DIES PREPEELING APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

Field

[0001] The present technology relates to fabrication of semiconductor devices.

Description of Related Art

[0002] After a wafer is divided into a plurality of individual dies 10 attached on a dicing tape 20 via a die attach film 22, a device in a so called pick up process will pick up the singularized die 10 from the dicing tape 20 as shown in FIG. 1A. FIG. 1B shows an enlarged schematic side view of a pickup mechanism for picking up semiconductor dies 10 from the dicing tape 20. The singularized dies 10 are pressed on their back side through the dicing tape 20 using an ejector 30 such as a thrust pin. As a result, the semiconductor dies 10 are peeled from the dicing tape 20 while being held by a suction device 40 located opposite the thrust pin 30 on the upper side. The suction device 40 is typically known as a rubber tip connected to the vacuum pump.

[0003] During the pickup process, in the case where a semiconductor die 10 is as thin as 100 μm or less, when the backside of a semiconductor die 10 is pushed up by the ejector 30 and the frontside of the semiconductor die 10 is attached to the suction device 40, due to residual bonding strength of the adhesive between the die attach film 22 and the dicing tape 20, the peripheral part of the semiconductor die 10 is subject to a bending force at a relatively high speed. In this case, defects such as cracks or chipping occur, starting at the peripheral part of the semiconductor die 10, thus resulting in yield loss or a decrease in product quality. Therefore, there have been demands for improvements in apparatus and method for fabricating semiconductor devices.

DESCRIPTION OF THE DRAWINGS

[0004] FIGS. 1A and 1B are schematic side views showing a pick up process for fabricating semiconductor devices;

[0005] FIG. 2 is an exploded schematic perspective view of an apparatus for prepeeling semiconductor dies according to the present technology;

[0006] FIG. 3 is a partial schematic side view of an apparatus for prepeeling semiconductor dies according to the present technology;

[0007] FIG. 4 is a schematic top view of a chamber of the apparatus for prepeeling semiconductor dies according to the present technology;

[0008] FIG 5A and 5B are schematic side view of an apparatus for prepeeling semiconductor dies according to the present technology;

[0009] FIGS. 6A-6E are schematic views showing a method for fabricating semiconductor devices including a method of prepeeling semiconductor dies according to a first embodiment of the present technology;

[0010] FIG. 7 is an enlarged view of a deformed dicing tape with a dome-like shape according to the first embodiment of the present technology; and

[0011] FIG. 8 is an enlarged view of a deformed dicing tape with a reverse dome-like shape according to a second embodiment of the present technology.

DETAILED DESCRIPTION

[0012] Embodiments will now be described with reference to Figs. 2 through 8, which relate to an apparatus and a method for prepeeling semiconductor dies from a dicing tape. It is understood that the present technology may be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete and will fully convey the present technology to those skilled in the art. Indeed, the present technology is intended to cover alternatives, modifications and equivalents of these embodiments, which are included within the scope and spirit of the invention as defined by the appended claims. Furthermore, in the following detailed description of the present technology, numerous specific details are set forth in order to provide a thorough understanding of the present technology. However, it will be clear to those of ordinary skill in the art that the present technology may be practiced without such specific details.

[0013] The terms “top,” “bottom,” “upper,” “lower,” “vertical” and/or “horizontal” as may be used herein are for convenience and illustrative purposes only, and are not meant to limit the description of the present technology inasmuch as the referenced item can be exchanged in position.

[0014] FIG. 2 is an exploded schematic perspective view of an apparatus 100 for prepeeling semiconductor dies according to the present technology. The apparatus 100 includes a chamber 110 having a bottom base 112, a top opening 114 and an annular sidewall 116 extended upward from the periphery of the base 112. A dicing tape 200 with a plurality of

semiconductor dies 212 attached thereon is disposed above the chamber 110. The base 112 of the chamber 110 can have a flat or convex surface. As shown in Fig.2, the cross sectional shape of the annular sidewall 116 has a ring-like shape, but the present technology does not limit thereto and the sidewall 116 can have other geometries with a central opening in order to allow the semiconductor dies 212 on the dicing tape 200 located directly above the central opening. In this case, the semiconductor dies 212 can move freely with the dicing tape 200 if the dicing tape 200 is deformed during operation. The sidewall 116 has a substantially flat top surface so that a dicing tape 200 can be rested reliably on the top surface of the sidewall 116. The body of the chamber 110 can be made of metal, such as steel, aluminum, or copper.

[0015] The apparatus 100 further includes a cover 120 disposed above the chamber 110. The dicing tape 200 is placed between the top surface of the sidewall 116 and the cover 120. The dicing tape 200 typically has adhesive (not shown) applied on both sides, therefore the dicing tape 200 can bond the top surface of the sidewall 116 and the cover 120 together via the adhesive, thus hermetically sealing the top opening 114 of the chamber 110. As shown in FIG. 2, the cover 120 has a ring like shape, but the present technology does no limit thereto and the cover 120 can have other geometries with a central opening such that the semiconductor dies 212 on the dicing tape 200 are located directly below the central opening. In this case, the semiconductor dies 212 can move freely with the dicing tape 200 if the dicing tape 200 is deformed during operation. The cover 120 can be an annular member with substantially same cross-sectional shape and dimension as the top surface of the sidewall. The cover 120 can be made of metal, such as steel, aluminum, or copper. For example, the cover 120 can be a wafer ring attached on the dicing tape during a previous dicing step. The apparatus 100 can further include at least one holding member 130 for reliably fixing the cover 120 and the dicing tape 200 onto the top surface of the sidewall 116. The holding member 130 can include screw, pin, clamp, rivet or other means for improving the sealing of the chamber 110. For example, as shown in FIG. 2, there are four registration pins evenly distributed along the periphery of the cover 120 as the holding member 130. The holding member 130 can also be made of metal.

[0016] Optionally, the apparatus 100 can include a sealing member 140 disposed between the dicing tape 200 and the top surface of the sidewall 116 for improving the sealing of the chamber 116. As shown in FIG. 2, the sealing member 140 can be an O-ring in case that both the cover 120 and the sidewall 116 have a ring-like cross-sectional shape. Instead of resting directly on top of the sidewall 116, the sealing member 140 can be also received in a groove 170 formed in the top surface of the sidewall 116, as shown in a side view of FIG. 3. In this

case, the sealing member 140 can be rested more reliably onto the sidewall 116, thus improving the sealing of the chamber 110.

[0017] Furthermore, the apparatus 100 includes at least one inlet 118 disposed in the base 112. There can be a plurality of inlets 118 distributed in the base 112, but it is preferably that at least one inlet 118 is disposed at the center of the base 112 or at the vicinity of the center of the base 112. For example, FIG. 4 is a schematic top view of the chamber 110 with a plurality of inlets 118, in which one inlet 118 is placed at the center of the base 112 and rest of inlets 118 are distributed across the surface of the base. The apparatus 100 further comprises a pressure regulator 150 connected to the chamber 110 via the inlet(s) 118. The pressure regulator 150 can adjust the pressure inside the chamber 110 if the dicing tape 200 seals the top opening of the chamber 110, thus creating a pressure difference between opposing sides of the dicing tape 200, which could deform the dicing tape 200. For example, in case that the semiconductor dies 212 on the dicing tape 200 are placed outside the chamber 110 as shown in FIG. 5A, the pressure regulator 150' can include a fluid supply 152' providing a liquid or a gas into the chamber 110 to create a positive pressure inside the chamber 110 relative to ambient pressure such as atmosphere pressure. Preferably, the gas can be dried air or dried nitrogen for protecting the dicing tape 200 from the moisture. The pressure regulator 150' can also include a fluid controller 154' such as a valve with a gauge for controlling flow rate of the fluid in order to adjust the positive pressure. Alternatively, in case that the semiconductor dies 212 on the dicing tape 200 are placed inside the chamber 110 as shown in Fig. 5B, the pressure regulator 150" can include a vacuum pump 152" and a valve 154" for controlling vacuum degree, that is, a negative pressure inside the chamber 110 relative to ambient pressure.

[0018] In addition, the apparatus 100 can further include a radiation source (not shown) inside the chamber 110, such as a UV light source for irradiating on the dicing tape 200 when the dicing tape 200 is deformed due to the pressure difference introduced by the pressure regulator 150.

[0019] Further details regarding the apparatus 100 will be discussed as below with reference to a method for fabricating semiconductor devices according to the present technology.

[0020] FIGS. 6A-6E are schematic views showing a method for fabricating semiconductor devices according to a first embodiment of the present technology.

[0021] As shown in FIG. 6A, a wafer 210 is first attached onto a dicing tape 200 optionally via a die attach film (DAF) 220. Dicing tape 200 typically comprises base materials such as polyvinylchloride (PVC), polyethylene terephthalate (PET), polyolefin, or polyethylene with

an adhesive applied on both surfaces. The adhesive can also be UV sensitive to allow adhesive bond be broken upon UV irradiation. Die attach film 220 is typically used for thin die stack package in order to have a desired consistent bondline thickness in the package. The bond strength between the DAF 220 and the dicing tape 200 is typically smaller than the bond strength between the semiconductor dies 212 and the DAF 220, so that during the prepeeling and subsequent pick up process, the semiconductor dies 212 and the DAF 220 are separated from the dicing tape 200.

[0022] Next, as shown in FIG. 6B, the wafer 210 is divided into a plurality of individual semiconductor dies 212 on the dicing tape 200 by a cutting tool such as a diamond saw or a laser (not shown)in a so-called dicing process. The adhesive on the dicing tape holds the semiconductor dies in place. Preferably, both the wafer 210 and DAF 220 are completely cut through so that the dicing tape 200 is also scribed between semiconductor dies 210. In this case, the dicing tape 200 is weakened at locations between semiconductor dies 210, thus tends to be deformed more easily during subsequent processes.

[0023] Next, a method for prepeeling semiconductor dies 212 is performed. The dicing tape 200 with a plurality semiconductor dies 210 attached thereon is disposed on the apparatus 100 according to a first embodiment of the present invention, as shown in FIG. 6C. The dicing tape 200 hermetically seals the top opening of the chamber 110 due to the adhesive applied on the surface. The sealing of the chamber 110 can be further improved by the cover 120, the holding member(s) 130 and the sealing member 140, as discussed above. In addition, the cover 120 can be attached onto the dicing tape 200 in the previous dicing process as a wafer ring. In this embodiment, the semiconductor dies 212 are placed outside the chamber 110 and the apparatus 100 includes a fluid supply 152' and fluid controller 154'.

[0024] Next, a fluid is provided into the chamber 110 via the inlet(s) in the base 112 of the chamber 110 from the fluid supply 152' for creating a pressure difference between opposing sides of the dicing tape 200, that is a positive pressure inside the chamber 110 relative to the ambient pressure. The fluid can be gas or liquid. As discussed above, the fluid is preferably dried air or dried nitrogen to protect the dicing tape 200 from the moisture. For example, the pressure inside the chamber 110 is in a range from 0.1 MPa to 0.5 MPa, which is higher than the ambient pressure such as atmosphere pressure around 0.1 MPa. Such pressure difference deforms the dicing tape 200 as a convex shape such as dome-like shape, as shown in FIG. 6D.

[0025] FIG. 7 is an enlarged view of the dicing tape 200 with a dome-like shape. As shown in FIG. 7, the pressure difference between opposing two sides of the dicing tape 200 applies a

substantially uniform force onto the dicing tape 200 and semiconductor dies 212 attached thereon. Since the dicing tape 200 made of polymers as describe above is much more flexible than the semiconductor dies 212 made of silicon, at a given pressure level, the dicing tape 200 is subjected to a large elastic deformation or even small plastic deformation if the stress applied on the dicing tape 200 exceeds the yield strength of base material of the dicing tape 200, whereas the semiconductor dies 212 are only subjected to small elastic deformation. When the restoring force of the semiconductor dies 212 against such elastic deformation exceeds the bond strength between the DAF 220 and the dicing tape 200, the dicing tape 200 is pulled away from the semiconductor dies 212 and the DAF 220, starting at portions with the weakest bonding strength, which correspond to the peripheral portions of the semiconductor dies 212, such as corners of the semiconductor dies, thereby partially peeling the dicing tape 200 from the semiconductor dies 212 and the DAF 220 from the dicing tape 200 without picking up the semiconductor dies 212. Therefore this process is called "prepeeling" process.

[0026] The dome shape of the dicing tape 200 is characterized by dome width W and dome height H, as shown in FIG. 7, in which the DAF 220 is not shown for the sake of clarity. The dome width W is determined by dimension (for example, inner diameter of the chamber 110 with a cylindrical-like shape) of the chamber 110 of the apparatus 100. The dome height H is determined by the pressure difference between opposing sides of the dicing tape 200 and the flexibility of the dicing tape 200. For example, if the pressure inside the chamber is about 0.1-0.5 MPa and the ambient pressure is about 0.1 MPa, the pressure difference is in a range of about 0-0.4 MPa. Such pressure difference of about 0-0.4 MPa can introduce a dome height H in a range of about 0-60 mm for a typical PET based dicing tape 200 provided by Nitto Denko America Inc. (California, USA), given the inner diameter of chamber of about 350 mm. In this case, the deformed dicing tape 200 with a dome-like shape has an aspect ratio H/W of about 0-0.17. The deformed dicing tape 200 can have an aspect ratio H/W as high as 0.3. High aspect ratio of the deformed dicing tape 200 facilitates detachment of the semiconductor dies 212 and DAF 220 from the dicing tape 200, but might cause excessive plastic deformation of the dicing tape 200, thereby introducing positional errors for a subsequent pickup process, which will be discussed more in detail as below. In this case, the deformed dicing tape 200 preferably has an aspect ratio of about 0.06-0.3, in particular about 0.06-0.11. For example, the dome height H is preferably in a range of about 10-40 mm given that the dome width W is about 350 mm.

[0027] The flow rate of the fluid can be controlled by a fluid controller such as a valve with a gauge shown in FIG. 6D. High flow rate of the fluid creates the dome shape of the dicing tape 200 in a relatively short period of time, thus improving throughput, but some semiconductor

dies 212 might suffer cracking or chipping due to an impact force applied by the deformed dicing tape 200. Therefore, it is preferred to increase the pressure inside the chamber 110 gradually by controlling the flow rate of the fluid. For example, it is advantageous to have a substantially uniform low flow rate, for example about 0.5 L/min-10 L/min given a chamber volume of about 6.2 L. In addition, the configuration with at least one inlet 118 disposed at the center of the base of the chamber 110 facilitates to form the dome shape. When the aspect ratio or the dome height of the deformed dicing tape 200 reaches a predetermined value, it is preferred to keep the shape of the deformed dicing tape 200 for a predetermined period of time such as from few tens of seconds to a few minutes for separation developed between the dicing tape 200 and the DAF 220.

[0028] Next, the pressure inside the chamber 110 is released either by breaking the sealing of the top opening of the chamber 110 or by exhausting the fluid from the chamber 110 via inlet(s) 118. In this way, as shown in FIG. 6E, the dicing tape 200 is substantially recovered to a planar shape and the semiconductor dies 212 attached thereon are ready to be picked up from the dicing tape 200 in a subsequent pickup step. Since the bonding strength between the DAF 220 and the dicing tape 200 is reduced by the prepeeling process as described above, the semiconductor dies 212 can be picked up with a smaller pickup force in subsequent pickup process, thus reducing the risks of defect such as cracking or chipping and improving yields. The higher aspect ratio of the deformed dicing tape 200 is in the prepeeling process, the lower the pickup force is in the subsequent pickup process. For example, the pickup force can be reduced up to 30% when the deformed dicing tape 200 reaches an aspect ratio of about 0.09. The pickup process can be carried out either in situ on the apparatus 100 or in a separate pickup device (not shown).

[0029] Since as shown in FIG. 6A, a central portion of the dicing tape 200 has scribing lines between semiconductor dies 212 before the prepeeling process, the central portion of the dicing tape 200 has weaker strength than peripheral portions of the dicing tape 200. Therefore, the center portion of the dicing tape 200 is deformed more than the peripheral portions of the dicing tape 200 during the prepeeling process. If the yield strength of the dicing tape 200 is exceeded due to excessive deformation, the dicing tape 200 may not retain its original shape and dimension after the pressure is released, thus the semiconductor dies 212 attached on the dicing tape 200 might change positions relative to each other. In this case, the semiconductor dies 212 at the center portion of the dicing tape 200 might have a slight larger spacing relative to each other than the spacing of the semiconductor dies 212 at the peripheral portion of the dicing tape 200 after the prepeeling process, which might cause positional errors and pick up

miss for some semiconductor dies 212 during the pickup process. Therefore, it is necessary to control the deformation of the dicing tape 200 in the prepeeling process in order to avoid adverse effect on the pickup process.

[0030] If the adhesive on the dicing tape 200 is UV sensitive, the deformed dicing tape 200 can be further irradiated with a UV light source for example disposed in the base of the chamber 110. In this way, when a part of the deformed dicing tape 200 is separated from the DAF 220 and the semiconductor dies 212 during prepeeling process, the tackiness of the adhesive applied on the dicing tape 200 can be lowered, thereby further reducing the pickup force for the semiconductor dies 212.

[0031] In the first embodiment described above, the pressure difference between opposing sides of the dicing tape 200 is introduced by providing a fluid into the chamber 110. Alternatively, such pressure difference can also be introduced by gradually reducing the pressure inside the chamber 110 relative to the ambient pressure using a setup shown in FIG. 5B, for example, a vacuum pump 152" and a valve 154" according to a second embodiment of the present technology. In this way, the dicing tape 200 is deformed to have a concave shape such as a reversed dome-like shape shown in an enlarged schematic side view of FIG 8, which also does not show the DAF 220. In this way, the pressure inside the chamber 110 is for example in a range of 0.01-0.1 MPa, if the ambient pressure is one atmosphere pressure of 0.1 MPa. Further details regarding the second embodiment are substantially the same as those in the first embodiment and will not be repeated herein.

[0032] With the apparatus and method for prepeeling the semiconductor dies from the dicing tape according to the present technology, the pickup force and therefore the risks of cracking or chipping of the semiconductor dies can be reduced in the subsequent pickup process for fabricating the semiconductor devices. Since the dicing tape is deformed by the pressure difference, the stress during the prepeeling process is substantially uniform across the dicing tape, thus avoiding possible defects such as cracking or chipping due to stress concentration if a solid ejector device such as thrust pins making contact with the semiconductors dies was used to deform the dicing tape instead.

[0033] In one aspect, the present technology relates to an apparatus for prepeeling semiconductor dies from a dicing tape with the semiconductor dies attached thereon. The method comprises a chamber having a bottom base, a top opening and an annular sidewall extended upward from the periphery of the base, the side wall has a substantially flat top surface; a cover disposed above the chamber, the cover having a central opening, at least one

inlet disposed in the base; and a pressure regulator connected to the chamber via the at least one inlet. The dicing tape is disposed between the cover and the top surface of the sidewall to hermetically seal the top opening of the chamber, and the semiconductor dies are located directly above the top opening of the chamber.

[0034] In embodiments, the pressure regulator comprises a fluid supply providing fluid to the chamber via the inlet. The fluid comprises gas or liquid. The gas comprises dried air or nitrogen. The pressure regulator further comprises a fluid control device to control flow rate of the fluid. Alternatively, the pressure regulator comprises a vacuum pump.

[0035] In embodiments, the apparatus further comprising at least one holding member fixing the cover and the dicing tape onto the top surface of the sidewall. The holding member comprises screw, pin, clamp or, rivet. The apparatus further comprises a sealing member disposed between the dicing tape and the top surface of the sidewall. The top surface of the sidewall can comprise a groove receiving the sealing member.

[0036] In embodiments, both the top surface of the annular sidewall and the cover have a ring-like cross-sectional shape, and the sealing member is an O-ring. The cover can be a wafer ring. The base of the chamber has a planar or convex surface. The at least one of the inlet is disposed at the center of the base or at the vicinity of the center of the base. In addition, the apparatus further comprises a UV light source disposed within the chamber.

[0037] In another aspect, the present technology relates to a method for prepeeling semiconductor devices. The method comprises following steps: disposing the dicing tape above a chamber having a bottom base, a top opening and an annular sidewall extended upward from the periphery of the base so that the dicing tape hermetically seals the top opening of the chamber, wherein the semiconductor dies are located directly above the top opening of the chamber; introducing a pressure difference between opposing sides of the dicing tape so that the dicing tape is deformed to have a convex or concave shape relative to the top opening of the chamber; and releasing the pressure difference.

[0038] In embodiments, the pressure difference is introduced by a pressure regulator connected to the chamber via at least one inlet disposed in the base. In one example, the semiconductor dies are placed outside the chamber, and the pressure inside the chamber is larger than the pressure outside the chamber so that the dicing tape has a convex shape relative to the top opening of the chamber. The pressure regulator increases the pressure inside the chamber by introducing a fluid into the chamber. The pressure inside the chamber is increased gradually by controlling flow rate of the fluid. In another example, the semiconductor dies are

placed inside the chamber, and the pressure inside the chamber is smaller than the pressure outside the chamber so that the dicing tape has a concave shape relative to the top opening of the chamber. The pressure regulator decreases the pressure inside the chamber using a vacuum pump. The pressure inside the chamber is decreased gradually. The pressure inside the chamber is in a range of about 0.01 MPa – about 0.5 MPa. The deformed dicing tape has an aspect ratio of about 0.06-0.3. The semiconductors dies on a dicing tape which is deformed with a first aspect ratio are picked up with a smaller force than the semiconductor dies on the dicing tape which is deformed with a second aspect ratio smaller than the first aspect ratio in the step of picking up the semiconductor dies from the dicing tape after the step of releasing the pressure difference.

[0039] In embodiments, the method further comprises a step of irradiating a UV light onto the deformed dicing tape.

[0040] The foregoing detailed description of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. The described embodiments were chosen in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto.

We claim:

1. An apparatus for prepeeling semiconductor dies from a dicing tape with the semiconductor dies attached thereon, comprising:

a chamber having a bottom base, a top opening and an annular sidewall extended upward from the periphery of the base, the side wall has a substantially flat top surface;

a cover disposed above the chamber, the cover having a central opening,

at least one inlet disposed in the base; and

a pressure regulator connected to the chamber via the at least one inlet,

wherein the dicing tape is disposed between the cover and the top surface of the sidewall to hermetically seal the top opening of the chamber, and

the semiconductor dies are located directly above the top opening of the chamber.

2. The apparatus according to claim 1, wherein the pressure regulator comprises a fluid supply providing fluid to the chamber via the inlet.

3. The apparatus according to claim 2, wherein the fluid comprises gas or liquid.

4. The apparatus according to claim 3, wherein the gas comprises dried air or nitrogen.

5. The apparatus according to claim 2, wherein the pressure regulator further comprises a fluid control device to control flow rate of the fluid.

6. The apparatus according to claim 1, wherein the pressure regulator comprises a vacuum pump.

7. The apparatus according to claim 6, further comprising at least one holding member fixing the cover and the dicing tape onto the top surface of the sidewall.

8. The apparatus according to claim 7, wherein the holding member comprises screw, pin, clamp or rivet.

9. The apparatus according to claim 1, further comprising a sealing member disposed between the dicing tape and the top surface of the sidewall.

10. The apparatus according to claim 9, wherein the top surface of the sidewall comprises a groove receiving the sealing member.

11. The apparatus according to claim 9, wherein both the top surface of the annular sidewall and the cover have a ring-like cross-sectional shape, and the sealing member is an O-ring.

12. The apparatus according to claim 9, wherein the cover is a wafer ring.

13. The apparatus according to claim 1, wherein the base has a planar or convex surface.

14. The apparatus according to claim 1, wherein the at least one of the inlet is disposed at the center of the base or at the vicinity of the center of the base.

15. The apparatus according to claim 1, further comprising a UV light source disposed within the chamber.

16. A method for prepeeling semiconductor dies, comprising following steps of:
disposing a dicing tape above a chamber having a bottom base, a top opening and

an annular sidewall extended upward from the periphery of the base so that the dicing tape hermetically seals the top opening of the chamber, wherein a plurality of semiconductor dies are attached on to the dicing tape and are located directly above the top opening of the chamber;

introducing a pressure difference between opposing sides of the dicing tape so that the dicing tape is deformed to have a convex or concave shape relative to the top opening of the chamber; and

releasing the pressure difference, wherein the semiconductors dies on a dicing tape which is deformed with a first aspect ratio are picked up with a smaller force than the semiconductor dies on the dicing tape which is deformed with a second aspect ratio smaller than the first aspect ratio in a step of picking up the semiconductor dies from the dicing tape after the step of releasing the pressure difference.

17. The method according to claim 16, wherein the pressure difference is introduced by a pressure regulator connected to the chamber via at least one inlet disposed in the base.

18. The method according to claim 17, wherein the semiconductor dies are placed outside the chamber, and the pressure inside the chamber is larger than the pressure outside the chamber so that the dicing tape has a convex shape relative to the top opening of the chamber.

19. The method according to claim 18, wherein the pressure regulator increases the pressure inside the chamber by introducing a fluid into the chamber.

20. The method according to claim 19, wherein the pressure inside the chamber is increased gradually by controlling flow rate of the fluid.

21. The method according to claim 17, wherein the semiconductor dies are placed inside the chamber, and the pressure inside the chamber is smaller than the pressure outside the chamber so that the dicing tape has a concave shape relative to the top opening of the chamber.

22. The method according to claim 21, wherein the pressure regulator decreases the pressure inside the chamber using a vacuum pump.

23. The method according to claim 22, wherein the pressure inside the chamber is decreased gradually.

24. The method according to claim 16, wherein the pressure inside the chamber is in a range of about 0.01 MPa - about 0.5 MPa.

25. The method according to claim 16, wherein the deformed dicing tape has an aspect ratio of about 0.06-0.3.

26. The method according to claim 16, further comprising a step of irradiating a UV light onto the deformed dicing tape.