

WIRE SHAPE INSPECTING APPARATUS AND WIRE SHAPE INSPECTING METHOD

BACKGROUND

5 Technical Field

[0001] The present invention discloses a wire shape inspecting apparatus and a wire shape inspecting method to inspect the shape of a wire which is bonded between a semiconductor chip and a mounted body.

Related Art

10 **[0002]** Conventionally, wire bonding for mounting a semiconductor chip on a mounted body by bonding a wire between the semiconductor chip and the mounted body (a substrate or another semiconductor chip) has been widely known. Patent literature 1 discloses that after performing such wire bonding, a post bond inspection (PBI) is performed to inspect whether each part of the wire loop is accurately
15 wire-bonded to a given bonding position. By performing the post bond inspection, the reliability of a semiconductor apparatus that is manufactured can be further improved.

[0003] Meanwhile, in order to perform the post bond inspection, it is evidently necessary to detect the shape of the wire. Conventionally, the shape of the wire was often detected mainly by a method called the focus method. In the focus method, on
20 the basis of a focal distance when capturing an image and the position (coordinate) of a portion in focus (focused portion) in the image, the position of the focused portion in reality is identified. When the shape of the wire is detected by the focus method, the image of the wire is captured a plurality of times while changing the focal distance. Then, for each image, the coordinate of the focused portion of the wire that is in focus is

easily enters the camera 14 located above. As a result, in the first inspection image obtained by image-capturing with the camera 14, the light emitting portion which is an image of the light reflected by the wire 110, particularly by the neck portion 110b is imaged. Here, although the light of the first light sources 20 reflects at various height
5 positions of the neck portion 110b, what is imaged in the first inspection image is the reflected light at the height position where the focal distance matches. Therefore, if the position in image of the light emitting portion 50 imaged in the first inspection image and the focal distance during image-capturing are known, the actual position of the light emitting portion, that is, the position of the peripheral surface of the neck
10 portion 110b can be identified.

[0037] FIG. 7A to FIG. 7E are diagrams showing examples of the shape of the light emitting portion 50. FIG. 7A shows the light emitting portion 50 at point Pa in FIG. 4. That is, the light emitting portion 50 imaged in the image captured when focusing in the point Pa is shown. Similarly, FIG. 7B to FIG. 7E show the light emitting portion 50 at
15 the points Pb to Pe in FIG. 4.

[0038] As is clear from FIG. 7A to FIG. 7E, in the lateral portion 110a, only the periphery of the edge of the wire 110 is brightly reflected. As a result, in the image, two lumps of light (light emitting portion 50) that are completely separated or partially connected are imaged. In this way, the shape detection (second shape detecting
20 processing) using the focus method can be performed on the portion where two light emitting portions 50 are imaged. In addition, in the periphery of the ball portion 110c, the reflected light is easy to orient in the horizontal direction and thus is not prone to enter the camera 14. As a result, when point Pe is in focus, as shown in FIG. 7E, an entirely dark image without the light emitting portion 50 is obtained.

WHAT IS CLAIMED IS:

1. A wire shape inspecting apparatus which inspects a shape of a wire bonded between a semiconductor chip and a mounted body, comprising:

a camera, which captures images of a wire to be inspected from a first
5 direction;

a light, which illuminates the wire to be inspected from the first direction;
and

a control portion, which controls the driving of the camera and the light, and identifies the shape of the wire on the basis of the images captured by the camera;

10 wherein the wire has a lateral portion observable by the camera and a neck portion located on a back side of the lateral portion when viewed from the camera; and

wherein the control portion performs

an inspection image acquiring processing, in which a plurality of inspection images are acquired by causing the camera to capture images of the wire to be inspected

15 a plurality of times while changing a focal distance; and

a first shape detecting processing, in which identifying a coordinate of a light emitting portion which is an image part of reflected light where light from the light is reflected by the neck portion of the wire in one inspection image, and identifying a position of the light emitting portion in reality in a focal distance when the one
20 inspection image is acquired as an actual light emitting portion position on the basis of the coordinate, are performed for the plurality of inspection images respectively, and actual light emitting portion positions of a plurality of focal distances are connected respectively to detect the shape of the neck portion.

2. The wire shape inspecting apparatus according to claim 1,

wherein the control portion determines whether a lump of light is an image part of reflected light reflected by the neck portion of the wire or not on the basis of a number of the lump of light represented in the one inspection image.

3. The wire shape inspecting apparatus according to claim 2,

5 wherein the control portion further

performs a second shape detecting processing in which the position in reality of a focused portion where the image of the wire becomes clear is identified in the inspection image as an actual focused portion position on the basis of the position of the focused portion in the image and the focal distance when the inspection image is
10 acquired; and

wherein the control portion detects the shape of the lateral portion by the second shape detecting processing.

4. The wire shape inspecting apparatus according to claim 3,

wherein the light comprises:

15 one or more first light sources disposed on a first circle concentric with the camera; and

one or more second light sources disposed on a second circle concentric with the camera and having a larger diameter than the first circle; and

wherein the control portion lights the first light sources when the inspection
20 image used in the first shape detecting processing is captured, and lights the second light sources when the inspection image used in the second shape detecting processing is captured.

5. The wire shape inspecting apparatus according to claim 3 or 4,

wherein a change interval of the focal distance of a plurality of inspection

images used in the first shape detecting processing is narrower than a change interval of the focal distance of a plurality of inspection images used in the second shape detecting processing.

6. A wire shape inspecting method which inspects a shape of a wire laid
5 between a semiconductor chip and a mounted body, comprising:

an arrangement step, in which a camera for capturing images of a wire to be
inspected from a first direction is arranged and a light for illuminating the wire to be
inspected from the first direction is arranged, the wire having a lateral portion
observable by the camera and a neck portion located on a back side of the lateral portion
10 when viewed from the camera;

an inspection image acquiring step, in which a plurality of inspection images
are acquired by causing the camera to capture images of the wire to be inspected a
plurality of times while illuminating the wire to be inspected by the light and changing a
focal distance; and

15 a first shape detecting step, in which identifying a coordinate of a light
emitting portion which is an image part of reflected light where light from the light is
reflected by the neck portion of the wire in one inspection image, and identifying a
position of the light emitting portion in reality in a focal distance when the one
inspection image is acquired as an actual light emitting portion position on the basis of
20 the coordinate, are performed for the plurality of inspection images respectively, and
actual light emitting portion positions of a plurality of focal distances are connected
respectively to detect the shape of the neck portion.