

POSITIONING APPARATUS AND METHOD

Field of Invention

The invention relates to the manufacture of semiconductor devices. More particularly, the invention relates to an apparatus and a method for positioning of semiconductor devices into component pockets of holding trays used for containing the semiconductor devices.

Background

Manufacturing of semiconductor devices (referred to hereinafter as devices) is fully automated for cost savings to be achieved in terms of capital and material costs. Conventionally, the devices are individually molded and subsequently separated from lead-frames or substrates. After the devices are separated from the lead-frames or substrates, they are then placed and positioned on a plate. The devices then undergo intermediate and post processing such as washing and drying before being placed onto holding trays for transfer to other locations for further processing. However, during washing of the devices, the devices might be misaligned from their current positions on the plate. The positioning of the devices on the plate facilitate subsequent placement of the devices onto the holding trays.

During drying, the devices are typically blow-dried by using a blower. Additionally, heat is also providable to the plate to further aid in the drying of the devices. Once the devices are dried, they are then transferred into component pockets (referred to hereinafter as pockets) formed in the holding trays. However, as the plate has a flat surface, the large contact surface between the devices and the plate will then result in some of the devices adhering to the surface of the plate during transfer of the devices from the plate to the holding trays.

The pockets of the holding trays are typically sufficiently deep for receiving the devices. During transfer of the devices from the plate to the holding trays, the plate is first inverted and positioned above the holding trays. Each of the devices are positioned over a respective pocket. Vacuum that is initially provided to the plate for holding the devices is then removed, thereby releasing each of the devices into the respective pockets. However, due to

the depth of each of the pockets, misalignment tends to occur due to gravitational displacement of the devices during transfer of the devices from the plate to the holding trays.

When some of the devices adhere to the plate or suffer from misalignment during transfer from the plate to the holding trays, human intervention is subsequently required. Since thousands of devices are typically transferred each time, considerable delay and additional costs will be incurred in the manufacturing process if any devices adhered to the plates or are misaligned during transfer from the plate to the holding trays.

In view of the foregoing deficiencies, there affirms a need for an apparatus and a method for allowing trouble-free transfer of semiconductor devices from the plate to the holding trays.

Summary of Invention

The present embodiment of the invention disclosed herein provides an apparatus and a method for transferring semiconductor devices into component pockets of holding trays.

In accordance with a first aspect of the invention, there is disclosed a positioning apparatus comprising a body and at least one protrusion. The at least one protrusion extends from the body and terminates at a free end. Each of the at least one protrusion defines a channel therein and the channel of each of the at least one protrusion terminates at an opening at the free end thereof. In addition, air drawn through the channel of each of the at least one protrusion substantially creates a vacuum at the opening thereof for vacuum coupling a component thereto. The body is spatially positionable for positioning the component couplable to one of the at least one protrusion over and towards a corresponding one of at least one pocket formed in a base. The one of the at least one protrusion is shaped and dimensioned for being received within the one of the at least one pocket and for guiding the component vacuum coupled thereto into the one of the at least one pocket.

In accordance with a second aspect of the invention, there is disclosed a positioning apparatus comprising a body, at least one protrusion and at least one pocket. The at least

one protrusion extends from the body and terminates at a free end. Each of the at least one protrusion defines a channel therein and the channel of each of the at least one protrusion terminates at an opening at the free end thereof. In addition, air drawn through the channel of each of the at least one protrusion substantially creates a vacuum at the opening thereof
5 for vacuum coupling a component thereto. The at least one pocket is formed in a base for receiving the component vacuum couplable to one of the at least one protrusion extending from the body. The one of the at least one protrusion is shaped and dimensioned for being received within the one of the at least one pocket and for guiding the component vacuum coupled thereto into the one of the at least one pocket.

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In accordance with a third aspect of the invention, there is disclosed a method of positioning a component using a positioning apparatus. The method comprises providing a body comprising at least one protrusion extending from a surface and terminating at a free end. The method also comprises creating vacuum at the opening of the channel of each of the at
15 least one protrusion for coupling the component to the protrusion. In addition, the method comprises positioning the component coupled to one of the at least one protrusion aligned to one of at least one pocket formed in a base. The base comprises a face. Further, the method comprises displacing the body until the component couplable to the one of the at least one protrusion is positioned within the one of the at least one pocket. Yet further, the method
20 comprises releasing the component coupled to the one of the at least one protrusion into the one of the at least one pocket. Lastly, the method comprises moving the body away from the face of the base to remove one of the at least one protrusion from the one of the least one pocket.

25 **Brief Description of the Drawings**

Embodiments of the invention are described hereinafter with reference to the following drawings, in which:

FIG. 1 is an isometric view of a positioning apparatus with semiconductor devices
30 positioned on protrusions according to an embodiment of the invention;

FIG. 2 is a cross-sectional view of the protrusions of the positioning apparatus of FIG. 1;

FIG. 3 is a cross-sectional view of the protrusions of the positioning apparatus of FIG. 1 vacuum-coupling the semiconductor devices;

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FIG. 4 is an isometric view of component pockets of a holding tray for receiving the semiconductor devices from the positioning apparatus of FIG. 1;

FIG. 5 is a cross-sectional view of the component pockets of FIG. 4;

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FIG. 6 is a cross-sectional view of a protrusion of the positioning apparatus of FIG. 1 using vacuum suction for vacuum-coupling a semiconductor device and invertedly positioning the semiconductor device above a component pocket of the holding tray of FIG. 4;

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FIG. 7 is a cross-sectional view of the protrusion of FIG. 6 vacuum-coupling the semiconductor device using vacuum suction and invertedly placing the semiconductor device into the component pocket of the holding tray of FIG. 4;

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FIG. 8 is cross-sectional view of the protrusion of FIG. 6 moving away from the component pocket after releasing the semiconductor device into the component pocket of the holding tray of FIG. 4; and

FIG. 9 is a process flow diagram of a positioning method using the positioning apparatus of FIG. 1.

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Detailed Description of the Embodiment

An apparatus and a method for transferring semiconductor devices into component pockets of holding trays are described hereinafter for addressing the foregoing problems.

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For purposes of brevity and clarity, the description of the invention is limited hereinafter for

manufacturing of semiconductor devices. This however does not preclude the embodiment of the invention from other applications of similar nature. The inventive principles of the embodiment of the invention remain common throughout.

- 5 Exemplary embodiments of the invention are described hereinafter in accordance with FIGs. 1 to 9 of the drawings, in which like elements are numbered with like reference numerals.

A positioning apparatus 100 according to an embodiment of the invention as shown in FIG. 1 for positioning semiconductor devices (referred to hereinafter as devices) 200 is described.

10 The positioning apparatus 100 comprises a body 202 having protrusions 204 on a surface 206 of the body 202. A channel 208 is formed within each protrusion 204 and terminates at an opening 210 at a free end of the protrusion 204 as shown in FIG. 2. In addition, the channel 208 of each protrusion 204 extends towards a manifold (not shown). The manifold interconnects the channel 208 of each protrusion 204 to a pump (not shown). Air is drawn

15 through the channel 208 to create a vacuum at the opening 210 for vacuum-coupling the devices 200 to the protrusions 204 as shown in FIG. 3. The body 202 comprises heating elements in which heat is generated by the heating elements when the devices 200 are vacuum-coupled to the protrusions 204 for drying the devices 200. Alternatively, the protrusion 204 is positionable for retracting into or for extending from the body 202.

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FIG. 4 illustrates component pockets (referred to hereinafter as pockets) 300 formed in a base 302 for receiving the devices 200. In addition, the pockets 300 are chamfered for aligning the devices 200 when the devices 200 vacuum-coupled to the positioning apparatus 100 are received into the pockets 300 as shown in FIG. 5. After the devices 200 are dried,

25 the protrusions 204 of the positioning apparatus 100 are positioned over the pockets 300 as shown in FIG. 6. The positioning apparatus 100 is then displaced until each of the devices 200 vacuum-coupled to the respective protrusions 204 is positioned within each of the pocket 300 and abuts a pedestal 304 formed in the pocket 300 as shown in FIG. 7. Alternatively, the positioning apparatus 100 is displaced until each of the devices 200

30 vacuum-coupled to each protrusion 204 is positioned within each of the pockets 300 and is

at a predetermined distance from the pedestal 304 formed in the pocket 300.

A channel 306 is formed in and terminates at an opening 308 on the pedestal 304 of each of the pockets 300. Air is drawn through the channel 306 of the pedestal 304 to create a vacuum at the opening 308. When each of the devices 200 coupled to the respective protrusions 204 of the positioning apparatus 100 abuts the pedestal 304 of each of the pockets 300, each of the devices 200 is released from the respective protrusions 204 by purging air through the channels 208 of the respective protrusions 204. Alternatively, when each of the devices 200 coupled to the positioning apparatus 100 is at a predetermined distance from the pedestal of each pocket 300, each of the devices 200 is released from the respective protrusions 204 by purging air through the channels 208 of the respective protrusions 204. After the devices 200 are received into the pockets 300, the positioning apparatus 100 then gradually moves away from the base 302.

FIG. 9 shows a process flow diagram of a positioning method 600 using the positioning apparatus 100 of FIG. 1. In a step 602, the devices 200 are positioned onto the protrusions 204 after the devices 200 are washed and dried. Then, in a step 604, the devices 200 are vacuum-coupled to the protrusions 204 by vacuum created at the opening 210 of each of the protrusions 204. Heat is then provided to the body 202 of the positioning apparatus 100 for drying the devices 200 vacuum-coupled to the protrusions 204 in a step 606. By heating the devices 200, any remaining moisture present on the devices 200 is substantially removable.

When the devices 200 are dried after undergoing the step 606, the devices 200 are displaced and positioned over the pockets 300 of the base 302. The devices 200 are then to be transferred to the pockets 300 of the base 302 for further processing. With the devices 200 being vacuum-coupled to the protrusions 204, the positioning apparatus 100 is then inverted for orientating the devices 200 towards the base 302 and subsequently positioned above the pockets 300 in a step 608. Each of the devices 200 being vacuum-coupled to the respective protrusions 204 is substantially aligned for insertion into each of the pockets 300 when being positioned above the pockets 300.

In a step 610, the positioning apparatus 100 is displaced until each of the devices 200 vacuum-coupled to the respective protrusions 204 is positioned within each of the pockets 300 and abuts the pedestal 304 of each of the pockets 300 in a step 612. Alternatively, the positioning apparatus 100 is displaced until each of the devices 200 vacuum-coupled to the respective protrusions 204 is positioned within each of the pockets 300 and is at a predetermined distance from the pedestal 304 of each of the pockets 300 in the step 612. The devices 200 are re-aligned when being guided towards the corresponding pedestals 304. Further, in a step 614, air is drawn through the channels 306 of the pedestals 304 to create vacuum at the openings 308 of the pedestals 304 to vacuum-couple the devices 200 to the pockets 300 after the devices 200 are decoupled from the protrusions 204. Decoupling of the devices 200 from the protrusions 204 is achieved by purging air through the openings 210. In a final step 616, the positioning apparatus 100 gradually moves away from the base 302.

In the foregoing manner, an apparatus and a method for transferring semiconductor devices into component pockets of holding trays are described according to embodiments of the invention for addressing the foregoing disadvantages of conventional semiconductor manufacturing process. Although only a few embodiments of the invention are disclosed, it will be apparent to one skilled in the art in view of this disclosure that numerous changes and/or modification can be made without departing from the scope and spirit of the invention.

Claims

1. A positioning apparatus comprising:
 - a body; and
 - at least one protrusion extending from the body and terminating at a free end,
 - 5 each of the at least one protrusion defining a channel therein, the channel of each of the at least one protrusion terminating at an opening at the free end thereof,
 - wherein air drawn through the channel of each of the at least one protrusion substantially creates a vacuum at the opening thereof for vacuum coupling a component thereto,
 - 10 wherein the body is spatially positionable for positioning the component couplable to one of the at least one protrusion over and towards a corresponding one of at least one pocket formed in a base, the one of the at least one protrusion being shaped and dimensioned for being received within the one of the at least one pocket and for guiding the component vacuum coupled thereto into the one of the at least
 - 15 one pocket.
2. The positioning apparatus as in claim 1, wherein heat is provided to the body for heating the component.
- 20 3. The positioning apparatus as in claim 1, wherein the each of the at least one protrusion is retractable into the body.
4. The positioning apparatus as in claim 1, wherein the one of the at least one protrusion abuts the component vacuum coupled thereto with a pedestal formed
- 25 within the one of the at least one pocket.
5. The positioning apparatus as in claim 1, wherein the body is inverted before transferring the component vacuum coupled to the one of the at least one protrusion to the one of the at least one pocket.

6. The positioning apparatus as in claim 1, wherein an opening of each of the at least one pocket is being chamfered for aligning the component.
7. The positioning apparatus as in claim 1, wherein the channel of each of the at least one protrusion is coupled to a pump for drawing air therefrom.
8. The positioning apparatus as in claim 7, wherein the channel of each of the at least one protrusion extends towards a manifold, the manifold for intercoupling the channel of each of the at least one protrusion to the pump.
9. The positioning apparatus as in claim 1, wherein each of the at least one pocket having a pedestal extending from the base thereof.
10. A positioning apparatus comprising:
 - a body;
 - at least one protrusion extending from the body and terminating at a free end, each of the at least one protrusion defining a channel therein, the channel of each of the at least one protrusion terminating at an opening at the free end thereof, air drawn through the channel of each of the at least one protrusion substantially creates a vacuum at the opening thereof for vacuum coupling a component thereto; and
 - at least one pocket formed in a base for receiving the component vacuum couplable to one of the at least one protrusion extending from the body, the one of the at least one protrusion being shaped and dimensioned for being received within the one of the at least one pocket and for guiding the component vacuum coupled thereto into the one of the at least one pocket.
11. The positioning apparatus as in claim 10, wherein heat is provided to the body for heating the component.
12. The positioning apparatus as in claim 10, wherein the each of the at least one

protrusion is retractable into the body.

13. The positioning apparatus as in claim 10, wherein the one of the at least one protrusion abuts the component vacuum coupled thereto with a pedestal formed within the one of the at least one pocket.
14. The positioning apparatus as in claim 10, wherein the body is inverted before transferring the component vacuum coupled to the one of the at least one protrusion to the one of the at least one pocket.
15. The positioning apparatus as in claim 10, wherein an opening of each of the at least one pocket is chamfered for aligning the component.
16. The positioning apparatus as in claim 10, wherein the channel of each of the at least one protrusion is coupled to a pump for drawing air therefrom.
17. The positioning apparatus as in claim 16, wherein the channel of each of the at least one protrusion extends towards a manifold, the manifold for intercoupling the channel of each of the at least one protrusion to the pump.
18. The positioning apparatus as in claim 10, wherein each of the at least one pocket having a pedestal extending from the base thereof.
19. A method of positioning a component using a positioning apparatus, the method comprising:
 - providing a body comprising at least one protrusion extending from a surface and terminating at a free end;
 - creating vacuum at the opening of the channel of each of the at least one protrusion for coupling the component to the protrusion;
 - positioning the component coupled to one of the at least one protrusion aligned to one of at least one pocket formed in a base, the base comprising a face;

displacing the body until the component couplable to the one of the at least one protrusion is positioned within the one of the at least one pocket;

releasing the component coupled to the one of the at least one protrusion into the one of the at least one pocket; and

5 moving the body away from the face of the base to remove one of the at least one protrusion from the one of the least one pocket.

20. The method as in claim 19 further comprises displacing the body away from the face of the base.

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21. The method as in claim 19, wherein heat is provided to the body for heating the component.

22. The method as in claim 19, wherein the each of the at least one protrusion is retractable into the body.

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23. The method as in claim 19, wherein the one of the at least one protrusion abuts the component vacuum coupled thereto with a pedestal formed within the one of the at least one pocket.

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24. The method as in claim 19, wherein the body is inverted before transferring the component vacuum coupled to the one of the at least one protrusion to the corresponding one of the least one pocket.

25. The method as in claim 19, wherein the corresponding one of the least one pocket is chamfered for aligning the component.

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26. The method as in claim 19, wherein the channel of each of the at least one protrusion is coupled to a pump for drawing air therefrom.

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27. The method as in claim 26, wherein the channel of each of the at least one protrusion extends towards a manifold, the manifold for intercoupling the channel of each of the at least one protrusion to the pump.
- 5 28. The method as in claim 19, wherein each of the at least one pocket having a pedestal extending from the base thereof.