

【DESCRIPTION】**【Title of the Invention】**

VISION INSPECTION MODULE AND DEVICE INSPECTION SYSTEM HAVING
SAME

【Field of the Invention】

[0001] The present invention relates to device inspection system, and more particularly, to a vision inspection module and device inspection system having the same for performing a vision inspection on a semiconductor device.

【Related Art】

[0002] Semiconductor device elements after a package process are tested, for example, a burn-in test and then, loaded on a customer tray and shipped.

[0003] Then, semiconductor device devices to be shipped undergo a marking process in which marks such as a serial number and a manufacturer's logo are displayed on the surface thereof by a laser or the like.

[0004] In addition, the semiconductor device element finally undergoes an inspection process for checking the appearance of the semiconductor device element such as whether the lead or the ball grid is damaged, cracked, scratched, or the like and whether the marking formed on the surface is good or not.

[0005] On the other hand, as the inspection process for checking the appearance of the semiconductor device element and the goodness of marking are added, the time for performing the whole process and the size of the installation are affected according to the inspection time and the arrangement of the modules.

[0006] Especially, according to loading of trays with multiple devices loaded, one or more modules for vision inspection of each device, and the configuration and arrangement

of the unloading module, the size of the installation becomes different.

[0007] And, the size of the installation may affect the number of device inspection systems installable in the device inspection line or the installation cost for device production depending on the installation of a predetermined number of device inspection systems.

【Disclosure】

【Technical Problem】

[0008] An object of the present invention is to provide a vision inspection module and device inspection system having the same for acquiring images on the surface of a semiconductor device and of a plurality of side surfaces adjacent to the surface at the same time to perform a vision inspection by recognizing the above points.

【Technical Solution】

[0009] Embodiments of the present invention provide vision inspection module 50 for performing a vision inspection of a semiconductor device 1 having a polygonal plane shape, the vision inspection module 50 including: a single image acquisition unit 100 configured to acquire a first plane image for a first plane of the semiconductor device 1 and side surface images for side surfaces of polygonal sides of the semiconductor device 1; and an optical system configured to form a first optical path L1 for enabling the first plane image for the first plane of the semiconductor device 1 to reach the single image acquisition unit 100, and a plurality of second optical paths L2 for enabling each of the side surface images for the side surfaces of the polygonal sides of the semiconductor device 1 to reach the single image acquisition unit 100.

[0010] The vision inspection module 50 may further include a focal length correction unit 400 that is installed in the optical system to correct a focal length difference of the first

optical path L1 and the second optical path L2.

[0011] The focal length correction unit 400 may include a medium unit 410 that is installed in a corresponding optical path L1 or L2 and consists of a transparent material that transmits light.

[0012] The focal length correction unit 400 may include a frame unit 420 detachably coupled to a structure 520, the frame unit 420 in which the medium unit 410 is detachably installed.

[0013] The frame unit 420 may be detachably coupled to the structure 520 by a magnetic force.

[0014] The optical system may include: a main reflection member 211 configured to reflect the first plane image for the first plane toward the single image acquisition unit 100; and a sub reflection member 311 installed corresponding to each side surface of the polygonal sides of the semiconductor device 1 to reflect a side surface image of each side surface of the polygonal sides of the semiconductor device 1 toward the main reflection member 211.

[0015] The main reflection member 211 may consist of a semi-transparent material that transmits light and include an illuminator 540 configured to emit light to the first plane and each side surface of the polygonal sides of the semiconductor device 1 at the other surface of a reflective surface that reflects the first plane image.

[0016] The focal length correction unit 400 may be installed in at least one of between each side surface of the polygonal sides of the semiconductor device 1 and the main reflection member 211 of the second optical path L2 and between the main reflection member 211 and the single image acquisition unit 100 of the second optical path L2.

[0017] The focal length correction unit 400 may be installed between each side surface

of the polygonal sides of the semiconductor device 1 and the main reflection member 211 of the second optical path L2, wherein the focal length correction unit 400 may be integrally formed with the sub reflection member 311.

[0018] In other embodiments of the present invention, a device inspection system includes: a loading unit 10 configured to load and linearly move a tray 2 on which a plurality of semiconductor devices 1 are put; a vision inspection module 50 installed on one side of the loading unit 10 perpendicular to a transfer direction of the tray 2 in the loading unit 10 to perform a vision inspection on the semiconductor device 1; a first guide rail 68 disposed perpendicularly to a movement direction of the tray 2 in the loading unit 10; a first transfer tool 61 coupled to the first guide rail 68 to move along the first guide rail 68 and configured to pick up and transfer a device from the loading unit 10 to the vision inspection module 50 to perform a vision inspection; and unloading units 31, 32, and 33 configured to receive the trays 2 on which the semiconductor devices 1 after the vision inspection are put from the loading unit 10 and sort the semiconductor devices 1 on a corresponding tray 2 according to a vision inspection result, wherein the vision inspection module 50 is a vision inspection module having the above configuration.

【Advantages】

[0019] The vision inspection module and the device inspection system having the same according to the present invention may perform various and quick inspections by acquiring images on the surface of a semiconductor device and of a plurality of side surfaces adjacent to the surface at the same time to perform a vision inspection.

[0020] Especially in acquiring images of the surface of a semiconductor device and a plurality of side surfaces adjacent to the surface, the difference in focal length according to different light paths is corrected by using a medium such as a transparent glass, so that it is

possible to acquiring images by single camera to simplify the configuration of the module for performing a vision inspection and to reduce the manufacturing cost.

【BRIEF DESCRIPTION OF THE FIGURES】

[0021] FIG. 1 is a plan view showing an example of device inspection system according to the present invention.

[0022] FIG. 2A is a conceptual view showing a configuration in a lateral direction of an example of the vision inspection module of the device inspection system of FIG 1.

[0023] FIG. 2B is a bottom view showing the arrangement of a semiconductor device and a sub reflection member in the vision inspection module of FIG. 2A.

[0024] FIG. 3 is a plan view showing an example of a focal length adjustment unit of the vision inspection module of FIG. 2.

[0025] FIG. 4 is a side view of the focal length adjustment unit of FIG. 3.

[0026] FIG. 5 is a conceptual view showing a configuration in a lateral direction of another example of the vision inspection module of the device inspection system of FIG 1.

[0027] FIG. 6 is a conceptual diagram showing the concept of the working distance for image acquisition in the vision inspection module of FIG. 2 or FIG. 5.

[0028] FIG. 7 is a conceptual diagram schematically showing an image obtained by the vision inspection module of FIG. 2 or FIG. 5.

【MODE FOR CARRYING OUT THE INVENTION】

[0029] Hereinafter, a vision inspection module and a device inspection system having the same according to the present invention will be described with reference to the accompanying figures.

[0030] As shown in FIG. 1, a device inspection system according to an embodiment of the present invention includes a loading unit 10 for loading and linearly moving a tray 2 on

which a plurality of semiconductor devices 1 are put; a vision inspection module 50 installed on one side of the loading unit 10 perpendicular to the transfer direction of the tray 2 in the loading unit 10 to perform a vision inspection on the semiconductor device 1; a first guide rail 68 disposed perpendicularly to the movement direction of the tray 2 in the loading unit 10; a first transfer tool 61 coupled to the first guide rail 68 to move along the first guide rail 68 and for picking up and transferring a device from the loading unit 10 to the vision inspection module 50 to perform a vision inspection; and unloading units 31, 32, and 32 for sorting the semiconductor devices 1 on the tray 2 according to a vision inspection result by receiving the tray 2 on which the semiconductor devices 1 after the vision inspection are put from the loading unit 10.

[0031] Here, the semiconductor device 1 may be any semiconductor device after semiconductor processing such as a memory, an SDRAM, a flash RAM, a CPU, and a GPU.

[0032] The tray 2 is configured such that one or more semiconductor devices 1 are loaded in matrix pattern and transferred, and generally standardized like a memory device.

[0033] The loading unit 10 is configured to load a semiconductor device 1 to be inspected so as to perform a vision inspection, and various configurations are possible.

[0034] For example, the loading unit 10 transfers the tray 2 on which the plurality of semiconductor devices 1 are put while the plurality of semiconductor devices 1 are seated in a seat concavity formed in the tray 2.

[0035] The loading unit 10 may have various configurations, and as shown in FIG. 1 and Korean Patent Publication No. 10-2008-0092671, the loading unit 10 may include a guide unit (not shown) for guiding the movement of the tray 2 on which the plurality of semiconductor devices 1 are loaded, and a driving unit (not shown) for moving the tray 2

along the guide unit.

[0036] The vision inspection module 50 is installed at one side of the loading unit 10 perpendicular to the transfer direction of the tray 2 in the loading unit 10 and performs a vision inspection on the semiconductor device 1 so that various configurations are possible.

[0037] It is apparent that the vision inspection module 50 may have various configurations according to the configuration of the system.

[0038] In particular, the vision inspection module 50 may be variously configured as a configuration for acquiring an image of an appearance for a bottom surface or the like of the semiconductor device 1 using a camera, a scanner, or the like.

[0039] Here, the image obtained by the vision inspection module 50 is used for a vision inspection such as a defect after image analysis using a program or the like.

[0040] Meanwhile, the vision inspection module 50 may have various configurations according to the type of vision inspection, and may be preferably configured to perform a vision inspection on any one surface (hereinafter, referred to as the 'first surface') of the top and bottom surfaces of the semiconductor device 1 and the side surface adjacent thereto.

[0041] More specifically, as shown in FIGS. 2A and 7, with respect to the semiconductor device 1 whose planar shape is rectangular, the vision inspection module 50 is preferably configured to perform all of the vision inspection on the opposite surface and the four side surfaces while the first transfer tool 61 picks up one surface of the semiconductor device 1.

[0042] For this, as shown in FIGS. 2 to 5, the vision inspection module 50 is a vision inspection module 50 for performing a vision inspection of the semiconductor device 1 having a polygonal plane shape, and may include a single image acquisition unit 100 for acquiring a first plane image for the first plane of the semiconductor device 1 and side

surface images for the side surfaces of the polygonal sides of the semiconductor device 1, and an optical system for forming a first optical path L1 for enabling the first plane image for the first plane of the semiconductor device 1 to reach the single image acquisition unit 100 and a plurality of second optical paths L2 for enabling each of the side surface images for the side surfaces of the polygonal sides of the semiconductor device 1 to reach the single image acquisition unit 100.

[0043] The single image acquisition unit 100 may be variously configured as a configuration for acquiring the first plane image for the first plane of the semiconductor device 1 and the side surface images for the side surfaces of the polygonal sides of the semiconductor device 1.

[0044] For example, the single image acquisition unit 100 may be a camera, a scanner, or the like.

[0045] Then, as shown in FIG. 7, in order for analysis of the acquired image, in relation to the single image acquisition unit 100, the first plane image for the first plane of the semiconductor device 1 and the side surface images for the side surfaces of the polygonal sides of the semiconductor device 1 may be delivered to a control unit (not shown) and their images may be analyzed using a program and then used for vision inspection such as whether or not they are defective.

[0046] The optical system may be variously configured as a configuration for forming the first optical path L1 for enabling the first plane image for the first plane of the semiconductor device 1 to reach the single image acquisition unit 100, and the plurality of second optical paths L2 for enabling each of the side surface images for the side surfaces of the polygonal sides of the semiconductor device 1 to reach the single image acquisition unit 100.

[0047] Specifically, in the optical system, depending on the semiconductor device 1 and the installation position of the single image acquisition unit 100, the numbers and the installation positions of the lens 110, the reflection members 211 and 311, the semi-transparent member, the prism, and the like may be selected.

[0048] In particular, the optical system may include a main reflection member 211 for reflecting the first plane image for the first plane toward the single image acquisition unit 100, and a sub reflection member 311 installed corresponding to each side surface of the polygonal sides of the semiconductor device 1 to reflect a side surface image of each side surface of the polygonal sides of the semiconductor device 1 toward the main reflection member 211.

[0049] The main reflection member 211 may be a configuration for reflecting the first plane image for the first plane toward the single image acquisition unit 100, and may use various members such as a reflection member and a semi-transparent member.

[0050] The sub reflection member 311 may be a configuration installed corresponding to each side surface of the polygonal sides of the semiconductor device 1 and for reflecting a side surface image of each side surface of the polygonal sides of the semiconductor device 1 toward the main reflection member 211, and may use various members such as a reflection member, a semi-transparent member, and the like.

[0051] Meanwhile, in the optical system, an illuminator 540 for emitting light on a first plane and side surfaces for vision inspection is installed, and the illuminator 540 may be installed variously according to the emission method.

[0052] The illuminator 540 may emit various kinds of light such as monochromatic light such as laser light, tricolor light such as R, G, B, and white light depending on the type of vision inspection, and various light sources such as LED devices may be used.

[0053] In addition, the illuminator 540 may be arranged in various ways according to the configuration of the optical system.

[0054] As an example, when the optical system includes the main reflection member 211 described above, the main reflection member 211 may consist of a semi-transparent material capable of transmitting light, and at this time, the illuminator 540 may be configured to emit light to the first plane and each side surface of the polygonal sides of the semiconductor device 1 at the other surface of the reflective surface that reflects the first plane image.

[0055] Also, as shown in FIG. 2, the illuminator 540 may be configured such that emission of the first plane and emission of each side surface are performed by a separate light source 545, and at this time, the above-described sub reflection member 311 may consist of a semi-transparent material capable of transmitting light and the illuminator 540 may be configured to emit light to each side surface of the polygonal sides of the semiconductor device 1 at the other surface of the reflective surface that reflects the side surface image.

[0056] Meanwhile, since the first plane image and the side surface images are acquired through different optical paths, i.e., the first optical path L1 and the second optical path L2, when an image is acquired by a single image acquisition device, i.e., a camera, due to the light path difference of the optical path, there is a problem that the focus of one of the first plane image and the side surface images is blurred.

[0057] Therefore, as shown in FIGS. 2 to 5, the vision inspection module 50 may further include a focal length correction unit 400 that is installed in the optical system to correct a focal length difference between the first optical path L1 and the second optical path L2.

[0058] Due to a path difference of an optical path, which is obtained through the first optical path L1 and the second optical path L2, the focal length correction unit 400 may be configured to compensate for the difference between the focal lengths and may be variously configured.

[0059] For example, the focal length correction unit 400 may include a medium unit 410 consisting of a transparent material that transmits light, which is installed in the corresponding optical path L1 or L2.

[0060] The medium unit 410, as a configuration installed on a corresponding optical path L1 or L2 to correct a focal length, is a configuration installed on an optical path L1 or L2 such as a transparent glass or quartz to correct a focal length due to a difference in refractive index.

[0061] In particular, the medium unit 410 is preferably installed on the second optical path L2 among the first optical path L1 and the second optical path L2.

[0062] Herein, in relation to the medium unit 410, based on an optical path, the incident and transmission surfaces of light may form a plane perpendicular to the optical path and the medium unit 410 may have a columnar shape such as a cylinder, a polygonal column, and the like with a predetermined thickness.

[0063] At this time, the thickness t of the medium unit 410 in the direction of the second optical path L2 is calculated according to FIG. 6 and the following equation.

[0064] $t = (1 - 1/n) / A1 - A2$ (where t is the thickness of the medium in the optical path direction, n is the refractive index of the medium, $A1$ is the working distance for image acquisition for the first plane, $A2$ is the working distance for image acquisition for the side surface)

[0065] Meanwhile, since the measurement result may be influenced when there is a

slight error, precise installation of the medium unit 410 is important, and for this, the focal length correction unit 400 may include a frame unit 420 which is detachably coupled to the structure 520 and to which the medium unit 410 is detachably installed.

[0066] The structure 520, as a configuration installed in a system, that is, a device inspection system, to support the medium unit 410, may be variously configured.

[0067] The frame unit 420, as a configuration, which is detachably coupled to the structure 520 and to which the medium unit 410 is detachably installed, may be variously configured.

[0068] As an example, as shown in FIG. 3, the frame unit 420 may be configured by a plurality of frame members 421 and 422 for forming an empty space 429 at the first optical path L1 to be optically transmitted and enabling the medium unit 413 to be installed at a portion corresponding to the second optical path L2.

[0069] Also, the frame unit 420 may be detachably coupled to the structure 520 by a magnetic force, and for this, at least one of the frame unit 420 and the structure 520 may have one or more magnets 424 and 524 installed therein.

[0070] Meanwhile, the focal length correction unit 400 may be variously arranged in combination with an optical system.

[0071] As an example, as shown in FIGS. 2 and 5, the focal length correction unit 400 may be installed in at least one of between each side surface of the polygonal sides of the semiconductor device 1 and the main reflection member 211 of the second optical path L2 and between the main reflection member 211 and the single image acquisition unit 100 of the second optical path L2.

[0072] And, when the focal length correction unit 400 is installed between each side surface of the polygonal sides of the semiconductor device 1 and the main reflection

member 211 of the second optical path L2, it may be formed integrally with the sub reflection member 311.

[0073] By installation of the focal length correction unit 400, it is possible to solve the problem that one of the first plane image and the side surface images is out of focus caused by the focal length difference due to the path difference of the optical path when images are acquired by a single image acquisition device, i.e., a camera,.

[0074] The first transfer tool 61, as a configuration coupled with the first guide rail 68 to move along the first guide rail 68 and for picking up and transferring a device from the loading unit 10 to the vision inspection module 50 to perform a vision inspection, may be variously configured.

[0075] As an example, the first transfer tool 61 includes at least one pick-up tool (not shown) for picking up the semiconductor device 1, and the pick-up tool may be provided in one line or a plurality of lines in order to increase the inspection speed and the like.

[0076] The pick-up tool, as a configuration for picking up the semiconductor device 1 by vacuum pressure, may be variously configured.

[0077] The first guide rail 680, as a configuration disposed perpendicularly to the movement direction of the tray 2 in the loading unit 10 to support the first transfer tool 61 and guide the movement, may be variously configured.

[0078] The unloading units 31, 32 and 33, as a configuration for receiving the trays 2 on which the semiconductor devices 1 after vision inspection are put from the loading unit 10 and for sorting the semiconductor devices 1 in the corresponding tray 2 according to a vision inspection result, may be variously configured.

[0079] The unloading units 31, 32, and 33 have a configuration similar to that of the loading unit 10, and classification grades for sorting such as good products G, defect 1 or

abnormality 1 R1, and defect 2 or abnormality 2 R2 may be given according to the number of inspection results of the semiconductor device 1.

[0080] And, in the unloading units 31, 32, and 33, a plurality of unloading tray units including a guide unit (not shown) installed parallel to one side of the loading unit 10 and a driving unit (not shown) for moving the tray 2 along the guide unit may be installed in parallel.

[0081] Meanwhile, the tray 2 may be transferred between the loading unit 10 and the unloading units 31, 32, and 33 by a tray transfer device (not shown) and the unloading unit 31, 32 and 33 may further include an empty tray unit 200 for supplying the empty tray 2 where the semiconductor device 1 is not loaded.

[0082] At this time, the empty tray unit 200 may include a guide unit (not shown) installed parallel to one side of the loading unit 10 and a driving unit (not shown) for moving the tray 2 along the guide unit.

[0083] Also, in the unloading units 31, 32 and 33, a sorting tool 62 for transferring the semiconductor device 1 between the unloading tray units may be additionally provided according to the classification grade of each unloading tray unit.

[0084] The sorting tool 62 has the same or similar structure as the first transfer tool 61 described above and may have a series structure or a linear structure.

[0085] Meanwhile, although it is described that the unloading units 31, 32 and 33 unload the tray 2 loaded in the loading unit 10 into a loaded state again, any configuration for loading and unloading the semiconductor device 1, for example, including a so-called tape and reel module loading and unloading a carrier tape where a pocket containing the semiconductor device 1 is formed, is possible.

[0086] Meanwhile, the present invention has a feature in a configuration where a focal

length compensation unit is installed in a vision inspection module, in particular, an optical path, so that the vision inspection module according to the present invention is not limited to one embodiment of the device inspection system suggested here.

[0087]

[0088] While the preferred embodiments of the present invention are described exemplary, the scope of the present invention is not limited to these specific embodiments, but may be appropriately changed within the scope of the claims.

【CLAIMS】

1. A vision inspection module 50 for performing a vision inspection of a semiconductor device 1 having a polygonal plane shape, the vision inspection module 50 comprising:

a single image acquisition unit 100 configured to acquire a first plane image for a first plane of the semiconductor device 1 and side surface images for side surfaces of polygonal sides of the semiconductor device 1; and

an optical system configured to form a first optical path L1 for enabling the first plane image for the first plane of the semiconductor device 1 to reach the single image acquisition unit 100, and a plurality of second optical paths L2 for enabling each of the side surface images for the side surfaces of the polygonal sides of the semiconductor device 1 to reach the single image acquisition unit 100.

2. The vision inspection module 50 of claim 1, further comprising a focal length correction unit 400 that is installed in the optical system to correct a focal length difference of the first optical path L1 and the second optical path L2.

3. The vision inspection module 50 of claim 2, wherein the focal length correction unit 400 includes a medium unit 410 that is installed in a corresponding optical path L1 or L2 and consists of a transparent material that transmits light.

4. The vision inspection module 50 of claim 2, wherein the focal length correction unit 400 includes a frame unit 420 detachably coupled to a structure 520, the frame unit 420 in which the medium unit 410 is detachably installed.

5. The vision inspection module 50 of claim 4, wherein the frame unit 420 is detachably coupled to the structure 520 by a magnetic force.

6. The vision inspection module 50 of any one of claims 1 to 5, wherein the optical system includes:

a main reflection member 211 configured to reflect the first plane image for the first plane toward the single image acquisition unit 100; and

a sub reflection member 311 installed corresponding to each side surface of the polygonal sides of the semiconductor device 1 to reflect a side surface image of each side surface of the polygonal sides of the semiconductor device 1 toward the main reflection member 211.

7. The vision inspection module 50 of claim 6, wherein the main reflection member 211 consists of a semi-transparent material that transmits light and includes an illuminator 540 configured to emit light to the first plane and each side surface of the polygonal sides of the semiconductor device 1 at the other surface of a reflective surface that reflects the first plane image.

8. The vision inspection module 50 of claim 7, wherein the focal length correction unit 400 is installed in at least one of between each side surface of the polygonal sides of the semiconductor device 1 and the main reflection member 211 of the second optical path L2 and between the main reflection member 211 and the single image acquisition unit 100 of the second optical path L2.

9. The vision inspection module 50 of claim 7, wherein the focal length correction unit 400 is installed between each side surface of the polygonal sides of the semiconductor device 1 and the main reflection member 211 of the second optical path L2,

wherein the focal length correction unit 400 is integrally formed with the sub reflection member 311.

10. A device inspection system comprising:

a loading unit 10 configured to load and linearly move a tray 2 on which a plurality of semiconductor devices 1 are put;

a vision inspection module 50 installed on one side of the loading unit 10 perpendicular to a transfer direction of the tray 2 in the loading unit 10 to perform a vision inspection on the semiconductor device 1;

a first guide rail 68 disposed perpendicularly to a movement direction of the tray 2 in the loading unit 10;

a first transfer tool 61 coupled to the first guide rail 68 to move along the first guide rail 68 and configured to pick up and transfer a device from the loading unit 10 to the vision inspection module 50 to perform a vision inspection; and

unloading units 31, 32, and 33 configured to receive the trays 2 on which the semiconductor devices 1 after the vision inspection are put from the loading unit 10 and sort semiconductor devices 1 on a corresponding tray 2 according to a vision inspection result,

wherein the vision inspection module 50 is the vision inspection module according to any one of claims 1 to 5.

11. The device inspection system of claim 10, wherein the optical system includes:

a main reflection member 211 configured to reflect the first plane image for the first plane toward the single image acquisition unit 100; and

a sub reflection member 311 installed corresponding to each side surface of the polygonal sides of the semiconductor device 1 to reflect a side surface image of each side surface of the polygonal sides of the semiconductor device 1 toward the main reflection member 211.

12. The device inspection system of claim 11, wherein the main reflection member 211 consists of a semi-transparent material that transmits light and includes an illuminator 540 configured to emit light to the first plane and each side surface of the polygonal sides of the semiconductor device 1 at the other surface of a reflective surface that reflects the first plane image.

13. The device inspection system of claim 12, wherein the focal length correction unit 400 is installed in at least one of between each side surface of the polygonal sides of the semiconductor device 1 and the main reflection member 211 of the second optical path L2 and between the main reflection member 211 and the single image acquisition unit 100 of the second optical path L2.

14. The device inspection system of claim 12, wherein the focal length correction unit 400 is installed between each side surface of the polygonal sides of the

semiconductor device 1 and the main reflection member 211 of the second optical path L2,

wherein the focal length correction unit 400 is integrally formed with the sub reflection member 311.