SEMICONDUCTOR PACKAGE INSPECTION APPARATUS AND SEMICONDUCTOR PACKAGE INSPECTION METHOD USING THE SAME

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a semiconductor package inspection apparatus and a semiconductor package inspection method using the same. More particularly, the present invention relates to a semiconductor package inspection apparatus and a semiconductor package inspection method using the same that are capable of simultaneously photographing a plurality of side images of a semiconductor package to be inspected while transferring the semiconductor package along a rectilinear transfer path to determine whether or not the semiconductor package is defective.

Description of the Related Art

An optical photography method is widely used to determine whether or not a semiconductor package is defective. A method of photographing a region of a semiconductor package to be inspected and comparing the photographed image with a reference image or reference data to determine whether or not the semiconductor package is defective may be used.

For example, whether or not formation of a lead of a semiconductor package is defective may be determined using an optical photography method. In order to determine whether or not formation of such a semiconductor package is defective, side images of the semiconductor package must be photographed.

A method of photographing side images of a semiconductor package includes lowering the semiconductor package into a photographing space, photographing the semiconductor package in the photographing space, and lifting the semiconductor package to obtain a side image of the semiconductor package. In this method, photographing efficiency may be lowered, and, in a process of photographing a plurality of sides of the semiconductor package, inspection efficiency may be further lowered.

Also, a conventional semiconductor package is configured to have a structure in which a lead serving as a contact point when the semiconductor package is mounted on a board protrudes. In recent years, however, a quad flat no lead (QFN) semiconductor package has been mainly used as a semiconductor package with a protruding lead being removed.

A protruding lead, which is included in the conventional semiconductor package, is removed from the QFN semiconductor package. However, it is necessary to

inspect whether each side of the semiconductor package is defective. For example, it may be necessary to determine whether gaps between lead terminals provided at the respective sides of the QFN semiconductor package are uniform, a phenomenon(a smear phenomenon) in which terminals spread during a singulation process occurs, or a portion insufficiently filled with a molding material or a crack is present at the sides of the semiconductor package.

It is necessary to inspect whether or not the bottom of the QFN semiconductor package is defective. The bottom of the QFN semiconductor package may be basically inspected using marking inspection or dimension inspection.

Also, examples of defects that may be found through inspection of the bottom of the QFN semiconductor package may include scratches, cracks, resin bleed, in which a lead terminal is oxidized during singulation (disconnection or cutting) thereof with the result that the color of the lead terminal is changed, or melting, in which a molding material sticks to the lead terminal during a singulation process.

Although the QFN semiconductor package was described as an example in the above, it is necessary to inspect whether or not each side and/or a bottom of a

semiconductor package is defective at various semiconductor manufacturing equipment for sawing and placement, pick and placement, WLP pick and placement, and 3D inspection of the semiconductor package.

Efficiency of an inspection process of determining whether each side or a bottom of a semiconductor package is defective may decide efficiency of a process of manufacturing the semiconductor package. Consequently, a method of efficiently inspecting whether or not the surface of a semiconductor package is defective is required.

SUMMARY OF THE INVENTION

Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a semiconductor package inspection apparatus and a semiconductor package inspection method using the same that are capable of simultaneously photographing a plurality of side images of a semiconductor package to be inspected while transferring the semiconductor package along a rectilinear transfer path to efficiently determine whether or not the semiconductor package is defective.

In accordance with an aspect of the present invention, the above and other objects can be accomplished

by the provision of a semiconductor package inspection apparatus comprising a pickup part configured to be transferred in directions parallel to an x-axis direction and a z-axis direction, which are perpendicular to each other, to be rotated about the z axis, and to suck semiconductor packages to be inspected, a first vision unit for photographing first to fourth side surface images of each of the semiconductor packages transferred while being sucked by the pickup part, first to fourth reflection units for reflecting the first side surface image to the fourth side surface image of each of the semiconductor packages transferred while being sucked by the pickup part so that the first vision unit can photograph the first side surface image to the fourth side surface image of each of the semiconductor packages, first and second re-reflection units for re-reflecting the third and fourth side surface images reflected by the third reflection unit and the fourth reflection unit to the first vision unit, a semiconductor package transfer part provided between a first region in which the first reflection unit and the second reflection unit are disposed and a second region in which the third reflection unit, the fourth reflection unit, the first re-reflection unit, and the second re-reflection unit are disposed, the semiconductor package transfer part functioning as a

semiconductor package transfer path and an illumination part for illuminating light to the semiconductor packages transferred while being sucked by the pickup part.

The semiconductor package inspection apparatus may further comprise a semiconductor package supply part comprising a table having loading grooves for aligning the semiconductor packages and an unloading part for unloading the inspected semiconductor packages based on inspection results.

The distance deviation between a first light path from the first side surface of each of the semiconductor packages to the first vision unit via the first reflection unit, a second light path from the second side surface of each of the semiconductor packages to the first vision unit via the second reflection unit, a third light path from the third side surface of each of the semiconductor packages to the first vision unit via the third reflection unit and the first re-reflection unit, and a fourth light path from the fourth side surface of each of the semiconductor packages to the first vision unit via the fourth reflection unit and the second re-reflection unit may be within a depth of focus of the first vision unit.

The first light path to the fourth light path may have the same length.

The first reflection unit is configured to be movable

in a direction along the first light path from the first side surface of each of the semiconductor packages to the first reflection unit, the third reflection unit is configured to be movable in a direction along the third light path from the third side surface of each of the semiconductor packages to the third reflection unit, and the first re-reflection unit is configured to be movable along a y axis perpendicular to the x axis and the z axis.

The second reflection unit is configured to be movable in a direction along the second light path from the second side surface of each of the semiconductor packages to the second reflection unit,

the fourth reflection unit is configured to be movable in a direction along the fourth light path from the fourth side surface of each of the semiconductor packages to the fourth reflection unit, and

the second re-reflection unit is configured to be movable along a y axis perpendicular to the x axis and the z axis.

The first vision unit may be configured to be movable along a y axis perpendicular to the x axis and the z axis to change focus based on a size of each of the semiconductor packages.

The semiconductor package inspection apparatus may

further comprise a second vision unit disposed under the semiconductor package transfer part to photograph a bottom image of each of the semiconductor packages transferred by the pickup part.

The illumination part may have a through hole formed at a central region thereof, and the second vision unit may be disposed under the through hole of the illumination part to photograph the bottom image of each of the semiconductor packages through the through hole of the illumination part.

The illumination part may be disposed apart from or in parallel with the second vision unit in the x-axis direction to illustrate light to the semiconductor package transfer part.

The illumination part may be disposed under the semiconductor package transfer part so that the illumination part may be apart from or parallel with the second vision unit in the x-axis direction.

The illumination part may be provided at the second vision unit.

The unloading part may comprise trays, on which the semiconductor packages are loaded based on the inspection results of the semiconductor packages, and at least two unloading tray transfer units for transferring the trays.

The side images of the semiconductor packages

received and aligned in the loading grooves of the table may be photographed and inspected while the semiconductor packages are transferred along the semiconductor package transfer part in a state in which the semiconductor packages are sucked by the pickup part, the semiconductor packages are loaded on the trays based on the inspection results, and the trays are discharged by the unloading tray transfer units.

And in accordance with an aspect of the present invention, the above and other objects can be accomplished by the provision of a semiconductor package inspection method may comprise a rotation step rotating semiconductor packages picked up by the pickup part about the z axis by a predetermined angle (a°), a transfer step transferring the semiconductor packages picked up by the pickup part along the semiconductor package transfer part and a photograph step photographing first to fourth side surface images of each of the semiconductor packages by the first vision unit while the illumination part illuminating light to the semiconductor packages transferred along the semiconductor package transfer part.

The rotation step rotating the semiconductor packages picked up by the pickup part about the z axis by the predetermined angle (a°) may be carried out while the semiconductor packages picked up by the pickup part are transferred along the semiconductor package transfer part.

The semiconductor package inspection method may further comprise a re-rotation step rotating the semiconductor packages picked up by the pickup part about the z axis by a predetermined angle (b°)(b° = -a° + (90*N)° or b° = (90 − a)° + (90*N)°; where, N may be an

integer) after the photograph step.

The semiconductor package inspection method may further comprise an auxiliary photograph step photographing a bottom image of each of the semiconductor packages picked up by the pickup part.

The auxiliary photograph step may be carried out using the illumination part used at the photograph step or an additional illumination part.

The photograph step may comprise a process of moving the first vision unit to adjust a focus of side images of each of the semiconductor packages based on a size of each of the semiconductor packages picked up by the pickup part.

At the photograph step, the first vision unit may be movable in the y-axis direction or the z-axis direction.

The photograph step may comprise a process of moving a second vision unit in the z-axis direction or changing a z-axis height of the pickup part to adjust a focus of a bottom image of each of the semiconductor packages based on a thickness of each of the semiconductor packages picked up by the pickup part.

The semiconductor package inspection method may further comprise a semiconductor package unloading step unloading the inspected semiconductor packages to different trays based on the inspection results at the

photograph step.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a view showing a semiconductor package inspection apparatus according to the present invention;

FIG. 2 is a view showing an inspection process carried out by a vision inspection part constituting the semiconductor package inspection apparatus according to the present invention;

FIGS. 3(a) and 3(b) are a plan view and a side view respectively showing the vision inspection part constituting the semiconductor package inspection apparatus according to the present invention;

FIG. 4 is a view showing another embodiment of the vision inspection part constituting the semiconductor package inspection apparatus according to the present invention;

FIG. 5 is a view showing yet another embodiment of the vision inspection part constituting the semiconductor

package inspection apparatus according to the present invention;

FIG. 6 is a block diagram showing the semiconductor package inspection apparatus according to the present invention; and

FIG. 7 is a flow chart showing a semiconductor package inspection method according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. However, the present invention is not limited to the embodiments described herein and may be variously modified. The embodiments described herein are provided to allow those skilled in the art to thoroughly and completely understand disclosed contents, and to sufficiently convey the scope of the present invention to those skilled in the art. In the drawings, the same or similar elements are denoted by the same reference numerals even though they are depicted in different drawings.

FIG. 1 is a view showing a semiconductor package inspection apparatus 1000 according to the present invention.

The semiconductor package inspection apparatus 1000

according to the present invention may include a pickup part 210 configured to be transferred in directions parallel to an x-axis direction and a z-axis direction, which are perpendicular to each other, to be rotated about the z axis, and to suck a semiconductor package to be inspected, a first vision unit 330a for photographing images of first to fourth side surfaces of the semiconductor package transferred while being sucked by the pickup part 210, first to fourth reflection units 321 for reflecting the first side surface image to the fourth side surface image of the semiconductor package transferred while being sucked by the pickup part 210 so that the first vision unit can photograph the first side surface image to the fourth side surface image of the semiconductor package, first and second re-reflection units 322 for respectively re-reflecting the third and fourth side surface images reflected by the third reflection unit and the fourth reflection unit to the first vision unit, a semiconductor package transfer part 311 provided between a first region in which the first reflection unit and the second reflection unit are disposed and a second region in which the third reflection unit, the fourth reflection unit, the first re-reflection unit, and the second re-reflection unit are disposed, the semiconductor package transfer part 311 functioning as a

semiconductor package transfer path, and an illumination part for illuminating light to the semiconductor package transferred while being sucked by the pickup part 210.

The semiconductor package inspection apparatus 1000 according to the present invention is an apparatus that, with omission of a lifting operation necessary for inspection at a process of picking up and transferring a semiconductor package which has been singulated, simultaneously photographing each side of the semiconductor package to be inspected to determine whether or not the semiconductor package is defected.

Upon completion of a singulation process, the semiconductor package to be inspected may be washed, dried in a dry block, and transferred to a semiconductor package supply part 100 of the semiconductor package inspection apparatus according to the present invention.

The semiconductor package supply part 100 shown in FIG. 1 may include a table 110 having loading grooves 112 for aligning a plurality of semiconductor packages.

The table 110 may include a sheet block at which the loading grooves 112 for aligning the loaded semiconductor packages are formed at predetermined intervals and a turntable at which the loading grooves and non-loading regions intersect.

The table 110 may be transferred by a table transfer

unit 120 in a predetermined direction (y-axis direction). Also, the table 110 of the semiconductor package supply part 100 may be configured to be rotated when the table 110 is transferred in the predetermined direction (y-axis direction). The table 110 is configured to be rotated so that a disposition relationship between a picker for supplying semiconductor packages and pickup units of the pickup part, which will be described below, can be adjusted by the table.

The semiconductor package inspection apparatus 1000 according to the present invention may include a pickup part 210 including a plurality of pickup units for respectively picking up and transferring semiconductor packages to be inspected, located on the table of the semiconductor package supply part 100.

The pickup part 210 includes a plurality of pickup units 211. The pickup part 210 may transfer a semiconductor package picked up by a pickup part transfer unit 220 for transferring the pickup part 210 in a direction perpendicular to the direction in which the table 110 is transferred by the table transfer unit 120.

As shown in FIG. 1, the semiconductor package inspection apparatus 1000 according to the present invention includes a pair of pickup parts 210a and 210b and a pair of pickup part transfer units 220a and 220b.

The pickup part transfer units 220a and 220b are disposed in parallel. The respective pickup parts 210a and 210b may be mounted so that the respective pickup parts 210a and 210b can be transferred in a direction parallel to the respective pickup part transfer units 220a and 220b.

Each of the pickup parts 210a and 210b includes a plurality of pickup units 211. The pair of pickup part transfer units 220a and 220b, at which the respective pickup parts 210a and 210b are mounted so that the respective pickup parts 210a and 210b can be transferred by the pickup part transfer units 220a and 220b, may be disposed in a state in which the pickup part transfer units 220a and 220b are spaced apart from each other by the minimum distance at which interference between the pickup units 211 does not occur during transfer of the pickup parts mounted at the respective pickup part transfer units 220a and 220b. Consequently, it is possible to minimize the transfer distance of a vision inspection part 300, which will be described below, transferred to the respective pickup sides for vision inspection.

Also, the pickup part 210 picks up semiconductor packages located in loading grooves at a specific row parallel to the transfer direction of the pickup part among semiconductor packages located on the table 110 of

the semiconductor package supply part and transfers the picked up semiconductor packages to the vision inspection part 300, including the semiconductor package transfer part 311 functioning as a semiconductor package transfer path and as a photographing space, for inspection of the semiconductor packages.

Consequently, the pickup units 211 of the pickup part 210 may be arranged in a line in a direction parallel to the transfer direction of the pickup part.

The table 110 is transferred by the table transfer unit in a predetermined direction, i.e. a y-axis direction, and the pickup part 210 is transferred in a direction perpendicular to the transfer direction of the table, i.e. an x-axis direction. Consequently, the pickup part 210 may sequentially pick up semiconductor packages located in loading grooves of a specific row of the table and transfer the picked up semiconductor packages to the vision inspection part 300.

Also, the pickup parts 210a and 210b are transferred in the predetermined direction, i.e. the x-axis direction, and therefore, the y-axis pickup position of the pickup units 211 is not changed.

Since a pair of pickup parts 210a and 210b is provided so that the pickup parts 210a and 210b can be transferred in parallel, the table 110 may be alternately

transferred to the pickup positions of the respective pickup parts 210a and 210b so that the pickup units of the respective pickup parts can pick up semiconductor packages to be inspected.

Consequently, the semiconductor packages picked up by the respective pickup parts 210a and 210b are alternately photographed and inspected by a single vision inspection part 300, and therefore, a pickup process of the pickup parts 210a and 210b may be controlled so that the pickup process of the pickup parts 210a and 210b can be alternately carried out.

The semiconductor package inspection apparatus 1000 according to the present invention shown in FIG. 1 may include a vision inspection part 300 disposed on the transfer path of the semiconductor package picked up by the pickup part 210 to simultaneously photograph a plurality of sides of the semiconductor package transferred by the pickup part 210 along a rectilinear transfer path.

The vision inspection part may be provided between the table 110 constituting the semiconductor package supply part 100 and an unloading part 400. Alternatively, the vision inspection part may be provided at one side of the table 110 constituting the semiconductor package supply part 100.

As previously described, the pair of pickup parts 210a and 210b is provided so that the pickup parts 210a and 210b can be transferred in parallel, and the vision inspection part 300 may be disposed so as to be transferred in a direction perpendicular to the transfer direction of the pickup part so that semiconductor packages transferred by the respective pickup parts 210a and 210b can be photographed and inspected by the vision inspection part 300.

Consequently, the vision inspection part 300 can be transferred by a vision inspection part transfer unit 350 in a y-axis direction. The vision inspection part will be described in detail below.

The semiconductor package inspection apparatus 1000 according to the present invention may include an unloading part 400 for unloading the semiconductor package inspected by the vision inspection part 300.

A tray, a tub offloader, or a sheet block may be used as the unloading part 400 for unloading the inspected semiconductor package.

In FIG. 1, an example in which trays 410t and 420t and unloading tray transfer units 410 and 420 constitute the unloading part 400 will be described for the convenience of description.

The unloading part 400 may include at least two

unloading tray transfer units 410 and 420 for transferring the respective trays 410t and 420t in a direction perpendicular to the transfer direction of the pickup part so that semiconductor packages can be sorted and unloaded based on the inspection results of the vision inspection part.

In this case, trays may be provided so that semiconductor packages inspected by the vision units are loaded on the trays based on the inspection results. Images of the sides of the semiconductor packages received and aligned in the loading grooves 112 of the table 110 may be photographed and inspected while the semiconductor packages are transferred along the semiconductor package transfer part in a state in which the semiconductor packages are sucked by the pickup part 210, and the semiconductor packages may be loaded on the respective trays 410t and 420t based on the inspection results.

Specifically, a pair of unloading tray transfer units 410 and 420 constituting the unloading part 400 of the semiconductor package inspection apparatus 1000 according to the present invention is arranged in parallel. The respective unloading tray transfer units 410 and 420 may transfer an unloading tray on which good semiconductor packages are loaded and an unloading tray on which defective semiconductor packages are loaded.

The pickup parts 210 and 201b may load the semiconductor packages photographed and inspected by the vision inspection part onto the unloading trays 410t and 420t, having loading grooves 412 in which good or defective semiconductor packages are loaded, for unloading the good or defective semiconductor packages based on the inspection results of the respective semiconductor packages.

Consequently, a controller of the semiconductor package inspection apparatus 1000 according to the present invention may control the pickup part to compare an image of the semiconductor package photographed by the vision inspection part 300 with a reference image or reference data stored in the controller to distinguish good semiconductor packages from defective semiconductor packages and to locate the inspected semiconductor packages on the corresponding trays.

The pickup part 210 may be configured so that the pickup units 211, which are arranged in a line, of the pickup part 210 pick up semiconductor packages located at a specific row of the table 110, the picked up semiconductor packages are sequentially inspected by the vision inspection part 300, and the inspected semiconductor packages are unloaded to the corresponding trays.

Consequently, the pickup units of the pickup part 210 may be arranged in a line in parallel to the transfer direction of the pickup part 210, and the respective pickup units 211 may be configured to be independently rotated, lifted, picked up, and released, which will be described in detail below.

The respective unloading tray transfer units 410 and 420 may transfer the trays 410t and 420t in a predetermined direction (y-axis direction), and the inspected semiconductor packages may be unloaded by the pickup parts 210a and 210b.

Since the respective pickup parts 210a and 210b are transferred in the predetermined direction (y-axis direction), the respective unloading tray transfer units 410 and 420 may transfer the respective trays under the pickup part transferred to the unloading part for unloading so that one of the pickup parts 210a and 210b carrying out an unloading process can unload the inspected semiconductor packages.

In the embodiment shown in FIG. 1, a pair of unloading tray transfer units and a pair of trays are provided. Alternatively, the number of the unloading tray transfer units and the trays may be increased so that semiconductor packages can be unloaded based on the kinds of defect.

FIG. 2 is a view showing an inspection process carried out by the vision inspection part constituting the semiconductor package inspection apparatus according to the present invention. For the convenience of description, a process of inspecting a semiconductor package sp picked up by the second pickup part 210b, one of the pickup parts of the semiconductor package inspection apparatus according to the present invention shown in FIG. 1 will be described.

The semiconductor package inspection apparatus according to the present invention includes a vision inspection part 300 for simultaneously photographing a plurality of sides of each semiconductor package transferred by the pickup part along a rectilinear transfer path tp. The vision inspection part 300 may simultaneously photograph sides of semiconductor packages picked up by the pickup units of the pickup part in the order in which the semiconductor packages pass through the vision inspection part.

Consequently, the vision inspection part 300 may include a plurality of reflection units 321 for reflecting images of the sides of a semiconductor package to be inspected so that the first vision unit 330a constituting the vision inspection part 300 photographs the sides of the semiconductor package. The reflection units 321 may be

mounted to an inspection block 310. The inspection block may be partitioned into two.

The inspection block 310 of the vision inspection part 300 may include a semiconductor package transfer part 311 functioning as a transfer path of a semiconductor package to be inspected and as a photographing space in which the semiconductor package is photographed. The semiconductor package transfer part 311 may be disposed on the transfer path along which the semiconductor package picked up by the pickup part 210 is transferred.

The reflection units 321 may be provided to reflect sides of a semiconductor package sp to be inspected so that the sides of the semiconductor package can be simultaneously photographed by the first vision unit 330a constituting the vision inspection part 300.

The reflection units 321 may be disposed so that the respective images of the sides of the semiconductor package can reach the vision units while reflection paths of the respective images of the sides of the semiconductor package do not interfere with each other, and the semiconductor package sp may be rotated so that the respective sides of the semiconductor package can be disposed opposite to the reflection units.

As shown in FIG. 2, first to fourth reflection units 321a, 321b, 321c, and 321d are provided to reflect a first

side surface image to a fourth side surface image of a semiconductor package transferred while being sucked by the pickup part 210 so that the semiconductor package can be photographed by the first vision unit 330a.

First and second re-reflection units 322x and 322y may be further provided to re-reflect images of the third and fourth side surfaces reflected by the third reflection unit 321c and the fourth reflection unit 321d to the first vision unit 330a.

A semiconductor package sp passing through a photographing position PP of the vision inspection part 300 may be in a state in which the semiconductor package is rotated by a predetermined angle so that one of the diagonal lines connecting opposite vertices of the semiconductor package is parallel to the transfer path of the pickup part 210.

In a case in which a semiconductor package sp to be inspected is formed in the shape of a square, the predetermined angle may be 45 degrees. Of course, if a semiconductor package to be inspected is located on the table 110 in a rotated state, it is not necessary to additionally rotate the semiconductor package through the pickup part 210.

Of course, the diagonal line connecting the vertices of the semiconductor package may not be parallel to the

transfer path of the pickup part 210, and the rotation angle of the semiconductor package may not be 45 degrees depending upon the disposition of the reflection units. A representative example of the above case may be a case in which a semiconductor package is formed in the shape of a rectangle. Consequently, the rotation angle may be changed depending upon the shape of a semiconductor package, sides of which are to be inspected, and one of the diagonal lines connecting opposite vertices of the semiconductor package may not be parallel to the transfer path of the pickup part 210.

Since semiconductor packages sp can be rotated so that the semiconductor packages sp face the respective reflection units, physical interference between the transfer path of the semiconductor packages sp and the reflection units may be prevented.

Since the vision inspection part 300 constituting the semiconductor package inspection apparatus 1000 according to the present invention is disposed on the transfer path of the semiconductor packages picked up by the pickup part 210, the semiconductor packages may be photographed while the semiconductor packages pass through the semiconductor package transfer part 311 of the vision inspection part without additional upward and downward movement of the pickup units 210 during inspection.

That is, the above characteristic means that it is possible to perform a flying type inspection process without a stop operation or a lifting operation during inspection of semiconductor packages.

In addition, in a case in which the vision inspection part 300 is positioned between the table 100 and the unloading part 400, semiconductor packages may be inspected while the semiconductor packages are transferred in one direction or in a flying fashion. On the other hand, in a case in which the vision inspection part 300 is positioned at one side of the table 100, some of the semiconductor packages may be photographed when the semiconductor packages are transferred to the vision inspection part and some of the semiconductor packages may be photographed when the semiconductor packages are transferred to the unloading part.

That is, in a case in which a semiconductor package to be inspected has a plurality of sides, it is possible to photograph images of the sides in stages.

Consequently, the pickup units 211 of the pickup part 210 may be arranged in a line in parallel to the transfer direction of the pickup part, and the respective pickup units may be configured to be independently rotated. After inspection through photographing, the pickup units may be rotated in the loading direction of the loading grooves of

the unloading trays to unload inspected semiconductor packages.

Specifically, as shown in FIG. 2, the respective pickup units 211 (see FIG. 1) picking up semiconductor packages transferred to the photographing space of the vision inspection part 300 may sequentially rotate the semiconductor packages so that the respective sides of the semiconductor packages can be directed to the respective sides of the semiconductor packages before the semiconductor packages reach the photographing position PP of the photographing space.

Also, the respective pickup units 211 (see FIG. 1) picking up the semiconductor packages, upon which the inspection through photographing has been completed in the photographing space of the vision inspection part 300, may rotate the respective semiconductor packages in the loading direction of the loading grooves of the unloading trays after passing through the photographing position PP of the photographing space or after photographing.

During transfer of the respective semiconductor packages, the respective images of the sides of the respective semiconductor packages may be reflected by the respective reflection units without interference between the respective semiconductor packages and the respective reflection units 321.

More specifically, in a case in which, after inspection through photographing, the pickup units are re-rotated in the loading direction of the loading grooves of the unloading trays to unload inspected semiconductor packages, the respective angles may be described as follows.

A semiconductor package picked up by the pickup part 210 may be inspected in a state in which the semiconductor package is rotated about a z axis by a predetermined angle a°, and a process of rotating the semiconductor package by the predetermined angle a° and inspecting the semiconductor package may be carried out while the semiconductor package picked up by the pickup part 210 is transferred along the semiconductor package transfer part 311. After inspection through photographing, the semiconductor package picked up by the pickup part (the pickup unit) may be re-rotated about the z axis by a predetermined angle b° (b° = -a° + (90*N)° or b° = (90 - a)° + (90*N)°; where, N is an integer).

The predetermined angle a° is not limited to 45°. This is because, in a case in which a semiconductor package is not formed in the shape of a square, the predetermined angle a° must be decided based on the shape of the semiconductor package so that the respective sides of the semiconductor package face the respective

reflection units.

Re-rotation of the semiconductor package by a predetermined angle -a° after rotation of the semiconductor package by the predetermined angle a° and inspection of the semiconductor package may not be limited. The semiconductor package may be further rotated by an angle of (90 − a)° so as to correspond to the loading direction of the trays provided to unload the inspected semiconductor packages, and the semiconductor package may be further rotated by (90*N)° so that semiconductor packages having various shapes can correspond to the loading direction of the trays.

Also, the reason that the predetermined angle b° is set to -a° + (90*N)° or (90 − a)° + (90*N)° is that it is not necessary to limit the direction in which the semiconductor package is re-rotated after inspection of the semiconductor package to a direction opposite to the rotation direction before inspection.

The vision inspection part 300 shown in FIG. 2 includes a total of 4 reflection units, i.e. first to fourth reflection units 321a, 321b, 321c, and 321d. Since each semiconductor package sp to be inspected is formed in the shape of a square, images of the respective sides a, b, c, and d may be reflected so that the sides can be photographed by the first vision unit 330a.

Some of the first to fourth reflection units 321a, 321b, 321c, and 321d constituting the vision inspection part 300 may reflect the respective images of the sides of the semiconductor package sp to be inspected to the first vision unit 330a constituting the vision inspection part 300.

The first and second reflection units 321a and 321b disposed on the transfer path tp of the semiconductor package sp to be inspected along which the semiconductor package is transferred by the pickup part 201b or on the transfer path on the basis of the semiconductor package transfer part 311 reflect the images of the first and second side surfaces of the semiconductor package to the first vision unit 330a.

Others of the first to fourth reflection units 321a, 321b, 321c, and 321d constituting the vision inspection part 300 may reflect the respective images of the sides of the semiconductor package to be inspected to the re-reflection units 322 for reflecting the respective images of the sides of the semiconductor package to be inspected to the first vision unit 330a.

Specifically, the images of the third and fourth side surfaces of the semiconductor package sp to be inspected can be incident upon the reflection units 330. However, focal distances between the third and fourth side surface

images and the first and second side surface images la and lb reflected by the first and second reflection units 321a and 321b may not coincide with each other. For this reason, the third and fourth reflection units 321c and 321d are disposed so that the third and fourth reflection units 321c and 321d face the third and fourth side surfaces c and d to reflect the third and fourth side surface images lc and ld.

Here, the distance between the respective sides of the semiconductor package to be inspected by the vision inspection part 300 and the respective reflection units may not be the same. Specifically, in order to prevent interference between optical paths of the first and second side surface images la and lb reflected by the first and second reflection units 321a and 321b and the third and fourth reflection units 321c and 321d, the distance between the third and fourth reflection units 321c and 321d and the third and fourth side surfaces of the semiconductor package sp may be set to be greater than the distance between the first and second reflection units 321a and 321b and the first and second side surfaces of the semiconductor package sp.

Of course, the reverse case is possible. However, further increase of the focal distances of the first and second side surface images la and lb is not preferable.

For this reason, the distance between the third and fourth reflection units 321c and 321d and the third and fourth side surfaces of the semiconductor package sp may be set to be greater than the distance between the first and second reflection units 321a and 321b and the first and second side surfaces of the semiconductor package sp.

Also, the vision inspection part 300 according to the present invention may include first and second re-reflection units 322x and 322y for changing focal distances and reflection directions of the third and fourth side surface images lc and ld reflected by the third and fourth reflection units 321c and 321d.

The first and second side surface images la and lb are reflected by the first and second reflection units 321a and 321b provided on the transfer path tp or above the semiconductor package transfer part 311 with the result that deviation between the focal distances of the first and second side surface images la and lb and the focal distances of the third and fourth side surface images lc and ld may occur. For this reason, the first and second re-reflection units 322x and 322y are provided to compensate for the focal distances by the distances between the third and fourth reflection units 321c and 321d and the first and second re-reflection units 322x and 322y, and the reflection directions of the vision units

provided under the third and fourth reflection units 321c and 321d may be changed by the first and second re-reflection units 322x and 322y.

Consequently, the vision inspection part may simultaneously reflect four side images of the square semiconductor package sp to be inspected to the first vision unit 330a through the first to fourth reflection units 321a, 321b, 321c, and 321d and the first and second re-reflection units 322x and 322y.

On the assumption that paths of the respective reflected images are denoted by P (path) in connection with the focal distances, distance deviation between a first light path P(la) from the first side surface a of the semiconductor package sp to be inspected to the first vision unit 330a via the first reflection unit 321a, a second light path P(lb) from the second side surface of the semiconductor package sp to be inspected to the first vision unit 330a via the second reflection unit, a third light path P(lc) from the third side surface of the semiconductor package sp to be inspected to the first vision unit 330a via the third reflection unit and the first re-reflection unit, and a fourth light path P(ld) from the fourth side surface of the semiconductor package sp to be inspected to the first vision unit 330a via the fourth reflection unit and the second re-reflection unit

may be within the depth of focus of the first vision unit 330a.

Here, the depth of focus means an imaging range of a subject within which, when an image of the subject is formed on a lens or a reflection mirror, the image can be clearly obtained. That is, although the respective sides are not disposed with the same focal distance, a focusing range may be present within a certain range. If the distance deviation between the light paths P(la), P(lb), P(lc), and P(ld) of the respective side images is within the depth of focus of the first vision unit 330a, therefore, clear images of the respective sides can be obtained by the first vision unit 330a.

Of course, there may be no distance deviation between the first light path P(la) to the fourth light path P(ld), and therefore, the distances between the first light path P(la) to the fourth light path P(ld) may be the same.

As previously described, the pickup units 211 of the pickup part 210 may be arranged in a line in parallel to the transfer direction of the pickup part.

In connection with pitch of the plurality of pickup units 211 in the transfer direction of the pickup part 210, the pitch of the pickup units 211 during photographing and inspection of the semiconductor packages performed by the semiconductor package inspection

apparatus 1000 according to the present invention is set so that the gap at which the pickup units 211 do not interfere with the side images reflected by the reflection units and incident upon the vision units during inspection of the semiconductor packages is the minimum gap.

As shown in FIG. 2, it is necessary for the gap between the pickup units in the transfer direction, i.e. the pitch of the pickup units 211, to be set so that the pickup units 211 do not interfere with the optical paths P(la) and P(lb) of the first and second side surface images reflected by the reflection units 321a and 321b disposed above the semiconductor package transfer part 311 among the paths of the respective side images.

Also, the pickup units 211 of the pickup part 210 may be configured so that the gap between the pickup units (the pitch of the pickup units) can be varied.

In addition, in a case in which the pickup units are configured so that the pitch of the pickup units can be varied, the pitch of the pickup units may be varied to correspond to the pitch of the loading grooves 112 of the table 110 of the semiconductor package supply part or to correspond to the pitch of the loading grooves 412 and 422 of the trays of the unloading part 400 so that a plurality of semiconductor packages can be simultaneously loaded and/or unloaded.

That is, in a case in which the pickup units 211 are configured so that the gap between the respective pickup units 211 in the transfer direction, i.e. the pitch of the pickup units 211, can be adjusted although the pitch of the loading grooves 112 of the table 110 of the semiconductor package supply part 100 is different from the pitch of the loading grooves 412 and 422 of the trays 410t and 420t of the unloading part 400, the pitch of the pickup units may be varied so that a plurality of semiconductor packages can be simultaneously picked up, photographed, inspected, and/or unloaded.

Of course, since the pickup units are configured so that the pickup units can be individually movable upward and downward, sequential loading and/or unloading is possible.

As shown in FIG. 2, the side images of the semiconductor package reflected by the reflection units 321 and the re-reflection units 322 constituting the vision inspection part 300 may be incident upon the vision units in the horizontal direction, and the image photographed by the first vision unit 330a of the vision inspection part 300 may be a single image in which the respective side images of the semiconductor package to be inspected are arranged in a line.

The first vision unit 330a may photograph four side

images of the semiconductor package sp as a single image. The controller of the semiconductor package inspection apparatus according to the present invention may compare the image photographed by the vision units 330 with a reference image or reference data stored in the controller to distinguish good semiconductor packages from defective semiconductor packages.

The reflection units 321 and the re-reflection units 322 constituting the vision inspection part 300 of the semiconductor package inspection apparatus 1000 according to the present invention may be independently driven, and the positions and angles at which the reflection units 321 and the re-reflection units 322 are disposed may be adjusted.

In the embodiment shown in FIG. 2, as previously described, the semiconductor package to be inspected may be formed in the shape of a square. According to circumstances, however, the size of the semiconductor package may be increased, or the semiconductor package may be formed in another shape (for example, a rectangular shape).

In order to inspect semiconductor packages having various shapes and various sizes, therefore, the reflection units 321 and the re-reflection units 322 constituting the vision inspection part 300 may be

configured so that the reflection units 321 and the re-reflection units 322 can be adjacent to or distant from the transfer path of the semiconductor packages. Preferably, the installation angle of the reflection units 321 and the re-reflection units 322 is adjusted.

Specifically, as shown in FIG. 2, the first reflection unit 321a may be movable in a direction perpendicular to the first side surface a of the semiconductor package(or in a direction along the first light path from the first side surface of each of the semiconductor packages to the first reflection unit), the third reflection unit 321c may be movable in a direction perpendicular to the third side surface c of the semiconductor package(or in a direction along the third light path from the third side surface of each of the semiconductor packages to the third reflection unit), and the first re-reflection unit 322x may be movable along a y axis perpendicular to an x axis and a z axis, based on the size of the semiconductor package. The first re-reflection unit 322x is configured to be movable in the y-axis direction so that the movement of the first re-reflection unit 322x can correspond to the movement of the third reflection unit 321c.

The third reflection unit 321c must be movable in a direction perpendicular to the third side surface c of the

semiconductor package to reflect the third side surface image. On the other hand, the first re-reflection unit 322x can re-reflect the image reflected by the third reflection unit 321c when the first re-reflection unit 322x is movable in the y-axis direction during movement of the third reflection unit 321c. The first re-reflection unit 322x may be configured so that the first re-reflection unit 322x can be movable in the y-axis direction so as to prevent interference between the first re-reflection unit 322x and the second re-reflection unit 322y.

For the same reason, the second reflection unit 321b may be movable in a direction perpendicular to the second side surface b of the semiconductor package(or in a direction along the second light path from the second side surface of each of the semiconductor packages to the second reflection unit), the fourth reflection unit 321d may be movable in a direction perpendicular to the fourth side surface d of the semiconductor package(or in a direction along the fourth light path from the fourth side surface of each of the semiconductor packages to the fourth reflection unit), and the second re-reflection unit 322y may be movable along the y axis perpendicular to the x axis and the z axis.

The first vision unit 330a shown in FIG. 2 may be

configured so that the first vision unit 330a can be movable along the y axis perpendicular to the x axis and the z axis to change focus based on the size of the semiconductor package.

FIGS. 3(a) and 3(b) are a plan view and a side view respectively showing the vision inspection part constituting the semiconductor package inspection apparatus according to the present invention. A description of portions identical to those described with reference to FIGS. 1 and 2 will be omitted.

Specifically, FIG. 3(a) is a plan view showing the vision inspection part 300 of the semiconductor package inspection apparatus according to the present invention, and FIG. 3(b) is a side view showing the vision inspection part 300 of the semiconductor package inspection apparatus according to the present invention.

The inspection block 310 and the first vision unit 330a constituting the vision inspection part 300 according to the present invention may be mounted on a mounting member 370. The inspection block 310 and the first vision unit 330a may be transferred by the vision inspection part transfer unit 350 (see FIGS. 1 and 2) in a y-axis direction in a state in which the inspection block 310 and the first vision unit 330a are mounted on the mounting member 370.

Although not additionally shown, the inspection block 310 and the first vision unit 330a may be individually driven, and the first vision unit 330a may be independently driven so as to adjust the focal distance.

The transfer path along which the mounting member 370 is transferred by the vision inspection part transfer unit 350 may be perpendicular to the transfer path tp along which the semiconductor package to be inspected is transferred by the pickup part.

As shown in FIG. 3(b), side images of the semiconductor package reflected by the reflection units 321 constituting the vision inspection part 300 may be incident upon the first vision unit 330a in the horizontal direction.

In a case in which the installation space of the vision inspection part transfer unit 350 transferring the mounting member 370, on which the first vision unit 330a is mounted, is sufficient, the first vision unit 330a may be installed so that the side images of the semiconductor package incident upon the first vision unit 330a can be incident in the horizontal direction (the direction parallel to the transfer direction of the table and perpendicular to the transfer direction of the pickup part), as shown in FIGS. 1 to 3.

Also, the vision inspection part 300 of the

semiconductor package inspection apparatus according to the present invention may include an illumination part 360 for providing photographing light to the vision units 300.

The illumination part 360 may be provided under the semiconductor package transfer part 311 to illuminate light to the semiconductor package transferred while being sucked by the pickup part 210. The illumination part 360 may be provided under the transfer path of the semiconductor package located between a first region 328 in which the first reflection unit 321a and the second reflection unit 321b are disposed and a second region 329 in which the third reflection unit 321c, the fourth reflection unit 321d, the first re-reflection unit, and the second re-reflection unit are disposed.

That is, the inspection block 310 may be partitioned into two, and the respective inspection blocks may provide the first region 328 and the second region 329 at which the reflection units or the re-reflection units are mounted.

The illumination part 360 may include a board 361 and at least one light source 363, such as a light emitting diode (LED), provided on the board 361.

The illumination part 360 may be provided under the inspection block of the vision inspection part 300 to illuminate light to the semiconductor package transfer

part 311.

The illumination part 360 may provide indirect illumination in the side direction of the semiconductor package which is photographed to improve quality of an image photographed by the first vision unit 330a.

The pickup units of the pickup part 210b can be rotated about the z axis, and therefore, semiconductor packages, side images of which have been photographed, can be rotated to original positions thereof, as previously described.

FIG. 4 is a view showing another embodiment of the vision inspection part constituting the semiconductor package inspection apparatus according to the present invention. A description of portions identical to those described with reference to FIGS. 1 and 2 will be omitted.

As previously described, the first vision unit 330a of the vision inspection part 300 shown in FIGS. 1 to 3 is disposed in the horizontal direction to photograph an image incident in the horizontal direction. In a case in which an installation space of the vision unit is restricted, however, the vision unit may be installed in the vertical direction.

Consequently, the reflection units and the re-reflection units constituting the vision inspection part 300 of the semiconductor package inspection apparatus

according to the present invention may further include a reflection member 325 for reflecting the respective side images of semiconductor packages to be inspected in a first direction (for example, in the horizontal direction) and reflecting the images, reflected in the horizontal direction, in a second direction (for example, in the vertical direction).

The side images la, lb, lc, and ld of the semiconductor packages to be inspected, reflected by the reflection member 325, may be photographed by the first vision unit 330a, which are installed in the vertical direction.

The reflection member 325 may be further provided to variously change the installation position of the first vision unit 330a.

Also, as shown in FIGS. 3 and 4, the first vision unit 330a may be moved to adjust the focus of the side images of the semiconductor package based on the size of the semiconductor package picked up by the pickup part 210.

Specifically, at the photograph step, the first vision unit 330a may be moved in the y-axis direction (see FIG. 2 or 3) or in the z-axis direction (see FIG. 4 in which the reflection member is used).

FIG. 5 is a view showing yet another embodiment of

the vision inspection part constituting the semiconductor package inspection apparatus according to the present invention.

In the embodiments shown in FIGS. 1 to 4, the sides of semiconductor packages are simultaneously reflected and photographed to confirm defective elements at the sides of the semiconductor packages, thereby determining whether or not the semiconductor packages are defective.

For example, in a case in which semiconductor packages to be inspected are QFN semiconductor packages, the bottoms of the semiconductor packages may be defective. Examples of defects may include poor marking, incorrect dimensions, scratches, cracks, resin bleed, in which a lead terminal is oxidized during singulation (disconnection or cutting) thereof with the result that the color of the lead terminal is changed, or melting, in which a molding material sticks to the lead terminal during a singulation process.

To find such defects, the bottom of the semiconductor package transferred by the pickup part 210 may be photographed and inspected through the second vision unit 330b mounted under the photographing space in the z-axis direction.

The second vision unit 330b disposed under the semiconductor package transfer part 311 to photograph a

bottom image of the semiconductor package transferred by the pickup part 210 may be further included. The illumination part 360 may have a through hole formed at the central region thereof, and the second vision unit 330b may be disposed under the through hole of the illumination part 360 to photograph and inspect the bottom image of the semiconductor package through the through hole of the illumination part 360.

Consequently, the illumination part 360 provided under the photographing space or the semiconductor package transfer part may be configured in the shape of a ring having an opening formed at the central portion thereof so that the second vision unit 330b can photograph and inspect the bottom image of the semiconductor package.

In conclusion, the illumination part 360 may be configured in the shape of a ring having an opening, and the vision inspection part may include a first vision unit 330a for inspecting sides of a semiconductor package and a second vision unit 330b provided under the photographing space for photographing the bottom of the semiconductor package through the opening of the illumination part 360.

In the embodiment shown in FIG. 5, therefore, it is possible to simultaneously photograph sides and bottoms of quadrangular semiconductor packages to be inspected, thereby determining whether or not the semiconductor

packages are defective through images photographed by the respective vision units.

Of course, in the embodiment shown in FIG. 5, in a case in which side inspection of semiconductor packages is not necessary, it is possible to determine whether or not the bottoms of the semiconductor packages transferred by the pickup part 210 are defective using only the second vision unit 330b without the use of the first vision unit 330a.

Also, an illumination part for illuminating light to the semiconductor packages to be inspected may be configured in the shape of a ring as shown in FIG. 5; however, the shape of the illumination part is not limited thereto.

That is, the illumination part may be disposed apart from or in parallel with the second vision unit to illustrate light to the bottom of the semiconductor package transfer part.

Here, the illumination part may be disposed apart from or in parallel with the second vision unit as follows. The illumination part may be disposed under the semiconductor package transfer part so that the illumination part is apart from or parallel with the second vision unit in the x-axis direction.

Also, the illumination part 360 may be provided

separately from the second vision unit 330b. Alternatively, the illumination part 360 may be mounted at the second vision unit 330b.

The illumination part may include a plurality of illumination parts.

Also, as shown in FIG. 5, the second vision unit 330b may be moved in the z-axis direction, or the z-axis height of the pickup part 210 may be changed, to adjust the focus of the bottom image of the semiconductor package based on the size of the semiconductor package picked up by the pickup part 210.

FIG. 6 is a block diagram showing the semiconductor package inspection apparatus 1000 according to the present invention.

The controller of the semiconductor package inspection apparatus 1000 according to the present invention may include a memory 710 for storing data, with which images photographed by the vision unit 330 (the first vision unit and/or the second vision unit) are compared, and a processor 720 for comparing the photographed images with information stored in the memory to determine whether or not sides of a semiconductor package to be inspected are defective.

Also, the semiconductor package inspection apparatus 1000 according to the present invention may further

include a communication module 730 for communicating with a singulation apparatus for performing a preceding process, e.g. a singulation process, or a subsequent process, e.g. an unloading process. The controller 700 of the semiconductor package inspection apparatus 1000 according to the present invention may minimize a gap between the respective processes of a semiconductor manufacturing process based on information provided through the communication module 730.

At least one detection unit 500 may be provided to confirm states of the respective components constituting the semiconductor package inspection apparatus 1000 according to the present invention.

The controller 700 of the semiconductor package inspection apparatus 1000 according to the present invention may control the table 110, on which semiconductor packages to be inspected are located, and the table transfer unit 120 for transferring the table 110 so that the table can be rotated and transferred to positions at which the pickup units of the respective pickup parts pick up the semiconductor packages.

The controller 700 of the semiconductor package inspection apparatus 1000 according to the present invention may control a plurality of pickup units 211 included in the pickup part and the pickup part transfer

unit 220 to control the positions of the pickup part and operations of the respective pickup units 211.

As previously described, there is provided a pair of pickup parts, each of which includes the pickup units 211. Since the semiconductor packages picked up by the pickup parts, each of which includes the pickup units 211, can be alternately photographed and inspected by a single vision inspection part 300, therefore, the controller 700 may control a pickup process to be alternately carried out by the pickup parts, each of which includes the pickup units 211.

The controller 700 of the semiconductor package inspection apparatus 1000 according to the present invention may compare images of the semiconductor packages photographed by the vision units 330 constituting the vision inspection part with a reference image or reference data stored in the memory 710 of the controller 700 to distinguish good semiconductor packages from defective semiconductor packages, and may selectively release a picked up state of the inspected semiconductor packages at the unloading trays included in the unloading part so that an unloading process can be carried out.

The controller 700 may control the vision units 330 constituting the vision inspection part 300, the vision inspection part transfer unit 350, and the illumination

part 360 so that side images or bottom images of the semiconductor packages to be inspected to obtain an image for inspection.

In this case, the controller 700 may control the unloading tray transfer units 410 and 420 of the unloading part to locate the respective unloading trays at positions corresponding to the pickup units of the respective pickup parts.

FIG. 7 is a flow chart showing a semiconductor package inspection method according to the present invention.

The semiconductor package inspection method according to the present invention inspects semiconductor packages using the above-described semiconductor package inspection apparatus.

The semiconductor package inspection method according to the present invention may include a semiconductor package rotation step (S200) of rotating a semiconductor package picked up by the pickup part at a pickup step (S100) about a z axis by a predetermined angle a°, a semiconductor package transfer step (S300) of transferring the semiconductor package picked up by the pickup part along the semiconductor package transfer part, and a semiconductor package photograph step (S400) of the illumination part illuminating light to the semiconductor

package moved along the semiconductor package transfer part and the first vision unit photographing first to fourth side surface images of the semiconductor package.

The semiconductor package rotation step (S200) of rotating the semiconductor package picked up by the pickup part about the z axis by the predetermined angle a° may be carried out during the semiconductor package transfer step (S300) of transferring the semiconductor package picked up by the pickup part along the semiconductor package transfer part.

That is, the semiconductor package rotation step (S200) and the semiconductor package transfer step (S300) may be simultaneously carried out.

Also, the semiconductor package inspection method according to the present invention may further include an auxiliary photograph step (S500) of photographing a bottom image of the semiconductor package together with or independently of the semiconductor package photograph step (S400) of photographing the side images of the semiconductor package picked up by the pickup part. At the auxiliary photograph step (S500), the bottom image of the semiconductor package may be photographed using the illumination part used at the semiconductor package photograph step (S400), or an additional illumination part may be used to photograph the bottom image of the

semiconductor package.

That is, as previously described, a plurality of illumination parts may be provided.

The semiconductor package photograph step (S400) may include a process of moving the first vision unit to adjust the focus of the side images of the semiconductor package based on the size of the semiconductor package picked up by the pickup part. The movement direction of the first vision unit may be a transfer direction of the semiconductor package or a direction perpendicular to the transfer direction of the semiconductor package.

In the same manner, at the auxiliary photograph step (S500), photographing is carried out by the second vision unit. The auxiliary photograph step (S500) may include a process of moving the second vision unit in a z-axis direction or changing a z-axis height of the pickup part to adjust the focus of the bottom image of the semiconductor package based on the thickness of the semiconductor package picked up by the pickup part.

Also, the semiconductor package inspection method according to the present invention may further include a re-rotation step (S600) of rotating the semiconductor package picked up by the pickup part about a z axis by a predetermined angle b° (b° = -a° + (90*N)° or b° = (90 - a)° + (90*N)°; where, N is an integer) after the

semiconductor package photograph step (S400) or the auxiliary photograph step (S500), as previously described.

Also, the semiconductor package inspection method according to the present invention may further include a semiconductor package unloading step (S700) of unloading the inspected semiconductor package to a corresponding tray based on the inspection results at the semiconductor package photograph step (S400) or the auxiliary photograph step (S500). That is, semiconductor packages may be unloaded in a state in which good semiconductor packages and defective semiconductor packages are located on different trays based on the inspection results.

In the semiconductor package inspection apparatus and the semiconductor package inspection method according to the present invention, semiconductor packages to be inspected are photographed and inspected while the semiconductor packages are transferred along a rectilinear transfer path with the result that a lifting process for individually photographing and inspecting the semiconductor packages may be omitted, thereby greatly improving inspection efficiency.

Also, in the semiconductor package inspection apparatus and the semiconductor package inspection method according to the present invention, it is possible to perform a flying type inspection process without a stop

operation or a lifting operation for photographing and inspecting semiconductor packages, thereby greatly improving inspection efficiency.

Also, in the semiconductor package inspection apparatus and the semiconductor package inspection method according to the present invention, it is possible to simultaneously photograph and inspect a plurality of sides of semiconductor packages to be inspected upon photographing and inspecting the semiconductor packages, thereby greatly improving inspection efficiency.

Also, in the semiconductor package inspection apparatus and the semiconductor package inspection method according to the present invention, it is possible to photograph and inspect bottoms of semiconductor packages to be inspected as well as a plurality of sides of the semiconductor packages upon photographing and inspecting the semiconductor packages, thereby greatly improving photographing and inspection efficiency.

Also, in the semiconductor package inspection apparatus and the semiconductor package inspection method according to the present invention, a pickup part for picking up and transferring semiconductor packages to be inspected to a photographing space includes a plurality of pickup units which are arranged in a line in parallel to the transfer direction with the result that continuous

inspection in the photographing space is possible, thereby greatly improving photographing and inspection efficiency.

Also, in the semiconductor package inspection apparatus and the semiconductor package inspection method according to the present invention, a plurality of pickup parts configured so as to be transferred in parallel is provided with the result that it is possible to alternately carry out a pickup process, a photographing process, and an unloading process, thereby minimizing a gap of an inspection process at a vision inspection part.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

WHAT IS CLAIMED IS:

1. A semiconductor package inspection apparatus comprising:

a pickup part configured to be transferred in directions parallel to an x-axis direction and a z-axis direction, which are perpendicular to each other, to be rotated about the z axis, and to suck semiconductor packages to be inspected;

a first vision unit for photographing first to fourth side surface images of each of the semiconductor packages transferred by the pickup part;

first to fourth reflection units for reflecting the first side surface image to the fourth side surface image of each of the semiconductor packages transferred by the pickup part so that the first vision unit can photograph the first side surface image to the fourth side surface image of each of the semiconductor packages;

first and second re-reflection units for re-reflecting the third and fourth side surface images reflected by the third reflection unit and the fourth reflection unit to the first vision unit;

a semiconductor package transfer part provided between a first region in which the first reflection unit and the second reflection unit are disposed and a second

region in which the third reflection unit, the fourth reflection unit, the first re-reflection unit, and the second re-reflection unit are disposed, the semiconductor package transfer part functioning as a semiconductor package transfer path; and

an illumination part for illuminating light to the semiconductor packages transferred by the pickup part.

2. The semiconductor package inspection apparatus according to claim 1, further comprising:

a semiconductor package supply part comprising a table having loading grooves for aligning the semiconductor packages; and

an unloading part for unloading the inspected semiconductor packages based on inspection results.

3. The semiconductor package inspection apparatus according to claim 1 or 2, wherein distance deviation between a first light path from the first side surface of each of the semiconductor packages to the first vision unit via the first reflection unit, a second light path from the second side surface of each of the semiconductor packages to the first vision unit via the second reflection unit, a third light path from the third side surface of each of the semiconductor packages to the first

vision unit via the third reflection unit and the first re-reflection unit, and a fourth light path from the fourth side surface of each of the semiconductor packages to the first vision unit via the fourth reflection unit and the second re-reflection unit is within a depth of focus of the first vision unit.

4. The semiconductor package inspection apparatus according to claim 3, wherein the first light path to the fourth light path have the same length.

5. The semiconductor package inspection apparatus according to claim 3, wherein

the first reflection unit is configured to be movable in a direction along the first light path from the first side surface of each of the semiconductor packages to the first reflection unit,

the third reflection unit is configured to be movable in a direction along the third light path from the third side surface of each of the semiconductor packages to the third reflection unit, and

the first re-reflection unit is configured to be movable along a y axis perpendicular to the x axis and the z axis.

6. The semiconductor package inspection apparatus according to claim 3, wherein

the second reflection unit is configured to be movable in a direction along the second light path from the second side surface of each of the semiconductor packages to the second reflection unit,

the fourth reflection unit is configured to be movable in a direction along the fourth light path from the fourth side surface of each of the semiconductor packages to the fourth reflection unit, and

the second re-reflection unit is configured to be movable along a y axis perpendicular to the x axis and the z axis.

7. The semiconductor package inspection apparatus according to claim 1 or 2, wherein the first vision unit is configured to be movable along a y axis perpendicular to the x axis and the z axis to change focus based on a size of each of the semiconductor packages.

8. The semiconductor package inspection apparatus according to claim 1 or 2, further comprising a second vision unit disposed under the semiconductor package transfer part to photograph a bottom image of each of the semiconductor packages transferred by the pickup part.

9. The semiconductor package inspection apparatus according to claim 8, wherein the illumination part has a through hole formed at a central region thereof, and the second vision unit is disposed under the through hole of the illumination part to photograph the bottom image of each of the semiconductor packages through the through hole of the illumination part.

10. The semiconductor package inspection apparatus according to claim 8, wherein the illumination part is disposed apart from or in parallel with the second vision unit in the x-axis direction to illustrate light to the semiconductor package transfer part.

11. The semiconductor package inspection apparatus according to claim 10, wherein the illumination part is disposed under the semiconductor package transfer part so that the illumination part is apart from or parallel with the second vision unit in the x-axis direction.

12. The semiconductor package inspection apparatus according to claim 10, wherein the illumination part is provided at the second vision unit.

13. The semiconductor package inspection apparatus according to claim 2, wherein the unloading part comprises trays, on which the semiconductor packages are loaded based on the inspection results of the semiconductor packages, and at least two unloading tray transfer units for transferring the trays.

14. The semiconductor package inspection apparatus according to claim 13, wherein the side images of the semiconductor packages received and aligned in the loading grooves of the table are photographed and inspected while the semiconductor packages are transferred along the semiconductor package transfer part in a state in which the semiconductor packages are sucked by the pickup part, the semiconductor packages are loaded on the trays based on the inspection results, and the trays are discharged by the unloading tray transfer units.

15. A semiconductor package inspection method using the semiconductor package inspection apparatus according to claim 1, comprising:

a rotation step rotating semiconductor packages picked up by the pickup part about the z axis by a predetermined angle (a°);

a transfer step transferring the semiconductor

packages picked up by the pickup part along the semiconductor package transfer part; and

a photograph step photographing first to fourth side surface images of each of the semiconductor packages by the first vision unit while the illumination part illuminating light to the semiconductor packages transferred along the semiconductor package transfer part.

16. The semiconductor package inspection method according to claim 15, wherein the rotation step rotating the semiconductor packages picked up by the pickup part about the z axis by the predetermined angle (a°) is carried out while the semiconductor packages picked up by the pickup part are transferred along the semiconductor package transfer part.

17. The semiconductor package inspection method according to claim 15 or 16, further comprising a re-rotation step rotating the semiconductor packages picked up by the pickup part about the z axis by a predetermined angle (b°)(b° = -a° + (90*N)° or b° = (90 − a)° + (90*N)°; where, N is an integer) after the photograph step.

18. The semiconductor package inspection method according to claim 15, further comprising an auxiliary

photograph step photographing a bottom image of each of the semiconductor packages picked up by the pickup part.

19. The semiconductor package inspection method according to claim 17, wherein the auxiliary photograph step is carried out using the illumination part used at the photograph step or an additional illumination part.

20. The semiconductor package inspection method according to claim 15, wherein the photograph step comprises a process of moving the first vision unit to adjust a focus of side images of each of the semiconductor packages based on a size of each of the semiconductor packages picked up by the pickup part.

21. The semiconductor package inspection method according to claim 20, wherein, at the photograph step, the first vision unit is movable in the y-axis direction or the z-axis direction.

22. The semiconductor package inspection method according to claim 15, wherein the photograph step comprises a process of moving a second vision unit in the z-axis direction or changing a z-axis height of the pickup part to adjust a focus of a bottom image of each of the

semiconductor packages based on a thickness of each of the semiconductor packages picked up by the pickup part.

23. The semiconductor package inspection method according to claim 15 or 18, further comprising a semiconductor package unloading step unloading the inspected semiconductor packages to different trays based on the inspection results at the photograph step.