

SPECIFICATION

Title of Invention

DIVIDING METHOD AND DIVIDING DEVICE OF BRITTLE MATERIAL
SUBSTRATE

Technical Field

[0001]

The present invention relates to a dividing method and dividing device for dividing a thin brittle material substrate.

Background Art

[0002]

In the case of dividing a brittle material substrate, as disclosed in Patent Literature 1, a scribe line is previously formed on the brittle material substrate, and the substrate is held on a support base via a dicing ring. Then, a break bar is lowered from an upper portion to depress the substrate from just above the scribe line to thereby break the substrate.

[0003]

However, in the case where the brittle material substrate is thin, a peripheral portion of the substrate is easily warped, and if the brittle material substrate is warped, a monitor camera becomes difficult to focus in the case of confirming from below a scribing line

formed on the substrate. Therefore, there arises a problem that it becomes difficult to depress a break bar accurately from just above the scribe line to divide the substrate.

[0004]

Patent Literature 2 discloses a processing device using laser beams for dividing a substrate such as a semiconductor wafer. In this processing device, it is suggested that, in the case where the substrate is divided using laser beams, an upward curved portion may be caused in end portions thereof. In order to correct the upward curved portion, air is introduced into a recessed space from above the semiconductor wafer to thereby press and correct the curved portion.

Citation List

Patent Literature

[0005]

Patent Literature 1: Japanese Unexamined Patent Publication JP-A 2015-188968

Patent Literature 2: Japanese Unexamined Patent Publication JP-A 2010-29930

Summary of Invention

Technical Problem

[0006]

In the case where a brittle material substrate is

divided using the device of Patent Literature 2, since air is introduced into a recessed space from above the substrate and press from above the same, the recess should be kept airtight. Therefore, a pump for introducing air is required and there has been a problem that a structure becomes complicated.

[0007]

Therefore, the present invention has been made in consideration of these problems, and an object thereof is to closely adhere even a thin substrate to be easily curved onto a table, thereby allowing the substrate to be precisely divided.

Solution Means

[0008]

In order to solve these problems, a method of dividing a brittle material substrate of the present invention includes: adhering the brittle material substrate formed with a scribe line, onto an adhesive tape that is held by a frame-like body to thereby hold the brittle material substrate; integrally holding a transparent elastic support plate on a transparent table; holding the brittle material substrate together with the frame-like body on the elastic support plate; closely adhering the brittle material substrate onto the elastic support plate by rolling a roller from above the brittle

material substrate held on the frame-like body; detecting the scribe line formed on the brittle material substrate closely adhered to the elastic support plate using a monitor camera; and lowering a break bar from above the brittle material substrate along the scribe line detected by the monitor camera to thereby divide the brittle material substrate along the scribe line.

[0009]

In order to solve these problems, a dividing device of the present invention is for use in dividing a brittle material substrate, includes: a frame-like body for holding the brittle material substrate formed with a scribe line, on an adhesive tape; a transparent table; a transparent elastic support plate for holding the frame-like body on the transparent table; an elevating mechanism for vertically moving a brake bar up and down with respect to a surface of the brittle material substrate held by the elastic support plate; a roller rotatably held above the transparent table and having a rotating shaft in parallel to a surface of the transparent table; relative moving means adapted to relatively move the transparent table with respect to the break bar and the roller; and a monitor camera for detecting the scribe line formed on the brittle material substrate, from below the transparent table.

Advantageous Effects of Invention

[0010]

According to the present invention having the specific features as mentioned above, the brittle material substrate is held on the elastic support plate and even a thin substrate which is easily to be curved is closely adhered to the elastic support plate by pressing the substrate with the roller. Therefore, it is possible to accurately perform a positioning of the break bar by confirming the substrate closely adhered onto the elastic support plate by the monitor camera. Also, there can be obtained an effect that the brittle material substrate can be accurately divided by pressing down the break bar along the scribe line to thereby break the substrate.

Brief Description of Drawings

[0011]

Fig. 1 is a schematic perspective view of a dividing device according to an embodiment of the present invention;

Fig. 2 is a schematic side view of the dividing device according to the embodiment of the present invention;

Fig. 3 is a perspective view showing details of a

glass table and a brittle material substrate held on an upper portion thereof; and

Figs. 4 (a) to (c) are side views showing a state of holding the brittle material substrate onto an elastic support plate on the glass table using a dicing ring and a state of adhering the same.

Description of Embodiments

[0012]

Next, a dividing device 10 of the present embodiment for use in dividing a brittle material substrate will be schematically described below. Fig. 1 is a schematic perspective view of the dividing device according to an embodiment of the present invention, and Fig. 2 is a schematic side view thereof. The dividing device 10 has a transparent glass table 12 that is movable in a positive or negative direction of y-axis on a base 11. Below the glass table 12, there is provided a Y-axis moving mechanism 13 that moves the glass table 12 in the y-axis direction along the surface thereof and rotates along the surface thereof. A U-shaped frame-like fixing member 14 is provided above and across the glass table 12 and a servo motor 15 is held thereon. A ball screw 16 is directly coupled to a rotating shaft of the servo motor 15 and a lower edge of the ball screw 16 is rotatably supported by a horizontal fixing member 17. An upper

movement member 18 is provided with a female thread 19 in a middle portion thereof so as to be threaded with the ball screw 16 and further provided with a pair of supporting shafts 20a and 20b extending downward from the both end portions thereof. The supporting shafts 20a and 20b penetrate a pair of through holes of the horizontal fixing member 17 and coupled to a lower movement member 21. A break bar 24, to be described later, is attached to a lower surface of the lower movement member 21 so as to be freely elevated with respect to a surface of the glass table 12. With this configuration, in the case where the ball screw 16 is rotated by the servo motor 15, the upper movement member 18 and the lower movement member 21 are integrally moved vertically, so that the brake bar is also moved up and down at the same time. A roller 22 is rotatably provided in a lower portion inside the frame-like fixing member 14. It is assumed that the rotating shaft of the roller 22 is in parallel to the surface of the glass table 12. Further, it is preferable that a rotating shaft body is held by a spring and is made freely movable up and down so that the rotating shaft body is moved up and down in parallel in a predetermined range and a downward urging force is applied. In this arrangement, the Y-axis moving mechanism 13 constitutes relative moving means adapted

to relatively move the glass table 12 with respect to the break bar 24 and the roller 22. Meanwhile, the frame-like fixing member 14, servo motor 15, the horizontal fixing member 17, and the upper and lower movement members 18 and 21 constitute an elevating mechanism for elevating the break bar 24.

[0013]

Fig. 2 is a side view showing a part of the dividing device 10. As shown in Fig. 2, the glass table 12 is provided on the base 11. And a monitor camera 23 is provided inside the base 11 for confirming a scribe line of the brittle material substrate placed on the glass table 12. The break bar 24 attached to the lower movement member 21 is an elongated flat plate metal member having a tip end of a V shape in cross section and it is used for pressing and dividing the brittle material substrate.

[0014]

Fig. 3 is a perspective view showing details of the glass table 12 and the brittle material substrate held on the upper portion thereof. In the present embodiment, a sapphire substrate 30 is used as a target of the brittle material substrate to be divided, and a dicing ring 31, which is an annular frame-like body for use in dividing a semiconductor wafer into chips, is used for holding this substrate. As shown in Fig. 3, an adhesive tape 32

having an adhesive material is attached upward inside the dicing ring 31. This adhesive tape 32 is a two-layer structural tape consisting of a base layer made of vinyl chloride and the like and an adhesive material layer formed on an upper surface thereof. The base layer is formed to have a thickness of, for example, $80\mu\text{m}$ and the adhesive material layer is formed to have a thickness of $20\mu\text{m}$ and the adhesive tape 32 is formed to have a total thickness of $100\mu\text{m}$. Then, the sapphire substrate 30 to be divided is attached to a central portion of an upper surface of the adhesive tape 32. In the present embodiment, the thickness of the sapphire substrate 30 is 0.05 mm to 1 mm and in this configuration, the thickness of the substrate is, for example, 0.1 mm. On this sapphire substrate 30, multiple ICs of such as epitaxial films are arranged in a matrix form, each of which has a size of, for example, 1 mm square. In order to obtain individual multiple square IC chips, each having a size of 1×1 mm square, the sapphire substrate 30 should be divided with high accuracy. A scribe line is previously formed in a square-block shape on the upper surface of the sapphire substrate 30. Also, a transparent protective film 33 is attached to the upper surface of the sapphire substrate 30 for protecting the sapphire substrate 30.

[0015]

In the present embodiment, a transparent elastic support plate 40 is used in breaking the sapphire substrate 30. As shown in the perspective view of Fig. 3, the elastic support plate 40 is, for example, an elastic circular flat plate made of such as transparent silicone rubber, and the size thereof is equal to or slightly smaller than that of the glass table 12. Also, a transparent film 41 having the same shape as the elastic support plate 40 is integrally formed on the upper surface of the elastic support plate 40 in order to allow the sapphire substrate 30 to slide more smoothly at the time of dividing the substrate and protect the surface of the elastic support plate 40. PET is preferably used as a material of the film 41.

[0016]

Next, a method of dividing the sapphire substrate 30 is described below. First, as shown in Fig. 4(a), the elastic support plate 40 having the film 41 fixed to the upper surface thereof is placed on the glass table 12 of the dividing device 10 mentioned above. Then, the sapphire substrate 30 is arranged above the glass table 12 with the dicing ring 31 reversed so that the sapphire substrate 30 is positioned just above the elastic support plate 40. At this time, the thin sapphire substrate 30

is curved so as to be slightly protruded upward.
Therefore, there exists a slight clearance between the protective film 33 and the film 41.

[0017]

Next, as shown in Fig. 4(b), the roller 22 is contacted with the upper surface of the adhesive tape 32 and the sapphire substrate 30 is pressed onto the elastic support plate 40 with the roller 22 by moving the glass table 12. Thus, as shown in Fig. 4(c), the air in the clearance between the protective film 33 and the film 41 is forced out and the sapphire substrate 30 can be entirely closely adhered to the glass table 12 via the elastic support plate 40.

[0018]

Thus, even though the sapphire substrate 30 is curved, the lower surface of the protective film 33 is adhered to the elastic support plate 40 via the film 41. Therefore, as shown in Fig. 2, at the time of monitoring the sapphire substrate 30 by the monitor camera 23, the monitor camera 23 can be focused. Thus, the scribe line with respect to the entire parts of the sapphire substrate 30 can be accurately confirmed by the monitor camera 23.

[0019]

Next, the glass table 12 is moved by the Y-axis moving mechanism 13 so that the sapphire substrate 30

is positioned immediately beneath the break bar 24. At this time, since the glass table 12 and the elastic support plate 40 are transparent, the sapphire substrate 30 can be moved so that the scribe line is accurately positioned beneath the break bar 24.

[0020]

Next, the servo motor 15 is driven and the upper movement member 18 and the lower movement member 21 are lowered at the same time, so that the break bar 24 is gradually moved downward while the break bar 24 is kept to be perpendicular to the glass table 12. Thus, the sapphire substrate 30 is pressed and deformed by the break bar 24 and depressed downward. As a result, the elastic support plate 40 is slightly deformed to be a V shape and there arises a crack extending upward along the scribe line. Then, by moving down the break bar 24 fully, the crack generated inside the sapphire substrate 30 further extends and the dividing thereof is completed. Upon completion of the dividing, the servo motor 15 is reversely driven and the break bar 24 is moved upward.

[0021]

Next, after the glass table 12 is slightly moved in the y-axis direction at a predetermined pitch by the Y-axis moving mechanism 13, the break bar 24 is lowered again and the dividing process is similarly repeated.

After the dividing process is thoroughly finished in a certain direction, the glass table 12 is turned by 90 degrees by the Y-axis moving mechanism 13. At this time, the sapphire substrate 30 may be press-contacted with the elastic support plate 40 again using the roller 22. Then, the break bar 24 is lowered and divides the sapphire substrate 30. Then, the glass table 12 is moved in the y-axis direction by a distance corresponding to a pitch of the break line and the break bar 24 is lowered similarly. Thus, the dividing process of the entire surface of the sapphire substrate 30 is completed and the sapphire substrate 30 can be divided into a plurality of square-block shapes.

[0022]

Note that, although the sapphire substrate is used as the brittle material substrate to be divided in this embodiment, the present invention can be similarly applied even in the case of using the other brittle material substrate.

[0023]

Further, in the present embodiment, although the brittle material substrate is held on the adhesive tape attached to the frame-like dicing ring, the holding means is not limited to the dicing ring so long as it is a frame-like body.

Industrial Applicability

[0024]

According to the present invention, since a brittle material substrate can be accurately divided, it is suitable for a dividing device that precisely divides the brittle material substrate.

Reference Signs List

[0025]

- 10. Dividing device
- 11. Base
- 12. Glass table
- 13. Y-axis moving mechanism
- 14. Frame-like fixing member
- 15. Servo motor
- 17. Horizontal fixing member
- 18. Upper movement member
- 21. Lower movement member
- 22. Roller
- 23. Monitor camera
- 24. Break bar
- 30. Sapphire substrate
- 31. Dicing ring
- 32. Adhesive tape
- 33. Protective film
- 40. Elastic support plate

41. Film

CLAIMS

1. A method of dividing a brittle material substrate comprising:

adhering the brittle material substrate formed with a scribe line, onto an adhesive tape that is held by a frame-like body to thereby hold the brittle material substrate;

integrally holding a transparent elastic support plate on a transparent table;

holding the brittle material substrate together with the frame-like body on the elastic support plate;

closely adhering the brittle material substrate onto the elastic support plate by rolling a roller from above the brittle material substrate held on the frame-like body;

detecting the scribe line formed on the brittle material substrate closely adhered to the elastic support plate using a monitor camera; and

lowering a break bar from above the brittle material substrate along the scribe line detected by the monitor camera to thereby divide the brittle material substrate along the scribe line.

2. A dividing device for use in dividing a brittle

material substrate, comprising:

- a frame-like body for holding the brittle material substrate formed with a scribe line, on an adhesive tape;

- a transparent table;

- a transparent elastic support plate for holding the frame-like body on the transparent table;

- an elevating mechanism for vertically moving a brake bar up and down with respect to a surface of the brittle material substrate held by the elastic support plate;

- a roller rotatably held above the transparent table and having a rotating shaft in parallel to a surface of the transparent table;

- relative moving means adapted to relatively move the transparent table with respect to the brake bar and the roller; and

- a monitor camera for detecting the scribe line formed on the brittle material substrate, from below the transparent table.