TITLE OF INVENTION: BATTERY MODULE PROCESSING SYSTEM AND BATTERY MODULE PROCESSING METHOD

TECHNICAL FIELD

The present disclosure relates to a battery module processing system and a battery module processing method, and more particularly, to a battery module processing system and a battery module processing method that are capable of improving stability and reliability.

BACKGROUND ART

With the increasing interest in environmental protection, the development has been actively conducted on other types of vehicles, for example, hybrid vehicles (electric vehicle) or fuel cell vehicles in consideration of environmental-friendliness and fuel economy other than vehicles using combustion engines in the related art.

The hybrid or electric vehicle, which uses a motor as a driving source, requires a high voltage and a high electric current. Therefore, a battery module made by stacking a plurality of battery cells is used for the hybrid or electric vehicle.

In addition, heat is generated from the battery module (battery cell) when the battery module is used over a long period of time. If the heat generated from the battery module is not sufficiently removed (the battery module is not sufficiently cooled), the performance of the battery module deteriorates, or a risk of ignition or explosion increases. Therefore, a temperature of the battery module needs to be maintained to be an appropriate temperature.

In the related art, there has been proposed a configuration in which a cooling path is provided on an outer surface of a battery casing for accommodating a battery module, and the battery module is cooled by heat exchange between the battery module and a coolant flowing along the cooling path.

Meanwhile, a gap between the battery module and the battery casing is filled with a gap filler made of a thermally conductive material. If the gap between the battery module and the battery casing is not sufficiently filled with the gap filler (an empty space is formed in the gap between the battery module and the battery casing), there is a problem in that the efficiency of heat exchange between the battery module and the coolant deteriorates, and heat generated from the battery module (battery cell) is not sufficiently removed.

On the contrary, if the gap between the battery module and the battery casing is excessively filled with the gap filler (the gap filler is excessively applied so that the gap filler remains even after the gap between the battery module and the battery casing is filled with the gap filler), there is a problem in that manufacturing costs inevitably increase. Therefore, the gap between the battery module and the battery casing needs to be filled with an appropriate amount of gap filler corresponding to the gap.

However, in the related art, it is difficult to uniformly maintain the gap between the battery module and the battery casing because of manufacturing tolerance and assembling tolerance. Further, it is difficult to detect a size of the gap (height of the gap) between the battery module and the battery casing in a state in which the battery module is accommodated in the battery casing. For this reason, there is a problem in that it is difficult to optimize the amount of use of the gap filler (the application amount of the gap filler applied onto the battery casing) corresponding to the gap between the battery module and the battery casing.

Therefore, recently, various studies have been conducted to optimize the amount of use (application amount) of the gap filler corresponding to the gap between the battery module and the battery casing, but the study results are still insufficient. Accordingly, there is a need to develop a technology to optimize the amount of use (application amount) of the gap filler corresponding to the gap between the battery module and the battery casing.

SUMMARY

The present disclosure has been made in an effort to provide a battery module processing system and a battery module processing method that are capable of improving stability and reliability.

In particular, the present disclosure has been made in an effort to accurately detect a gap between the battery module and a battery casing and optimize the amount of use of gap filler with which the gap between the battery module and the battery casing is filled.

The present disclosure has also been made in an effort to ensure a heat exchange area between the battery module and the battery casing and improve efficiency and performance in cooling the battery module.

The present disclosure has also been made in an effort to reduce costs by minimizing the amount of unnecessary use of the gap filler.

The objects to be achieved by the embodiments are not limited to the above-mentioned objects, but also include objects or effects that may be understood from the solutions or embodiments described below.

An exemplary embodiment of the present disclosure provides a battery module processing method of processing a battery module including a battery casing having a cooling path through which a coolant moves, and a plurality of battery cells accommodated in the battery casing and configured to exchange heat with the coolant, the battery module processing method including: sensing a position of a target line defined on the battery cell; detecting a gap between the battery casing and the battery cell on the basis of a position of the target line relative to a preset reference line; and controlling a target application amount of a gap filler to be applied onto the battery casing on the basis of the gap so that the gap is filled with the gap filler.

This is to optimize the amount of use of the gap filler with which the gap between the battery module and the battery casing is filled.

That is, in the related art, it is difficult to uniformly maintain the gap between the battery module and the battery casing because of manufacturing tolerance and assembling tolerance. Further, it is difficult to detect a size of the gap (height of the gap) between the battery module and the battery casing in a state in which the battery module is accommodated in the battery casing. For this reason, there is a problem in that it is difficult to optimize the amount of use of the gap filler (the application amount of the gap filler applied onto the battery casing) corresponding to the gap between the battery module and the battery casing.

In contrast, in the embodiment of the present disclosure, the position of the target line defined on the battery cell is sensed, and the target application amount of the gap filler is controlled on the basis of the gap between the battery casing and the battery cell detected on the basis of the position of the target line relative to the reference line. Therefore, it is possible to obtain an advantageous effect of optimizing the application amount of the gap filler to be applied onto the battery casing to fill the gap between the battery cell and the battery casing even though a deviation of the gap between the battery cell and the battery casing occurs because of manufacturing tolerance and assembling tolerance.

Among other things, in the embodiment of the present disclosure, the gap between the battery module and the battery casing is sufficiently filled with the gap filler without an empty space. Therefore, it is possible to obtain an advantageous effect of effectively ensuring heat exchange efficiency between the battery module and the coolant, sufficiently removing heat generated from the battery module, and improving safety and reliability.

According to the exemplary embodiment of the present disclosure, the battery cell may include: a battery pouch; and a lead tab provided at a lateral side of the battery pouch and electrically connected to the battery pouch.

The target line may be defined at various positions in accordance with required conditions and design specifications.

According to the exemplary embodiment of the present disclosure, the target line may be defined on the lead tab. According to the exemplary embodiment of the present disclosure, the target line may be defined linearly along a lowermost end of the lead tab disposed adjacent to the battery casing.

For example, the battery module may include a busbar member having a guide slot through which the lead tab passes. The target line may be defined along a lowermost end of the lead tab disposed adjacent to the battery casing in a state in which the lead tab having passed through the guide slot of the busbar member is bent with respect to the battery pouch.

According to the exemplary embodiment of the present disclosure, in the sensing of the position of the target line, the position of the target line is sensed by capturing an image of the battery cell by using an image capturing part.

According to the exemplary embodiment of the present disclosure, the battery module processing method may include adjusting a position of the busbar member relative to the battery cell on the basis of a position of the target line relative to the reference line.

This is based on the fact that the gap between the battery cell and the battery casing is determined on the basis of the position (vertical position) of the busbar member relative to the battery casing. The gap between the battery cell and the battery casing may be optimized (minimized) by adjusting the position of the busbar member relative to the battery cell on the basis of a position deviation between the preset reference line (reference position information) and the target line. Therefore, it is possible to obtain an advantageous effect of reducing manufacturing costs by reducing the amount of use (target application amount) of the gap filler with which the gap is filled.

According to the exemplary embodiment of the present disclosure, in the detecting of the gap, the gap (the gap between the battery casing and the battery cell) may be detected on the basis of a relative position between the reference line and any one target line disposed to be farthest from the reference line among the plurality of target lines respectively defined on the plurality of battery cells.

As described above, the gap between the battery casing and the battery cell is predicted by comparing the reference line and the target line disposed to be farthest from the reference line. Therefore, it is possible to obtain an advantageous effect of preventing an empty space from being formed in the gap between the battery cell and the battery casing.

According to the exemplary embodiment of the present disclosure, the battery module processing method may include: measuring a spacing distance from a reference line parallel to an inner surface of the battery casing to a bottom portion of the battery room; and adjusting the target application amount of the gap filler on the basis of the spacing distance.

This is based on the fact that heights of the inner surfaces of the battery casings (the bottom portions of the battery rooms) are different from one another because of manufacturing tolerance of the battery casing. Because the target application amount of the gap filler is adjusted on the basis of the spacing distance from the reference line parallel to the inner surface of the battery casing to the bottom portion of the battery room, it is possible to obtain an advantageous effect of more accurately controlling the target application amount of the gap filler and minimizing the occurrence of an empty space in the gap between the battery cell and the battery casing.

Among other things, according to the embodiment of the present disclosure, the target application amount of the gap filler may be controlled in consideration of all the manufacturing tolerance and assembling tolerance of the battery cell and the manufacturing tolerance of the battery casing. Therefore, it is possible to obtain an advantageous effect of optimizing the target application amount of the gap filler for each condition and more effectively suppressing the occurrence of an empty space in the gap between the battery cell and the battery casing.

According to the exemplary embodiment of the present disclosure, in the adjusting of the target application amount of the gap filler, the target application amount of the gap filler may be adjusted on the basis of the longest spacing distance among the plurality of spacing distances corresponding to the plurality of battery rooms.

As described above, according to the embodiment of the present disclosure, the target application amount of the gap filler is adjusted on the basis of the spacing distance to the reference line from the bottom portion disposed to be farthest from the reference line. Therefore, it is possible to obtain an advantageous effect of preventing an empty space from being formed in the gap between the battery cell and the battery casing in all the battery rooms.

Another exemplary embodiment of the present disclosure provides a battery module processing system for processing a battery module including a battery casing having a cooling path through which a coolant moves, and a plurality of battery cells accommodated in the battery casing and configured to exchange heat with the coolant, the battery module processing system including: a sensor configured to sense a position a target line defined on the battery cell; a detector configured to detect a gap between the battery casing and the battery cell on the basis of a position of the target line relative to a preset reference line; and a controller configured to control a target application amount of a gap filler to be applied onto the battery casing on the basis of the gap so that the gap is filled with the gap filler.

According to the exemplary embodiment of the present disclosure, the battery cell may include: a battery pouch; and a lead tab provided at a lateral side of the battery pouch and electrically connected to the battery pouch, and the target line may be defined on the lead tab.

According to the exemplary embodiment of the present disclosure, the target line may be defined linearly along a lowermost end of the lead tab disposed adjacent to the battery casing.

According to the exemplary embodiment of the present disclosure, the battery module may include a busbar member having a guide slot through which the lead tab passes, and the sensor may sense the target line in a state in which the lead tab having passed through the guide slot is bent with respect to the battery pouch.

According to the exemplary embodiment of the present disclosure, the detector may detect the gap on the basis of a relative position between the reference line and any one target line disposed to be farthest from the reference line among the plurality of target lines respectively defined on the plurality of battery cells.

According to the exemplary embodiment of the present disclosure, a plurality of battery rooms may be defined on an inner surface of the battery casing, and the battery cells may be respectively and independently seated in the plurality of battery rooms.

According to the exemplary embodiment of the present disclosure, the battery module processing system may include: a measurement part configured to measure a spacing distance from a reference line parallel to an inner surface of the battery casing to a bottom portion of the battery room, in which the controller may adjust the target application amount of the gap filler on the basis of the spacing distance.

According to the exemplary embodiment of the present disclosure, the controller may adjust the target application amount of the gap filler on the basis of the longest spacing distance among the plurality of spacing distances corresponding to the plurality of battery rooms.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram for explaining a battery module processing method according to an embodiment of the present disclosure.

FIG. 2 is a view for explaining a battery module processing system according to the embodiment of the present disclosure.

FIG. 3 is a view for explaining a battery cell of the battery module processing system according to the embodiment of the present disclosure.

FIG. 4 is a view for explaining a busbar member of the battery module processing system according to the embodiment of the present disclosure.

FIG. 5 is a view for explaining a gap between a battery casing and the battery cell of the battery module processing system according to the embodiment of the present disclosure.

FIGS. 6 and 7 are views for explaining a lead tab of the battery cell of the battery module processing system according to the embodiment of the present disclosure.

FIG. 8 is a view for explaining a reference line and a target line of the battery module processing system according to the embodiment of the present disclosure.

FIG. 9 is a view for explaining the target line for each battery cell of the battery module processing system according to the embodiment of the present disclosure.

FIG. 10 is a view for explaining a measurement part of the battery module processing system according to the embodiment of the present disclosure.

FIG. 11 is a view for explaining a spacing distance for each battery room of the battery module processing system according to the embodiment of the present disclosure.

FIG. 12 is a block diagram illustrating a computing system that performs the battery module processing method according to the embodiment of the present disclosure.

DETAILED DESCRIPTION

Hereinafter, exemplary embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

However, the technical spirit of the present disclosure is not limited to some embodiments described herein but may be implemented in various different forms. One or more of the constituent elements in the embodiments may be selectively combined and substituted for use within the scope of the technical spirit of the present disclosure.

In addition, unless otherwise specifically and explicitly defined and stated, the terms (including technical and scientific terms) used in the embodiments of the present disclosure may be construed as the meaning which may be commonly understood by the person with ordinary skill in the art to which the present disclosure pertains. The meanings of the commonly used terms such as the terms defined in dictionaries may be interpreted in consideration of the contextual meanings of the related technology.

In addition, the terms used in the embodiments of the present disclosure are for explaining the embodiments, not for limiting the present disclosure.

In the present specification, unless particularly stated otherwise, a singular form may also include a plural form. The expression "at least one (or one or more) of A, B, and C" may include one or more of all combinations that can be made by combining A, B, and C.

In addition, the terms such as first, second, A, B, (a), and (b) may be used to describe constituent elements of the embodiments of the present disclosure.

These terms are used only for the purpose of discriminating one constituent element from another constituent element, and the nature, the sequences, or the orders of the constituent elements are not limited by the terms.

Further, when one constituent element is described as being 'connected', 'coupled', or 'attached' to another constituent element, one constituent element may be connected, coupled, or attached directly to another constituent element or connected, coupled, or attached to another constituent element through still another constituent element interposed therebetween.

In addition, the expression "one constituent element is provided or disposed above (on) or below (under) another constituent element" includes not only a case in which the two constituent elements are in direct contact with each other, but also a case in which one or more other constituent elements are provided or disposed between the two constituent elements. The expression "above (on) or below (under)" may mean a downward direction as well as an upward direction based on one constituent element.

With reference to FIGS. 1 to 11, an exemplary embodiment of the present disclosure provides a system 10 for processing a battery module 100 including a battery casing 110 having a cooling path 114 through which a coolant moves, and a plurality of battery cells 120 accommodated in the battery casing 110 and configured to exchange heat with the coolant. The battery module processing system 10 includes a sensor 200 configured to sense a position of a target line TL defined on the battery cell 120, a detector 300 configured to detect a gap BG between the battery casing 110 and the battery cell 120 based on a position of the target line TL relative to a preset reference line SL, and a controller 400 configured to control a target application amount of a gap filler (see 140 in FIG. 5) applied onto the battery casing 110 based on the gap BG so that the gap BG is filled with the gap filler.

The battery module 100 according to the embodiment of the present disclosure may be mounted on various subjects in accordance with required conditions and design specifications. The present disclosure is not restricted or limited by the type and structure of the subject.

Hereinafter, an example will be described in which the battery module 100 according to the embodiment of the present disclosure is applied to an electric vehicle (hybrid vehicle).

For reference, the battery module 100 may be manufactured by a process of stacking the plurality of (e.g., twelve) battery cells 120 in a reference stacking direction, a process of fastening endplates (not illustrated) to two opposite surfaces of the stack of the battery cells 120, a process of assembling busbar members 130 to two opposite ends of the stack of the battery cells 120, and a process of seating the battery cells 120 in the battery casing 110. The gap BG between the battery cell 120 and the battery casing 110 is filled with a gap filler 140 that performs insulation and heat-dissipation functions.

In the embodiment of the present disclosure, the battery cell 120 means a minimum unit of a secondary battery including one or more electrochemical cells that may be charged and discharged.

Various battery cells may be used as the battery cell 120 in accordance with required conditions and design specifications. The present disclosure is not restricted or limited by the type and properties of the battery cell 120.

For example, with reference to FIG. 3, the battery cell 120 may include a battery pouch 122 in which an electrode liquid, a positive electrode material, and a negative electrode material are sealed, and lead tabs 124 provided on two opposite surfaces of the battery pouch 122 and electrically connected to the battery pouch 122.

The lead tab 124 may be provided by coupling a polymer resin (PP or PE) material film to aluminum and nickel copper metal. The present disclosure is not restricted or limited by the material and structure of the lead tab 124.

With reference to FIG. 2, the battery casing 110 is provided to accommodate the plurality of battery cells 120.

The battery casing 110 may have various structures capable of accommodating the plurality of battery cells 120. The present disclosure is not restricted or limited by the structure and shape of the battery casing 110.

For example, a plurality of battery rooms 112 may be provided in the form of a lattice in an inner surface of the battery casing. The battery modules 100 made by stacking the plurality of battery cells 120 may be respectively independently seated in the battery rooms 112.

In addition, the battery casing 110 may have the cooling path 114 through which the coolant moves. The battery cell 120 accommodated in the battery casing 110 may be cooled by exchanging heat with the coolant.

For example, the battery casing 110 may include an outer casing (not illustrated) and an inner casing (not illustrated). The cooling path 114 having an approximately zigzag shape may be provided between the outer casing and the inner casing.

Meanwhile, the gap filler 140 is provided in the gap (see BG in FIG. 5) between the battery cell 120 and the battery casing 110 to ensure a heat exchange area between the battery cell 120 and the battery casing 110.

The gap filler 140 may be made of various materials having thermal conductivity. The present disclosure is not restricted or limited by the material and properties of the gap filler 140.

For example, the gap filler 140 may be made of a material made by mixing alumina (spherical alumina), magnesia, boron nitride, aluminum nitride, or the like with silicon resin or the like.

In the embodiment of the present disclosure, the position of the target line TL defined on the battery cell 120 is detected, and the target application amount of the gap filler 140 is controlled on the basis of the gap BG between the battery casing 110 and the battery cell 120 detected on the basis of the position of the target line TL relative to the reference line SL.

More specifically, the embodiment of the present disclosure provides a battery module processing method of processing the battery module 100 including the battery casing 110 having the cooling path 114 through which the coolant moves, and the plurality of battery cells 120 accommodated in the battery casing 110 and configured to exchange heat with the coolant. The battery module processing method includes step 10 of sensing the position of the target line TL defined on the battery cell 120, step 20 of detecting the gap BG between the battery casing 110 and the battery cell 120 based on the position of the target line TL relative to the preset reference line SL, and step 30 of controlling the target application amount of the gap filler 140 applied onto the battery casing 110 based on the gap BG so that the gap BG is filled with the gap filler 140.

STEP 1:

First, the position of the target line TL defined on the battery cell 120 is sensed.

For reference, in the embodiment of the present disclosure, the target line TL may be understood as position information (reference indicator) used to sense a position and a posture of the battery cell 120. The present disclosure is not restricted or limited by the structure, shape, number, and position of the target line TL.

With reference to FIG. 6, according to the exemplary embodiment of the present disclosure, the target line TL may be defined on the lead tab 124. In particular, the target line TL may be defined linearly along a lowermost end of the lead tab 124 disposed adjacent to the battery casing 110.

More specifically, with reference to FIG. 4, the battery module 100 may include the busbar member 130 having a guide slot 132 through which the lead tab 124 passes. In a state in which the lead tab 124 passes through the guide slot 132 of the busbar member 130 (see FIG. 7) and then is bent at about 90 degrees with respect to the battery pouch 122 (a state in which one surface of the lead tab 124 is in close contact with an outer surface of the busbar member 130) (see FIG. 8), the target line TL may be defined linearly along the lowermost end of the lead tab 124 disposed adjacent to the battery casing 110.

As described above, because the target line TL is defined in a linearly straight shape instead of a point, it is possible to obtain an advantageous effect of improving the accuracy in detecting the target line TL (e.g., a recognition rate related to image capturing).

In the embodiment of the present disclosure illustrated and described above, the example has been described in which the target line TL is defined along the lowermost end of the lead tab 124. However, according to another embodiment of the present disclosure, the target line may be defined on a lateral end of the lead tab or other portions (e.g., a battery pouch).

The process of sensing the position of the target line TL defined on the battery cell 120 may be performed by using the sensor 200.

Various sensing means capable of sensing the target line TL may be used as the sensor 200. The present disclosure is not restricted or limited by the type of the sensor 200 and the sensing method.

For example, the sensor 200 may sense the position of the target line TL by capturing an image of the battery cell 120 by using an image capturing part.

A typical camera such as a vision camera may be used as the image capturing part. The present disclosure is not restricted or limited by the type and properties of the image capturing part.

In particular, the sensor 200 may sense the position of the target line TL by capturing an image of a lower end of the lead tab 124 in a state in which the lead tab 124 having passed through the busbar member 130 is bent with respect to the battery pouch 122.

In the embodiment of the present disclosure illustrated and described above, the example has been described in which the sensor 200 senses the position of the target line TL in a non-contact manner. However, according to another embodiment of the present disclosure, the position of the target line may be sensed in a contact manner by using a contact sensor or the like. Alternatively, the position of the target line may be sensed by capturing an image of the lower end of the lead tab before the lead tab is bent with respect to the battery pouch.

STEP 2:

Next, the gap BG between the battery casing 110 and the battery cell 120 is detected on the basis of the position of the target line TL relative to the preset reference line SL.

This is based on the fact that when position information (measurement position information) of the target line TL defined on the battery cell 120 is known, the gap BG between the battery casing 110 and the battery cell 120 may be predicted on the basis of a position deviation between the preset reference line SL (reference position information) and the target line TL.

In this case, the gap BG between the battery casing 110 and the battery cell 120 may be detected by using the detector 300.

For example, the detector 300 may detect the gap BG between the battery casing 110 and the battery cell 120 by comparing the target line TL (measurement position information) and the reference line SL (reference position information) stored in advance in a storage part (not illustrated).

For reference, reference position information (reference line) related to the battery cell 120 (e.g., lead tab) may be stored in advance in the storage part. The storage part may include a storage medium of at least one type among memories of types such as a flash memory, a hard disk, a micro memory, a card (e.g., a secure digital (SD) card or an extreme digital (XD) card) memory, a random-access memory (RAM), a static RAM (SRAM), a read-only memory (ROM), a programmable ROM (PROM), an electrically erasable PROM (EEPROM), a magnetic memory (MRAM), a magnetic disk, and an optical disk.

The detector 300 may be implemented in the form of hardware, software, or a combination of hardware and software. Particularly, the processor 400 may be implemented as microprocessor.

STEP 3:

Thereafter, the target application amount of the gap filler 140 to be applied onto the battery casing 110 to fill the gap BG is controlled on the basis of the gap BG between the battery casing 110 and the battery cell 120.

In this case, the target application amount of the gap filler 140 may be controlled by the controller 400.

The controller 400 controls the target application amount of the gap filler 140 corresponding to the gap BG between the battery casing 110 and the battery cell 120 predicted (detected) in the step of detecting the gap BG.

In this case, the configuration in which the controller 400 controls the target application amount of the gap filler 140 corresponding to the gap BG between the battery casing 110 and the battery cell 120 may be understood as a configuration in which the application amount of the gap filler 140 to be applied onto the battery casing 110 is controlled to the extent that the gap BG between the battery casing 110 and the battery cell 120 is filled with the gap filler 140 without an empty space.

The application amount of the gap filler 140 to be applied onto the battery casing 110 may be controlled by adjusting a discharge amount (discharge speed) of the gap filler 140 discharged from a nozzle 410 and adjusting a movement speed or the like of the nozzle 410.

For reference, the controller 400 may be implemented in the form of hardware, software, or a combination of hardware and software. Particularly, the controller 400 may be implemented as microprocessor.

As described above, in the embodiment of the present disclosure, the position of the target line TL defined on the battery cell 120 is sensed, and the target application amount of the gap filler 140 is controlled on the basis of the gap BG between the battery casing 110 and the battery cell 120 detected on the basis of the position of the target line TL relative to the reference line SL. Therefore, it is possible to obtain an advantageous effect of optimizing the application amount of the gap filler 140 to be applied onto the battery casing 110 to fill the gap BG between the battery cell 120 and the battery casing

110 even though a deviation of the gap BG between the battery cell 120 and the battery casing 110 occurs because of manufacturing tolerance and assembling tolerance.

Among other things, in the embodiment of the present disclosure, the gap BG between the battery cell 120 and the battery casing 110 is sufficiently filled with the gap filler 140 without an empty space. Therefore, it is possible to obtain an advantageous effect of effectively ensuring heat exchange efficiency between the battery cell 120 and the coolant, sufficiently removing heat generated from the battery cell 120, and improving safety and reliability.

According to the exemplary embodiment of the present disclosure, the battery module processing method may include a step of adjusting the position of the busbar member 130 relative to the battery cell 120 on the basis of the position of the target line TL relative to the reference line SL.

In this case, the configuration in which the position of the busbar member 130 relative to the battery cell 120 is adjusted may be understood as a configuration in which a vertical position of the busbar member 130 relative to the battery cell 120 is adjusted.

This is based on the fact that the gap BG between the battery cell 120 and the battery casing 110 is determined on the basis of the position (vertical position) of the busbar member 130 relative to the battery casing 110. The gap BG between the battery cell 120 and the battery casing 110 may be optimized (minimized) by adjusting the position of the busbar member 130 relative to the battery cell 120 on the basis of a position deviation between the preset reference line SL (reference position information) and the target line TL. Therefore, it is possible to obtain an advantageous effect of reducing manufacturing costs by reducing the amount of use (target application amount) of the gap filler with which the gap BG is filled.

Meanwhile, because the battery module 100 is provided by stacking the plurality of battery cells 120, the positions of the lead tabs 124 of the battery cells 120 may be different from one another because of manufacturing tolerance and assembling tolerance. For this reason, different target lines TL may be defined on the battery cells 120.

With reference to FIG. 9, according to the exemplary embodiment of the present disclosure, in the step of detecting the gap BG, the gap BG (the gap between the battery casing and the battery cell) may be detected on the basis of a relative position (position deviation) (e.g., L1) between the reference line SL and any one target line (e.g., TL1) disposed to be farthest from the reference line SL among the plurality of target lines TL1, TL2, and TL3 respectively defined on the plurality of battery cells.

As described above, the gap BG between the battery casing 110 and the battery cell 120 is predicted by comparing the reference line SL and the target line TL1 disposed to be farthest from the reference line SL. Therefore, it is possible to obtain an advantageous effect of preventing an empty space from being formed in the gap BG between the battery cell 120 and the battery casing 110.

That is, the target application amount of the gap filler 140 may be controlled by predicting the gap BG between the battery casing 110 and the battery cell 120 on the basis of a relative position L3 between the reference line SL and any one target line (e.g., TL3) disposed to be closest to the reference line SL among the plurality of target lines TL1, TL2, and TL3 respectively defined on the plurality of battery cells. However, in this case, an empty space may be formed in the gap BG corresponding to the target line TL1 disposed to be farthest from the reference line SL as the gap BG cannot be sufficiently filled with the gap filler 140.

In contrast, according to the embodiment of the present disclosure, the detector 300 detects the gap BG between the battery casing 110 and the battery cell 120 by comparing the reference line SL and the target line TL1 disposed to be farthest from the reference line SL, and the target application amount of the gap filler 140 is controlled on the basis of the gap BG. Therefore, it is possible to obtain an advantageous effect of preventing an empty space from being formed in the gap BG between the battery cell 120 and the battery casing 110.

With reference to FIGS. 1 and 10, according to the exemplary embodiment of the present disclosure, the battery module processing method may include step S40 of measuring a spacing distance BL from a reference line HSL parallel to the inner surface of the battery casing 110 to a bottom portion of the battery room 112, and step S50 of adjusting the target application amount of the gap filler 140 on the basis of the spacing distance BL.

This is based on the fact that heights of the inner surfaces of the battery casings 110 (the bottom portions of the battery rooms 112) are different from one another because of manufacturing tolerance of the battery casing 110. Because the target application amount of the gap filler 140 is adjusted on the basis of the spacing distance BL from the reference line HSL parallel to the inner surface of the battery casing 110 to the bottom portion of the battery room 112, it is possible to obtain an advantageous effect of more accurately controlling the target application amount of the gap filler 140 and minimizing the occurrence of an empty space in the gap BG between the battery cell 120 and the battery casing 110.

Among other things, according to the embodiment of the present disclosure, the target application amount of the gap filler 140 may be controlled in consideration of all the manufacturing tolerance and assembling tolerance of the battery cell 120 and the manufacturing tolerance of the battery casing 110. Therefore, it is possible to obtain an advantageous effect of optimizing the target application amount of the gap filler 140 for each condition and more effectively suppressing the occurrence of an empty space in the gap BG between the battery cell 120 and the battery casing 110.

In this case, the spacing distance BL from the reference line HSL to the bottom portion of the battery room 112 may be detected by using the measurement part 500.

For example, various measurement means capable of measuring the spacing distance BL from the reference line HSL to the bottom portion of the battery room 112 may be used as the measurement part 500. The present disclosure is not restricted or limited by the type of the measurement part 500 and the measurement method.

Hereinafter, an example will be described in which a laser scanning device is used as the measurement part 500. According to another embodiment of the present disclosure, the spacing distance may be measured in a contact manner using a contact sensor.

The controller 400 may adjust (increase or decrease) the target application amount of the gap filler 140 on the basis of a measured value (spacing distance) measured by the measurement part 500.

Meanwhile, the spacing distance BL from the reference line HSL to the bottom portion of the battery room 112 may vary depending on the battery rooms 112.

With reference to FIG. 11, according to the exemplary embodiment of the present disclosure, in the step of adjusting the target application amount of the gap filler 140, the target application amount of the gap filler 140 may be adjusted on the basis of the longest spacing distance among the plurality of spacing distances BL corresponding to the plurality of battery rooms 112.

As described above, according to the embodiment of the present disclosure, the target application amount of the gap filler 140 is adjusted on the basis of the spacing distance BL1 to the reference line HSL from the bottom portion (corresponding to BL1) disposed to be farthest from the reference line HSL. Therefore, it is possible to obtain an advantageous effect of preventing an empty space from being formed in the gap BG between the battery cell 120 and the battery casing 110 in all the battery rooms 112.

That is, the target application amount of the gap filler 140 may be adjusted on the basis of the shortest spacing distance (e.g., corresponding to BL3) among the plurality of spacing distances BL corresponding to the plurality of battery rooms 112. However, in this case, an empty space may be formed in the gap BG corresponding to the bottom portion disposed to be farthest from the reference line HSL as the gap BG is not sufficiently filled with the gap filler 140.

In contrast, according to the embodiment of the present disclosure, the target application amount of the gap filler 140 is adjusted on the basis of the spacing distance BL1 to the reference line HSL from the bottom portion (corresponding to BL1) disposed to be farthest from the reference line HSL. Therefore, it is possible to obtain an advantageous effect of preventing an empty space from being formed in the gap BG between the battery cell 120 and the battery casing 110 in all the battery rooms 112.

Meanwhile, FIG. 12 is a block diagram illustrating a computing system that performs the battery module processing method according to the embodiment of the present disclosure.

With reference to FIG. 12, a computing system 1000 includes at least one processor 1100 connected through a bus 1200, a memory 1300, a user interface input device 1400, a user interface output device 1500, a storage 1600, and a network interface 1700.

The processor 1100 may be a central processing unit (CPU) or a semiconductor device that performs processing on commands stored in the memory 1300 and/or the storage 1600. The memory 1300 and the storage 1600 may include various types of volatile or nonvolatile storage media. For example, the memory 1300 may include a read-only memory (ROM) and a random-access memory (RAM).

Accordingly, steps of a method or algorithm described in connection with the embodiments disclosed herein may be directly implemented by a hardware module, a software module, or a combination thereof, executed by the processor 1100. The software module may reside in a storage medium (i.e., the memory 1300 and/or the storage 1600) such as a RAM memory, a flash memory, a ROM memory, an EPROM memory, an EEPROM memory, a register, a hard disk, a removable disk, and a CD-ROM. An exemplary storage medium is coupled to the processor 1100, which can read information from and write information to the storage medium. Alternatively, the storage medium may be integrated with the processor 1100. The processor and the storage medium may reside within an application-specific integrated circuit (ASIC). The ASIC may reside within a user terminal. Alternatively, the processor and the storage medium may reside as separate components within the user terminal.

According to the embodiment of the present disclosure as described above, it is possible to obtain an advantageous effect of improving stability and reliability.

In particular, according to the embodiment of the present disclosure, it is possible to obtain an advantageous effect of accurately detecting the gap between the battery module and the battery casing and optimizing the amount of use of the gap filler with which the gap between the battery module and the battery casing is filled.

In addition, according to the embodiment of the present disclosure, it is possible to obtain an advantageous effect of ensuring a heat exchange area between the battery module and the battery casing and improving efficiency and performance in cooling the battery module.

In addition, according to the embodiment of the present disclosure, it is possible to obtain an advantageous effect of reducing costs by minimizing the amount of unnecessary use of the gap filler.

While the embodiments have been described above, the embodiments are just illustrative and not intended to limit the present disclosure. It can be appreciated by those skilled in the art that various modifications and applications, which are not described above, may be made to the present embodiment without departing from the intrinsic features of the present embodiment. For example, the respective constituent elements specifically described in the embodiments may be modified and then carried out. Further, it should be interpreted that the differences related to the modifications and applications are included in the scope of the present disclosure defined by the appended claims.

WHAT IS CLAIMED IS:

[Claim 1] A battery module processing method of processing a battery module comprising a battery casing having a cooling path through which a coolant moves, and a plurality of battery cells accommodated in the battery casing and configured to exchange heat with the coolant, the battery module processing method comprising:

sensing a position of a target line defined on the battery cell;

detecting a gap between the battery casing and the battery cell on the basis of a position of the target line relative to a preset reference line; and

controlling a target application amount of a gap filler to be applied onto the battery casing on the basis of the gap so that the gap is filled with the gap filler.

[Claim 2] The battery module processing method of claim 1, wherein the battery cell comprises:

a battery pouch; and

a lead tab provided at a lateral side of the battery pouch and electrically connected to the battery pouch, and

wherein the target line is defined on the lead tab.

[Claim 3] The battery module processing method of claim 2, wherein the target line is defined linearly along a lowermost end of the lead tab disposed adjacent to the battery casing.

[Claim 4] The battery module processing method of claim 3, wherein the battery module comprises a busbar member having a guide slot through which the lead tab passes, and

wherein the sensing of the position of the target line is performed in a state in which the lead tab having passed through the guide slot is bent with respect to the battery pouch.

[Claim 5] The battery module processing method of claim 4, comprising:

adjusting a position of the busbar member relative to the battery cell on the basis of a position of the target line relative to the reference line.

[Claim 6] The battery module processing method of claim 1, wherein in the sensing of the position of the target line, the position of the target line is sensed by capturing an image of the battery cell by using an image capturing part.

[Claim 7] The battery module processing method of claim 1, wherein in the detecting of the gap, the gap is detected on the basis of a relative position between the reference line and any one target line disposed to be farthest from the reference line among the plurality of target lines respectively defined on the plurality of battery cells.

[Claim 8] The battery module processing method of claim 1, wherein a plurality of battery rooms is defined on an inner surface of the battery casing, and the battery cells are respectively and independently seated in the plurality of battery rooms.

[Claim 9] The battery module processing method of claim 8, comprising:

measuring a spacing distance from a reference line parallel to an inner surface of the battery casing to a bottom portion of the battery room; and adjusting the target application amount of the gap filler on the basis of the spacing distance.

[Claim 10] The battery module processing method of claim 9, wherein in the adjusting of the target application amount of the gap filler, the target application amount of the gap filler is adjusted on the basis of the longest spacing distance among the plurality of spacing distances corresponding to the plurality of battery rooms.

[Claim 11] A battery module processing system for processing a battery module comprising a battery casing having a cooling path through which a coolant moves, and a plurality of battery cells accommodated in the battery casing and configured to exchange heat with the coolant, the battery module processing system comprising:

a sensor configured to sense a position a target line defined on the battery cell;

a detector configured to detect a gap between the battery casing and the battery cell on the basis of a position of the target line relative to a preset reference line; and

a controller configured to control a target application amount of a gap filler to be applied onto the battery casing on the basis of the gap so that the gap is filled with the gap filler.

[Claim 12] The battery module processing system of claim 11, wherein the battery cell comprises:

a battery pouch; and

a lead tab provided at a lateral side of the battery pouch and electrically connected to the battery pouch, and

wherein the target line is defined on the lead tab.

[Claim 13] The battery module processing system of claim 12, wherein the target line is defined linearly along a lowermost end of the lead tab disposed adjacent to the battery casing.

[Claim 14] The battery module processing system of claim 13, wherein the battery module comprises a busbar member having a guide slot through which the lead tab passes, and

wherein the sensor senses the target line in a state in which the lead tab having passed through the guide slot is bent with respect to the battery pouch.

[Claim 15] The battery module processing system of claim 11, wherein the detector detects the gap on the basis of a relative position between the reference line and any one target line disposed to be farthest from the reference line among the plurality of target lines respectively defined on the plurality of battery cells.

[Claim 16] The battery module processing system of claim 11, wherein a plurality of battery rooms is defined on an inner surface of the battery casing, and the battery cells are respectively and independently seated in the plurality of battery rooms.

[Claim 17] The battery module processing system of claim 16, comprising:

a measurement part configured to measure a spacing distance from a reference line parallel to an inner surface of the battery casing to a bottom portion of the battery room,

wherein the controller adjusts the target application amount of the gap filler on the basis of the spacing distance.

[Claim 18] The battery module processing system of claim 17, wherein the controller adjusts the target application amount of the gap filler on the basis of the longest spacing distance among the plurality of spacing distances corresponding to the plurality of battery rooms.