METHOD FOR VISION INSPECTING SEMICONDUCTOR PACKAGES

BACKGROUND

1. Technical Field

The present invention relates to a method for inspecting semiconductor packages during manufacture of semiconductor packages, and, more particularly, to a method for inspecting semiconductor packages using a camera when the individual semiconductor packages are picked-up by a picker in a semiconductor package manufacturing apparatus.

2. Description of the Related Art

In general, during a post-process in manufacturing semiconductor packages, semiconductor chips with circuit elements, such as transistors, capacitors and the like highly integrated thereon are mounted on a lead frame, pads of the semiconductor chips are electrically connected to leads of the lead frame using conductive wires, and then the entire surface is subjected to a resin molding process. The molded semiconductor packages on the lead frame are singulated (or segmented) into individual units through a singulation process and foreign substances on the surfaces thereof are then removed through cleaning and drying processes.

The singulated semiconductor packages go through visual inspection in a picked-up state by a picker before being put in a tray and are accommodated in the tray after being classified based on a result of the visual inspection.

In a typical semiconductor package singulation apparatus, the picker simultaneously picks up a plurality of semiconductor packages by a vacuum for visual inspection in order to increase a throughput rate and transfers the semiconductor packages to the tray for accommodation.

In such a conventional semiconductor package singulation apparatus, however, under the condition where the picker picks up a plurality of semiconductor packages by a vacuum, the visual inspection is performed while the picker intermittently alternates

between movement and stop several times over a visual inspection region, which may result in poor productivity due to a slow inspection speed, increased vibration due to repeated acceleration and deceleration, and increased load of a motor which drives the picker.

BRIEF SUMMARY

The present invention has been made in view of the above problems, and an aspect of the present invention is to provide a method for visual inspection of semiconductor packages, which allows visual inspection at a high speed under a condition in which a picker picks up a plurality of semiconductor packages, while providing minimized vibration and motor load in the course of visual inspection.

In accordance with one aspect of the present invention, there is provided a method for visual inspection of semiconductor packages in a semiconductor package manufacturing apparatus including a table on which semiconductor packages to be inspected are mounted, a picker having a plurality of pick-up members with an adjustable gap therebetween for fixing the semiconductor packages, and a camera photographing the semiconductor package picked-up by the picker. The method includes: picking up some of the semiconductor packages from the table by the picker under a condition in which a gap between the pick-up members is a first pitch; adjusting the gap between the pick-up members of the picker to a second pitch which is less than the first pitch; and photographing the semiconductor packages picked-up by the picker using the camera while the picker moves relative to the camera.

According to an embodiment of the invention, by reducing the gap between the pick-up members of the picker, it is possible to reduce the number of semiconductor packages lying within a field of vision of the vision camera, which may result in reduction of an excursion length of the picker.

In addition, the semiconductor packages are photographed while the picker continues to move without staying above the camera, which may result in an increased visual inspection speed and significant reduction of vibration and motor load.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects, features and advantages of the invention will become apparent from the following description of exemplary embodiments given in conjunction with the accompanying drawings, in which:

Figs. 1 to 3 are schematic front views of one embodiment of a visual inspection unit in a semiconductor package manufacturing apparatus (for example, a semiconductor package singulation apparatus) to which a visual inspection method of the present invention is applied;

Fig. 4 is a plan view showing one embodiment of a table of the visual inspection unit shown in Fig. 1;

Fig. 5 is a plan view showing one embodiment of a tray of the visual inspection unit shown in Fig. 1;

Fig. 6 is a front view showing one embodiment of a picker of the visual inspection unit shown in Fig. 1; and

Fig. 7 is a flowchart of a visual inspection method according to one exemplary embodiment of the present invention.

DETAILED DESCRIPTION

Exemplary embodiments of the invention will be described in detail with reference to the accompanying drawings.

First, one embodiment of a visual inspection unit of a semiconductor package manufacturing apparatus (for example, a semiconductor package singulation apparatus) to which a visual inspection method of the present invention is applied will be described with reference to Figs. 1 to 4.

Referring to Figs. 1 to 3, the visual inspection unit includes a plurality of tables 10 (two tables in this embodiment) on which singulated semiconductor packages to be inspected are mounted, a picker 20 which holds and transfers the semiconductor packages

from the tables 10, a camera 30 which is located below the picker 20 and takes photographs of the semiconductor packages S held by the picker 20, and a tray 40 which accommodates the semiconductor packages S subjected to visual inspection by the camera 30.

As shown in Fig. 4, the table 10 is formed at an upper surface thereof with a plurality of vacuum holes 11, to which the semiconductor packages S are adsorbed by a vacuum. In this embodiment, the vacuum holes 11 are alternately arranged at a 2-pitch interval (P1) in each column on each of the two tables 10. Alternatively, the vacuum holes 11 may be arranged at one pitch interval in the form of a grid on each of the tables 10.

In addition, the tables 10 place the semiconductor packages S below the picker 20 while moving relative to the picker 20 below the picker 20 by means of a linear shifter (not shown).

As shown in Fig. 5, the tray 40 includes a plurality of pockets 41 in which the semiconductor packages S having completed visual inspection are to be accommodated. The pockets 41 are arranged at a certain interval P3 in the form of a grid. The tray 40 is also configured to move relative to the picker 20 below the picker 20 by means of a linear shifter (not shown).

The picker 20 is combined with the linear shifter (not shown) installed in a guide frame 50, which traverses above the tables 10, the camera 30 and the tray 40, and horizontally reciprocates along the guide frame 50. Examples of the linear shifter (not shown) for driving the picker 20 may include a system including ball screws and a motor, a system including a plurality of pulleys, a power transmission belt and a motor, a linear motor system, or various other linear shifters known in the art.

The picker 20 further includes a plurality of pick-up members 21 (8 pick-up members in this embodiment) which adsorb the semiconductor packages S by a vacuum and secure the semiconductor packages S. The pick-up members 21 are configured to allow adjustment of a gap therebetween. For example, as shown in Fig. 6, the pick-up members 21 are installed in a body 22 of the picker 20 to be horizontally moved by a movable block 23 and an LM (Linear Motion) guide rail 24 and are respectively connected to a plurality of inclined grooves 27 for gap adjustment formed in a cam plate 26 via

respective rollers 25. In the picker 20 configured as described above, as a motor 28 moves the cam plate 26 in the vertical direction, the pick-up members 21 are laterally moved by the inclined grooves 27 to adjust the gap therebetween.

Next, an inventive visual inspection method which is performed by the aforementioned visual inspection unit will be described with reference to Figs. 1 to 3 and 7.

First, as shown in Fig. 1, the picker 20 picks up target semiconductor packages using a vacuum from the tables 10 in S1 (Fig. 7). At this time, it is assumed that the pick-up members 21 of the picker 20 is preset to have the same gap (first pitch P1) as the gap between the semiconductor packages S mounted on the tables 10.

Then, as shown in Fig. 2, the picker 20 adjusts the pick-up members 21 to have a gap (second pitch P2) which is smaller than the preset gap and then moves above the camera 30 along the guide frame 50 in S2 (Fig. 7). The operation of reducing the gap between the pick-up members 21 of the picker may be performed immediately before the picker 20 moves along the guide frame 50, or alternatively while the picker 20 is moved along the guide frame 50.

Preferably, the gap (second pitch P2) between the pick-up members 21 adjusted in S2 is equal to the minimal gap between the pick-up members 21 or a gap (third pitch P3) between the pockets 41 of the tray 40. Such reduction of the gap between the pick-up members 21 provides an advantage of increase in the number of semiconductor packages S within a field of vision (FOV) of the camera 30 and reduction of an excursion length of the picker 20.

After the picker 20 moves above the camera 30, the picker 20 is photographed by the camera 30 while passing over the camera 30 without staying above the camera 30 in S3 (Fig. 7). At this time, the semiconductor packages S fixed on the picker 20 are consecutively photographed by the camera 30 corresponding to the number of semiconductor packages S within the FOV. For example, if 4 semiconductor packages S are allowed to be located in the FOV, 8 semiconductor packages S are consecutively photographed twice by photographing a group of four semiconductor packages S at a time. Of course, if all 8 semiconductor packages S are allowed to be located in the FOV, all of the semiconductor packages S may be photographed only once.

In addition, when the semiconductor packages S on the picker 20 are photographed by the camera 30 in S3, all of the semiconductor packages S picked-up by the picker 20 may be photographed during movement of the picker 20 in one direction. Alternatively, some of the semiconductor packages S picked-up by the picker 20 may be photographed during movement of the picker 20 in one direction and the others may be photographed during returning of the picker 20 in the opposite direction. For example, n semiconductor packages S among the semiconductor packages S on the picker 20 are photographed while the picker 20 is moved above the camera 30 from the tables 10 and the remaining n semiconductor packages S are photographed while the picker 20 returns to the tray 40.

Alternatively, some of the semiconductor packages S are photographed while the picker 20 is moved in one direction, some are photographed while the picker 20 is stopped, and the remaining semiconductor packages S are photographed while the picker 20 returns in the opposite direction.

Further, in S3 where the semiconductor packages S picked-up by the picker 20 are photographed by the camera 30, the picker 20 may be decelerated within the FOV of the camera 30 and the semiconductor packages S are photographed when the moving speed of the picker 20 is a preset speed or less in this deceleration section. Specifically, the picker 20 has a speed profile in which the picker 20 having picked up the semiconductor packages S from the tables 10 is accelerated during movement towards the camera and is then decelerated above the camera 30. Thus, in order to obtain a clean image, the semiconductor packages S must photographed when the picker 20 reaches the preset speed or less through deceleration above the camera 30.

After the semiconductor packages S picked-up by the picker 20 are photographed by the camera 30, the picker 20 is moved to the tray 40 along the guide frame 50 and accommodates the semiconductor packages S in empty pockets 41 of the tray 40 in S4, as shown in Fig. 3. Here, there is no need to readjust a gap between the pick-up members 21 of the picker 20 if the gap between the pick-up members 21 has already been adjusted to the gap P3 between the pockets 41 of the tray 40 in Step S2. On the other hand, if the gap between the pick-up members 21 is adjusted to the minimal gap, it is necessary to adjust

the gap between the pick-up members 21 to the gap P3 between the pockets 41 of the tray 40 during movement of the picker 20.

As described above, according to the embodiment of the invention, by reducing the gap between the pick-up members 21 of the picker 20 which picks up the semiconductor packages S from the tables 10, it is possible to reduce the number of semiconductor packages placed within the FOV of the camera 30, thereby reducing an excursion length of the picker 20. Further, the semiconductor packages S are photographed while the picker 20 moves without staying above the camera 30, thereby providing an increased visual inspection speed and significant reduction of vibration and motor load.

Although the method for semiconductor package visual inspection has been illustrated as being applied to the visual inspection unit of the semiconductor package singulation apparatus, it should be understood that the present invention is useful for inspection of conditions of processed semiconductor packages in a variety of semiconductor package manufacture or inspection apparatuses.

Although some embodiments have been described herein, it should be understood by those skilled in the art that these embodiments are given by way of illustration only, and that various modifications, variations, and alterations can be made without departing from the spirit and scope of the invention. Therefore, the scope of the invention should be limited only by the accompanying claims and equivalents thereof.

WHAT IS CLAIMED IS:

1. A method for visual inspection of semiconductor packages in a semiconductor package manufacturing apparatus including a table on which semiconductor packages to be inspected are mounted, a picker having a plurality of pick-up members with an adjustable gap therebetween for fixing the semiconductor packages, and a camera photographing the semiconductor package picked-up by the picker, the method comprising:

picking up the semiconductor packages from the table by the picker under a condition in which a gap between the pick-up members is a first pitch;

adjusting the gap between the pick-up members of the picker to a second pitch which is less than the first pitch; and

photographing the semiconductor packages picked-up by the picker using the camera while the picker moves relative to the camera.

2. The method of claim 1, wherein, in the step adjusting the gap between the pick-up members, the second pitch is the minimal gap between the pick-up members.

3. The method of claim 2, wherein, after the step of photographing the semiconductor packages, the gap between the pick-up members of the picker is adjusted to a third pitch which is equal to a gap between pockets of a tray accommodating inspected semiconductor packages.

4. The method of claim 1, wherein, in the step of adjusting the gap between the pick-up members, the second pitch is equal to a gap between pockets of a tray accommodating inspected semiconductor packages.

5. The method of any one of claims 1 to 4, wherein, in the step of photographing the semiconductor packages, some of the semiconductor packages picked-up by the picker are photographed by the camera while the picker is moved relative to the camera in a first direction and the others are photographed by the camera while the picker is stopped or is

moved relative to the camera in a second direction opposite the first direction.

6. The method of any one of claims 1 to 4, wherein, in the step of photographing the semiconductor packages, some of the semiconductor packages picked-up by the picker are photographed by the camera while the picker is moved relative to the camera in a first direction, others of the semiconductor packages picked-up by the picker are photographed by the camera while the picker is stopped, and remaining semiconductor packages picked-up by the picker are photographed by the camera while the picker is moved relative to the camera in a second direction opposite the first direction.

7. The method of any one of claims 1 to 4, wherein, in the step of photographing the semiconductor packages, a moving speed of the picker relative to the camera above the camera is less than a speed at which the picker is moved from the table towards the camera.

8. The method of any one of claims 1 to 4, wherein, in the step of photographing the semiconductor packages, the semiconductor packages are photographed while the picker is moved at a preset speed or less relative to the camera above the camera.