway situation.

(8) Further, an embodiment of the present disclosure is to provide a terminal block protective cover and battery module capable of suppressing exposure of a bus bar to the outside in a thermal runaway situation.

(9) Further, an embodiment of the present disclosure is to provide a battery module having a structure in which a terminal block protective cover is more easily mounted.

(10) Further, an embodiment of the present disclosure is to provide a battery module having a structure capable of insulating a fastening portion of an end plate.

(11) Meanwhile, an object of the present disclosure is not limited to the above-mentioned objects. That is, other objects that are not mentioned may be obviously understood from the following specification.

(12) In one general aspect, a battery module includes: a battery cell stack in which a plurality of battery cells are stacked; a terminal block electrically connected to the battery cell stack; a housing accommodating the battery cell stack; an insulating cover covering an opening of the housing and having a terminal block through hole exposing the terminal block to an outside and being formed on one side of the insulating cover; and a terminal block protective cover accommodating the

terminal block exposed to the outside, the terminal block protective cover being melted at a predetermined temperature and insulating the terminal block by covering the terminal block.

(13) The terminal block protective cover may include a coupling protrusion extending in one direction, a coupling slot may be formed in the insulating cover, and the coupling protrusion may be coupled to the coupling slot by sliding on the coupling slot.

(14) The insulating cover may further include shielding plates formed on one side and the other side of the terminal block exposed to the outside through the terminal block through hole.

(15) The terminal block protective cover may further include a melting portion accommodated in the shielding plates and a detachable protrusion protruding outwardly from one side of the melting portion, and the shielding plates further comprising a detachable hole into which the detachable protrusion is inserted.

(16) The battery module may further include a protective cover coupled to the outside of the insulating cover, the protective cover being formed with a cut-out hole to expose the terminal block to the outside through the cut-out hole at the time of coupling and being formed with a bolt hole for inserting a bolt for coupling with the insulating cover, wherein the terminal block protective cover includes: a terminal block protective portion accommodating the terminal block, and a bolt hole cover portion extending from the terminal block protective portion and covering an upper end of the bolt hole.

(17) A bolt insulating member inserted into the bolt hole, made of an insulating material, and surrounding an outer periphery of a bolt inserted into the bolt hole may be inserted into the protective cover.

(18) The terminal block protective cover may include an outer shape portion accommodating the terminal block, and a melting portion protruding from a surface of the outer shape portion opposite to an upper surface of the terminal block, and the melting portion may be melted at a first temperature, and the outer shape portion may be melted at a second temperature, which is a temperature higher than the first temperature.

(19) The outer shape portion and the melting portion may be made of different materials.

(20) The melting portion may have a thickness thinner than a thickness of the outer shape portion.

(21) In another general aspect, a battery pack including a terminal block protective cover includes: a plurality of battery modules; and a bus bar having both ends and electrically connecting the battery modules by connecting the both ends to terminal blocks of the battery modules.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

- (1) FIG. 1 is a perspective view illustrating a state in which the conventional battery modules are connected to each other through a bus bar;
- (2) FIG. 2 is a perspective view of a battery module according to an embodiment of the present disclosure;
- (3) FIG. 3 is an exploded perspective view of the battery module according to an embodiment of the present disclosure;
- (4) FIG. 4 is a perspective view of an insulating cover according to an embodiment of the present disclosure;
- (5) FIG. 5 is an assembly view of the battery module according to an embodiment of the present disclosure;
- (6) FIG. 6 is a perspective view of a terminal block protective cover according to an embodiment of the present disclosure;
- (7) FIG. 7 is a rear bottom perspective view of the terminal block protective cover according to an embodiment of the present disclosure;

(8) FIG. 8 is a bottom view of the terminal block protective cover according to an embodiment of the present disclosure;

(9) FIG. 9 is a cross-sectional view taken along line A-A' of FIG. 2; and

(10) FIG. 10 is a cross-sectional view illustrating a state in which a melting portion is melted.

DESCRIPTION OF THE INVENTION

(11) Prior to describing the technical spirit of the present disclosure in more detail using the accompanying drawings, the terms or words used in the present specification and claims should not be construed as being limited to conventional or dictionary meanings, and should be interpreted as a meaning and concept consistent with the technical spirit of the present disclosure based on the principle that the inventor may appropriately define the concept of a term in order to explain the disclosure in the best way.

(12) Therefore, since the embodiments described in the present specification and the configurations shown in the drawings are only the most preferred embodiment of the present disclosure and do not represent all of the technical spirits of the present disclosure, it should be understood that there may be various modifications that may be substituted for them at the time of filing of the present application.

(13) Hereinafter, a technical spirit of the present disclosure will be described in more detail with reference to the accompanying drawings. The accompanying drawings are only examples shown to describe the technical spirit of the present disclosure in more detail, and therefore, the technical spirit of the present disclosure is not limited to the form of the accompanying drawings.

(14) FIG. 2 is a perspective view of a battery module including a terminal block protective cover according to an embodiment of the present disclosure. A battery pack including a terminal block protective cover according to an embodiment of the present disclosure includes a structure in which a plurality of battery modules **10** are accommodated in a battery pack case, and the battery modules **10** disposed to be adjacent to each other are electrically connected to each other by connecting one end of a bus bar **20** to a terminal block provided on each battery module **10**, as illustrated in FIG. 2. The battery module **10** including the terminal block protective cover according to an embodiment of the present disclosure mainly includes a battery cell stack, a bus bar frame **100**, a terminal block **200**, a housing **300**, an insulating cover **400**, a protective cover **500**, and a terminal block protective cover **600**.

(15) FIG. 3 is an exploded perspective view of the battery module including a terminal block protective cover according to an embodiment of the present disclosure. A detailed configuration of the battery module **10** including a terminal block protective cover according to an embodiment of the present disclosure will be described with reference to FIG. 3.

(16) The battery cell stack has a structure in which a plurality of battery cells are mutually stacked in one direction so that the plurality of battery cells may be electrically connected to each other. In this case, the battery cell may be formed of a pouch-type secondary battery. The battery cell may include an electrode assembly, a battery case, and an electrode lead **110**. Here, the electrode assembly may include a cathode plate, an anode plate, and a separator. A pair of electrode leads **110** may be provided in one battery cell, and may be electrically connected to the electrode assembly.

(17) The bus bar frame **100** serves to electrically connect the electrode leads **110** provided in the plurality of battery cells. A pair of bus bar frames **100** is provided, and each of the bus bar frames **100** is coupled to cover one side and the other side of the battery cell stack.

(18) The terminal block **200** is provided on one side of the bus bar frame **100**. The terminal block **200** is electrically connected to the battery cell stack through at least one of the electrode leads **110**. The terminal block **200** is formed of a copper or aluminum material.

(19) The housing **300** has a rigidity of a certain level or more. The housing **300** is formed to surround an outer surface of the battery cell stack to which the bus bar frame **100** is coupled except for both sides to which the bus bar frame **100** is coupled, so that the battery cell stack is accommodated.

(20) The insulating cover **400** is formed to cover the outside of the bus bar frame **100**. The insulating cover **400** is made of an insulating material, for example, a plastic material to insulate the outside of the bus bar frame **100**. At this time, a terminal block through hole **401** exposing the terminal block **200** to the outside is formed on one side of the insulating cover **400**.

(21) It will be described in more detail through a perspective view of the insulating cover of FIG. **4**. The insulating cover **400** is further provided with shielding plates **410** on both sides of the terminal block through hole **401**. That is, the terminal block **200** exposed to the outside through the terminal block through hole **401** is accommodated in a pair of shielding plates **410** and serves to primarily prevent metal particles that may occur in a thermal runaway situation from being introduced into the terminal block **200**. In this case, the shielding plates **410** are preferably formed to be sufficiently longer in a vertical direction than a range in which the terminal block **200** is exposed. The shielding plates **410** may be further formed with a detachable hole **411** that is in contact with the terminal block through hole **401** and formed to be connected to the terminal block through hole **401**. The detachable hole **411** is a configuration into which a detachable protrusion **616** of a terminal block protective cover **600** to be described later is inserted. A description thereof will be provided later in more detail when describing a shape of the terminal block protective cover.

(22) In addition, the shielding plates **410** may be formed with a coupling slot **412** elongated in a vertical direction along a front end surface of the shielding plates **410** and a coupling slot **412** along an upper surface of the shielding plates **410**. The coupling slot **412** is configured to enable sliding coupling of the terminal block protective cover **600** to be described later. The coupling slot **412** is configured to more firmly cover the terminal block when the terminal block protective cover **600** is coupled. The coupling slot **412** may also be formed in a section between the pair of shielding plates **410** among the upper surfaces of the insulating cover **400**. The coupling slots **412** formed on each of the shielding plates **410** and the upper surface of the insulating cover **400** may be formed to be in contact with each other and connected to each other.

(23) In the section between the shielding plates **410**, a support **420** formed parallel to the terminal block is further formed below the terminal block **200** to connect the pair of shielding plates **410** to each other. The support **420** serves to maintain a constant distance between the two shielding plates **410** and to supplement a mechanical rigidity of the shielding plates **410**. For effective insulation, the support **420** may be preferably formed to be in contact with a lower surface of the terminal block **200**.

(24) FIG. **5** is an assembly view of the battery module including the terminal block protective cover according to an embodiment of the present disclosure.

(25) As illustrated in FIGS. **3** and **5**, the protective cover **500** is configured to be coupled to the outside of the insulating cover **400** to provide a rigidity of a certain level or more to the outside of the insulating cover **400**. Such a protective cover **500** is made of an aluminum material in order to provide a rigidity of a certain level or more. A cut-out hole **510** is formed on one side of the protective cover **500**. The pair of shielding plates **410** formed on the insulating cover **400** and the terminal block **200** are exposed to the outside of the protective cover **500** through the cut-out hole **510**.

(26) Meanwhile, the protective cover **500** is provided with at least one pair of bolt holes **520**. A separately provided bolt penetrates through the bolt hole **520** and is fastened to a fastening portion (not illustrated) provided on one side of the housing to fix the protective cover. In this case, the bolt hole **520** may be further provided with a bolt insulating member **521** made of an insulating material and inserted into the bolt hole **520** to surround an outer periphery of the bolt and an upper surface of the bolt hole **520** in a predetermined section. This is to prevent current from flowing to the protective cover **500** by insulating the bolt and the protective cover **500** from each other when the bolt made of a metal material is in contact with and electrically connected to the bus bar frame, terminal block, electrode lead, and the like in a process of fastening.

(27) FIG. **6** is a perspective view of a terminal block protective cover according to an embodiment

of the present disclosure, FIG. 1 is a rear bottom perspective view of the terminal block protective cover according to an embodiment of the present disclosure, and FIG. 8 is a bottom view of the terminal block protective cover according to an embodiment of the present disclosure.

(28) As illustrated in FIGS. 5 to 8, the terminal block protective cover **600** is coupled to the insulating cover **400** exposed to the outside through the cut-out hole **510** to accommodate the terminal block **200**. The terminal block protective cover **600** is made of an insulating material having high temperature and heat resistance, and may be made of, for example, ethylene propylene diene monomer (EPDM), MICA, glass tape, glass wool, aerogel, urethane, or thermo plastic elastomer (TPE). The terminal block protective cover **600** is most preferably made of a TPE material. The terminal block protective cover **600** is melted in a situation of a certain temperature or higher to cover and insulate the outer surface of the terminal block.

(29) A shape of the terminal block protective cover **600** will be described in more detail. The terminal block protective cover **600** is generally divided into a terminal block protective portion **610** accommodating the terminal block **200**, and a bolt hole cover portion **630** extending from the terminal block protective portion **610** and covering an upper end of the bolt hole **520** located on the side closest to the terminal block **200**.

(30) First, the terminal block protective portion **610** will be described. The terminal block protective portion **610** includes an outer shape portion **611**, a coupling protrusion **617**, and a melting portion **613** formed of a rib and melted at a certain temperature or higher.

(31) The outer shape portion **611** forms the outermost side of the terminal block protective portion **610** while at the same time secondarily preventing metal particles, which may occur in a thermal runaway situation, from being introduced into the terminal block **200**. The outer shape portion **611** formed to accommodate the terminal block is formed in a bucket shape in which an opening is disposed to face downward. When the outer shape portion **611** is coupled to the insulating cover **400**, a lower end portion thereof is accommodated in the coupling slot **412** formed on the upper surfaces of the two shielding plates **410** of the insulating cover **400**. At this time, it is preferable that the lower end of the outer shape portion **611** is formed to correspond to the coupling slot **412** so as to be fitted into the coupling slot **412**. A rear side surface of the lower end of the outer shape portion **611**, that is, a surface on a side disposed to face an outer side surface of the insulating cover **400**, is accommodated in the coupling slot **412** formed in the section between the pair of shielding plates **410** among the upper surfaces of the insulating cover **400**.

(32) On the other hand, a surface on the front side of the outer shape portion is formed to extend by a predetermined length downward without a separate coupling element to at least partially close the section between the shielding plates **410**. Here, a lower end of the surface on the front side of the outer shape portion is located above the terminal block **200**, so that a predetermined gap is formed between the lower end of the surface on the front side of the outer shape portion and the support **420**. The gap is a gap for the other end of the bus bar connected to the terminal block **200** to be exposed to the outside of the terminal block protective cover **600**, but in a thermal runaway situation, there is a concern that the occurred metal particles may be introduced into the terminal block **200** through the gap.

(33) In order to prevent such a problem, a guide plate **612** as illustrated in FIG. 6 is additionally formed at an end portion on the front side of the outer shape portion. The guide plate **612** is formed to externally extend from the end portion of the front side of the outer shape portion to be inclined downward, and serves to guide the bus bar exposed through the gap downward and at the same time cover the gap. An angle of the guide plate **612** is formed from 10 degrees to 50 degrees, preferably from 10 degrees to 45 degrees, and most preferably from 10 degrees to 30 degrees with respect to the front surface of the outer shape portion.

(34) FIG. 9 is a cross-sectional view taken along line A-A' of FIG. 2.

(35) Referring to FIGS. 5, 7, and 9, a pair of coupling protrusions **617** extending downwardly from a front side surface of the outer shape portion are provided. Each coupling protrusion **617** is formed

to be inserted into the coupling slot **412** formed on the front side surface of the shielding plate **410** when coupled to the insulating cover **400**. That is, the terminal block protective cover **600** may be coupled simply through sliding through the configuration of the coupling slots **412** and the coupling protrusions **617**.

(36) The melting portion **613** includes a first melting portion **614** protruding from a portion opposite to the upper surface of the terminal block inside the outer shape portion **611**, and a second melting portion **615** protruding from an inner upper surface of the outer shape portion **611** and in contact with an inner side surface of the shielding plates **410**.

(37) In addition to the shielding plates and the outer shape portion **611**, the second melting portion **615** thirdly prevents the metal particles that may occur in a thermal runaway situation from being introduced into the terminal block **200**. In addition, a detachable protrusion **616** in the form of a wide top and narrow bottom is outwardly formed on one side of a lower end of the second melting portion **615**, and is inserted into the detachable hole **411** of the shielding plates **410** to prevent the terminal block protective cover **600** from being easily separated from the insulating cover **400**.

(38) FIG. **10** illustrates a cross section of FIG. **9** in a state in which the melting portion is melted. As an example, the melting portion **613** is melted at a first temperature, and the outer shape portion **611** is melted at a second temperature that is higher than the first temperature. To this end, the melting portion **613** may be first melted by forming the outer shape portion **611** and the melting portion **613** of different materials, or forming a thickness of the melting portion **613** to be thinner than a thickness of the outer shape portion **611** even if the outer shape portion **611** and the melting portion **613** are formed of the same material. As described above, if the melting portion **613** is formed to be melted before the outer shape portion **611**, the outer shape portion **611** in a situation of the first temperature allows the melted melting portion **613** to first insulate the upper surface of the terminal block **200** inside the outer shape portion **611** as illustrated in FIG. **10**. This has an effect that even if the melted outer shape portion **611** flows to the outside of the shielding plates **410** and disappears at the time of melting the outer shape portion **611**, the first melted melting portion **613** protects the terminal block **200** to prevent the metal particles from being in contact with the terminal block **200**. Preferably, the melting portion **613** is appropriately set to have a melting point of about 160 degrees Celsius.

(39) As described above, the bolt hole cover portion **630** is formed to extend from the terminal block protective portion **610** to cover the upper end of the bolt hole **520** located on the side closest to the terminal block **200**. A bolt groove **633** capable of accommodating a head portion of the bolt inserted into the bolt hole **520** is formed in a portion of the lower surface of the bolt hole cover portion **630** opposite to the bolt hole **520**. For stronger insulation, a plate-shaped extension **631** extending downward along a periphery of a lower end of the bolt hole cover portion **630** may be further formed around the lower end of the bolt hole cover portion **630**.

(40) The battery module including the terminal block protective cover for preventing the short circuit of the present disclosure having such a configuration may insulate the terminal block in a thermal runaway situation through the configuration of the terminal block protective cover.

(41) In particular, in a high-temperature situation, the outer shape portion may effectively insulate the terminal block by limiting an accommodating position of the melting portion, which is melted before the outer shape portion and is in a liquid state, to the upper surface of the terminal block.

(42) In addition, the assembly operation of the terminal block protective cover may be more easily performed through the configuration of the coupling protrusion and the coupling slot.

(43) In addition, it is possible to reduce the problem that the metal particles generated in a thermal runaway situation are introduced into the terminal block, through the configuration of the shielding plate.

(44) In addition, it is possible to prevent the terminal block protective cover from being easily detached from its original position through the configuration of the detachable protrusion and the detachable hole.

(45) In addition, it is possible to insulate the bolt hole through the bolt hole cover portion and the bolt insulating member.

(46) The present disclosure is not to be construed as being limited to the above-mentioned embodiment. The present disclosure may be applied to various fields and may be variously modified by those skilled in the art without departing from the scope of the present disclosure claimed in the claims. Therefore, these improvements and changes will fall within the scope of protection of the present disclosure as long as it is apparent to those skilled in the art.

(47) TABLE-US-00001 Detailed Description of Main Elements 10: battery module 20: bus bar 100: bus bar frame 200: terminal block 300: housing 400: insulating cover 410: shielding plates 411: detachable hole 412: coupling slot 420: support 500: protective cover 510: cut-out hole 520: bolt hole 521: bolt insulating member 600: terminal block protective 610: terminal block protective cover portion 611: outer shape portion 612: guide pin 613: melting portion 614: first melting portion 615: second melting portion 616: detachable protrusion 617: coupling protrusion 630: bolt hole cover portion 631: extension 633: bolt groove

Claims

1. A battery module comprising: a battery cell stack in which a plurality of battery cells are stacked; a terminal block electrically connected to the battery cell stack; a housing accommodating the battery cell stack; an insulating cover covering an opening of the housing and having a terminal block through hole exposing the terminal block to an outside of the housing and being formed on one side of the insulating cover; and a terminal block protective cover accommodating the terminal block exposed to the outside of the housing, a melting portion of the terminal block protective cover being melted at a predetermined temperature and insulating the terminal block exposed to the outside of the housing by covering the terminal block, wherein, a material of the terminal block protective cover is selected from at least one of ethylene propylene diene monomer (EPDM), mica, glass tape, glass wool, aerogel, urethane, or thermo plastic elastomer (TPE), wherein the insulating cover further comprises a pair of shielding plates formed on both sides of the terminal block through hole, wherein the terminal block is exposed through the terminal block through hole, wherein, in a section between the shielding plates, a support formed parallel to the terminal block is further formed below the terminal block to connect the pair of shielding plates, and wherein the support is formed to be in contact with a lower surface of the terminal block.
2. The battery module of claim 1, wherein the terminal block protective cover comprises a coupling protrusion extending in one direction, a coupling slot is formed in the insulating cover, and the coupling protrusion is coupled to the coupling slot by sliding on the coupling slot.
3. The battery module of claim 1, wherein the melting portion of the terminal block protective cover is accommodated in the shielding plates and the terminal block protective cover further comprising a detachable protrusion protruding outwardly from one side of the melting portion, and the shielding plates further comprising a hole into which the detachable protrusion is inserted.
4. The battery module of claim 1, wherein the terminal block protective cover comprises an outer shape portion accommodating the terminal block, and the melting portion protruding from a surface of the outer shape portion opposite to an upper surface of the terminal block, and the melting portion is melted at a certain temperature or higher to cover and insulate the outer surface of the terminal block.
5. The battery module of claim 4, wherein the melting portion is melted at a first temperature which is the certain temperature, and the outer shape portion is melted at a second temperature, which is higher than the first temperature.
6. The battery module of claim 5, wherein the outer shape portion and the melting portion are made of different materials.
7. The battery module of claim 4, wherein a thickness of the melting portion is thinner than a

thickness of the outer shape portion.

8. The battery module of claim 1, further comprising a protective cover coupled to the outside of the insulating cover, the protective cover being formed with a cut-out hole to expose the terminal block to the outside through the cut-out hole for coupling and being formed with a bolt hole for inserting a bolt for coupling with the insulating cover, and the terminal block protective cover comprises: a terminal block protective portion accommodating the terminal block, and a bolt hole cover portion extending from the terminal block protective portion and covering an upper end of the bolt hole.

9. The battery module of claim 8, wherein a bolt insulating member inserted into the bolt hole, made of an insulating material, and surrounding an outer periphery of the bolt inserted into the bolt hole is inserted into the protective cover.

10. A battery pack comprising: a plurality of battery modules of claim 1; and a bus bar electrically connecting the battery modules by connecting to terminal blocks of the battery modules.
