TITLE:

SEMICONDUCTOR MATERIAL CUTTING METHOD

CROSS REFERENCE TO RELATED APPLICATION

The present application claims priority to Korean Patent Application No. 10-2021-0091847, filed July 13, 2021, the entire contents of which are incorporated herein for all purposes by this reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The present disclosure relates to a semiconductor material cutting method for cutting the semiconductor material into individual semiconductor packages by using a semiconductor material cutting device.

Description of the Related Art

In a state in which a semiconductor material is adsorbed on a chuck table, a semiconductor material cutting device inspects a scheduled division line of the semiconductor material by using a visual inspection unit. By using a blade, the semiconductor material may be cut along the scheduled division line inspected by the visual inspection unit.

When the semiconductor material is cut, cutting water may

be sprayed to the blade and the semiconductor material through a cutting water supply nozzle. At this time, in order to cool frictional heat generated on the blade, cutting water is sprayed to the blade and the semiconductor material. Further, after cutting water collides with a surface of the semiconductor material, cutting water scatters and takes heat around thereof, so that the semiconductor material has a temperature that is lower than a temperature before a cutting process performed by cutting water is performed.

Therefore, a surface temperature of the semiconductor material is lower than a surface temperature at the time when the semiconductor material is inspected by the visual inspection unit, and the semiconductor material is contracted.

Meanwhile, the chuck table may adsorb the semiconductor material through an adsorption hole. At this time, even if the semiconductor material is absorbed in the chuck table, a gap may exist on an interface between the adsorption hole and the semiconductor material. Cutting water and air may be rapidly introduced into such a gap. Due to this situation, the temperature of the chuck table may be further reduced, and the chuck table may be cooled. The temperature of the semiconductor material absorbed on the chuck table may be further reduced by the cooled chuck table.

As such, the semiconductor material may be cooled and contracted due to the low temperature of cutting water and the

chuck table. Particularly, when the semiconductor material cutting device is configured of a plurality of chuck tables, the visual inspection is performed on one chuck table while the semiconductor material on the other chuck table is cut. Further, in the semiconductor material on the one chuck table on which the visual inspection is finished, a waiting time exists until the cutting of the semiconductor material on the other chuck table being cut is finished, so that the semiconductor material on the one chuck table may be more contracted.

However, when the semiconductor material is cut, the blade cuts the semiconductor material along an initial scheduled division line that is inspected during the visual inspection process. In other words, the blade performs the process of cutting the semiconductor material along the scheduled division line before the temperature is lowered by cutting water and the chuck table.

During the cutting process, the semiconductor material is contracted by cutting water and the cooled state of the chuck table, and the scheduled division line of the semiconductor material is changed according to the contraction of the semiconductor material. However, the blade performs the cutting process on the basis of the scheduled division line of the semiconductor material, the scheduled division line being inspected during the visual inspection process. Accordingly,

since the cutting process of the semiconductor material is performed along a position of the initial scheduled division line that is inspected by using the visual inspection unit, a position offset value of the scheduled division line of the contracted semiconductor material is not applied during the actual cutting process. Therefore, since a division line that is actually cut is changed, cutting quality is deteriorated, and there is a problem that the degree of precision of the cutting process is lowered.

Document of Related Art

(Patent Document 1) Korean Patent No. 10-1519470

SUMMARY OF THE INVENTION

Accordingly, the present disclosure has been made keeping in mind the above problems occurring in the related art, and an objective of the present disclosure is to secure cutting precision by performing a visual inspection (alignment) when a state where an environment is the same as an environment in which a semiconductor material is actually cut is formed when a scheduled division line of the semiconductor material is detected.

That is, a semiconductor material cutting method of the present disclosure has an objective that is to improve cutting

quality without having misalignment between the scheduled division line of the semiconductor material and a position of a division line that is actually cut, by pre-cooling the semiconductor material before a cutting process is performed so that the cutting process is performed on the basis of the scheduled division line of the semiconductor material that is in a cooled and contracted state.

In addition, an objective of the present disclosure is to provide a semiconductor material cutting method that does not reduce a UPH by cooling and contracting the semiconductor material transferred to one chuck table and by performing the visual inspection at the same time while the semiconductor material transferred to an upper portion of the other chuck table is cut.

In the semiconductor material cutting method of a semiconductor material cutting device according to an aspect of the present disclosure, the device including: a pair of chuck tables configured to vacuum adsorb a semiconductor material on each upper portion thereof and provided such that the pair of chuck tables is movable in a Y-axis direction and is rotatable; a strip picker configured to transfer the semiconductor material to the chuck table; a cutting unit configured to cut the semiconductor material while spraying cutting water on an upper surface of the semiconductor material that is adsorbed on each of the pair of chuck tables; and a washing nozzle provided

on an upper portion of a movement path of the pair of chuck tables, the method includes: A) transferring, by the strip picker, the semiconductor material to the upper portion of any one of the chuck tables among the pair of chuck tables; B) detecting, by a visual inspection unit, a scheduled division line by imaging the semiconductor material transferred to the any one of the chuck tables, and then cutting, by the cutting unit, the semiconductor material along the detected scheduled division line; C) during performing the B) process, transferring, by the strip picker, another semiconductor material to the upper portion of other remaining chuck table among the pair of chuck tables, and then cooling the another semiconductor material by spraying washing water on an upper surface of the another semiconductor material that is vacuum adsorbed to the upper portion of the other remaining chuck table by moving the other remaining chuck table to a lower portion of the washing nozzle, and then removing moisture of the another semiconductor material by spraying air on the upper surface of the another semiconductor material that is cooled; and D) detecting, by the visual inspection unit, the scheduled division line by imaging the cooled semiconductor material, and then cutting, by the cutting unit, the cooled semiconductor material along the detected scheduled division line.

In addition, before the B) process is performed, the method may further include: B0) cooling the semiconductor

material by spraying washing water to the upper surface of the semiconductor material that is vacuum adsorbed on the upper portion of any one of the chuck tables among the pair of chuck tables by moving the any one of the chuck tables to the lower portion of the washing nozzle, and then removing moisture on the semiconductor material by spraying air on the upper surface of the cooled semiconductor material.

In addition, in the B0) process or the C) process, the method may further include: a measuring process in which a temperature of the semiconductor material that is cooled by spraying washing water is measured by using a temperature sensor before moisture is removed or after moisture is removed, wherein the B) process or the D) process may be performed when the measured temperature reaches a predetermined temperature range, and washing water may be additionally sprayed on the upper surface of the semiconductor material when the measured temperature does not reach the predetermined temperature range.

In addition, before the A) process is performed, the method may further include: A01) preparing correlation data between a washing water spraying time or a washing water spraying frequency according to a type of the semiconductor material and a temperature change of the semiconductor material; and A02) setting the washing water spraying time or the washing water spraying frequency on the basis of the correlation data such that the semiconductor material that will

be cut is cooled to the predetermined temperature, wherein, in the C) process, washing water may be sprayed to the upper surface of the semiconductor material with the washing water spraying time or the washing water spraying frequency set in the A02) process.

In addition, in the A02) process, the method may further include: a process in which the semiconductor material that will be firstly cut among the semiconductor materials that will be cut is selected as a reference material and then a temperature of the reference material is measured, wherein the washing water spraying time or the washing water spraying frequency for cooling the semiconductor material to a predetermined temperature may be set as a reference value of the semiconductor material that will be cut, on the basis of the measured temperature.

In the semiconductor material cutting method according to the present disclosure, the cooling process of the semiconductor material may be more rapidly performed by using the washing nozzle before the cutting process is performed. Therefore, an environment similar to a cutting water spraying environment during the process of cutting the semiconductor material is formed in the process of cooling the semiconductor material, so that the semiconductor material may be pre-contracted. In addition, since the position of the scheduled division line of the semiconductor material is aligned when the

semiconductor material is cooled and contracted and the semiconductor material is cut on the basis of the aligned position, the scheduled division line in the visual inspection process and the scheduled division line that is actually cut are aligned, so that there is an effect that the cutting precision may be improved.

In addition, since the cooling process and the visual inspection process are performed on the semiconductor material when the semiconductor material is waiting to be cut, productivity of the entire cutting process may not be deteriorated. That is, during cutting the semiconductor material transferred to the upper surface of any one of the chuck tables among the pair of chuck tables, since the semiconductor material transferred to the upper surface of the other remaining chuck table is cooled and the scheduled division line of the cooled semiconductor material is inspected, no additional time for performing the cooling process and the visual inspection process is required, so that there is an effect that the cutting precision of the material may be ensured without deteriorating the UPH.

Therefore, in the semiconductor material cutting method of the present disclosure, the cutting process may be performed on the basis of the position of the scheduled division line of the contracted semiconductor material after the result (the position of the scheduled division line) of the visual

inspection of the contracted semiconductor material is provided, and the misalignment between the position of the scheduled division line of the semiconductor material and the position of the division line that is actually cut is prevented, so that there is an effect that the cutting quality may be improved.

In addition, in the semiconductor material cutting method of the present disclosure, the sufficiently cooled state of the semiconductor material may be checked by including the temperature measurement process using the temperature sensor, and the optimal washing water spraying time and the optimal washing water spraying frequency for cooling the semiconductor material may be set. Therefore, the change in position of the scheduled division line due to cutting water may be prevented by performing the cutting process when the semiconductor material is sufficiently cooled, and there is an effect that the cutting precision and cutting quality may be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objectives, features, and other advantages of the present disclosure will be more clearly understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a view schematically illustrating a

semiconductor material cutting device according to an exemplary embodiment of the present disclosure;

FIG. 2 is a view schematically illustrating a side cross-sectional view of FIG. 1; and

FIG. 3 is a flowchart illustrating a semiconductor material cutting method according to an exemplary embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

Contents of the description below merely exemplify the principle of the present disclosure. Therefore, those of ordinary skill in the art may implement the theory of the present disclosure and invent various apparatuses which are included within the concept and the scope of the disclosure even though it is not clearly explained or illustrated in the description. Furthermore, in principle, all the conditional terms and embodiments listed in this description are clearly intended for the purpose of understanding the concept of the present disclosure, and one should understand that this disclosure is not limited to the exemplary embodiments and the conditions.

The above described objectives, features, and advantages will be more apparent through the following detailed description related to the accompanying drawings, and thus

those of ordinary skill in the art may easily implement the technical spirit of the present disclosure.

The embodiments of the present disclosure will be described with reference to cross-sectional views and/or perspective views which schematically illustrate ideal embodiments of the present disclosure. For explicit and convenient description of the technical content, thicknesses of regions in the drawings may be exaggerated. Therefore, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, the embodiments should not be construed as limited to the particular shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing. The terms used in the present specification are only used to describe specific embodiments, and are not intended to limit the present disclosure. Singular expressions include plural expressions unless the context clearly indicates otherwise. It will be further understood that the terms “comprises” or “have” used in this specification, specify the presence of stated features, steps, operations, components, parts, or a combination thereof, but do not preclude the presence or addition of one or more other features, numerals, steps, operations, components, parts, or a combination thereof.

Hereinafter, an exemplary embodiment of the present

disclosure will be described in detail with reference to the accompanying drawings.

FIG. 1 is a view schematically illustrating a semiconductor material cutting device 100 according to an exemplary embodiment of the present disclosure, and FIG. 2 is a side cross-sectional view schematically illustrating the semiconductor material cutting device 100 according to an exemplary embodiment of the present disclosure. In FIG. 2, a strip picker 110, a washing unit 150, and a unit picker 160 are omitted.

As illustrated in FIG. 1, the semiconductor material cutting device 100 of the present disclosure may include the strip picker 110, a first chuck table CT1, a second chuck table CT2, a washing nozzle NZ, a cutting unit 120, a visual inspection unit 130, a temperature sensor 140, the washing unit 150, and the unit picker 160.

The strip picker 110 may adsorb a semiconductor material SR that is sequentially supplied from a material supply portion (not illustrated) on which a plurality of semiconductor materials SR is stacked. The strip picker 110 is provided such that the strip picker 110 is movable in an X-axis direction, so that the strip picker 110 may transfer the adsorbed semiconductor material SR to at least one of the first chuck table CT1 and the second chuck table CT2. In this situation, the semiconductor material SR transferred to the first chuck

table CT1 and seated on the first chuck table CT1 may be a first semiconductor material SR1. Further, the semiconductor material SR transferred to the second chuck table CT2 and seated on the second chuck table CT2 may be a second semiconductor material SR2. Therefore, the semiconductor material SR may include the first semiconductor material SR1 seated on the first chuck table CT1, and may include the second semiconductor material SR2 seated on the second chuck table CT2.

The chuck table may be provided in a pair of chuck tables. The pair of chuck tables includes the first chuck table CT1 and the second chuck table CT2. Further, the first chuck table CT1 and the second chuck table CT2 may be movable in a Y-axis direction, and may be provided such that the first chuck table CT1 and the second chuck table CT2 may be rotatable from the X-axis direction in FIG. 1 to the Y-axis direction or may be rotatable from the Y-axis direction to the X-axis direction. As an example, the first chuck table CT1 may be positioned in the X-axis direction or the Y-axis direction in FIG. 1. In a state in which the semiconductor material SR transferred to an upper portion of the first chuck table CT1 is adsorbed by vacuum, a scheduled division line is detected by imaging the semiconductor material SR with the visual inspection unit 130. A process in which the cutting unit 120 cuts the first semiconductor material SR1 along the scheduled division line in

the Y-axis direction or the X-axis direction of the first semiconductor material SR1 that is seated on the first chuck table CT1 may be performed along the detected scheduled division line. Then, the semiconductor cutting device 100 may change a cutting direction of the semiconductor material SR by rotating the first chuck table CT1 from the Y-axis direction to the X-axis direction or from the X-axis direction to the Y-axis direction so that the cutting unit 120 is positioned at the scheduled division line in the X-axis direction or the Y-axis direction of the first semiconductor material SR1.

The cutting unit 120 may be provided such that the cutting unit 120 is movable in the X-axis direction. The cutting unit 120 is moved in the X-axis direction, and may perform a cutting process in which the cutting unit 120 cuts the semiconductor materials SR along the scheduled division lines of the semiconductor materials SR that are respectively seated on the first chuck table CT1 and the second chuck table CT2.

The cutting unit 120 is provided with a blade cutting the semiconductor material SR, and is provided with a cutting water spraying nozzle spraying cutting water to the blade and the semiconductor material SR. The blade is mounted on a spindle that is rotatable, and is configured to cut the semiconductor material SR. Further, the blade is provided to be movable in the X-axis direction so that all of the scheduled division lines of the semiconductor material SR are capable of being cut

through a relative movement with the chuck table.

The cutting water spraying nozzle that extends along a side surface of the blade is provided on the cutting unit 120, and is capable of receiving cutting water by being connected to a pipe that sprays cutting water. The cutting water spraying nozzle is configured to cool heat generated on the blade during the cutting process of the semiconductor material SR. Further, the cutting water spraying nozzle is configured to discharge scrap that is generated during the cutting process of the semiconductor material SR, and is configured to supply cutting water to the blade and the semiconductor material SR so as to prevent a whitening phenomenon that is generated on a surface of the semiconductor material SR during the cutting process.

The washing nozzle NZ is provided on an upper portion of a movement path of the chuck table, and may remove the scrap generated during the cutting process and may wash an upper surface of the semiconductor material SR by spraying washing water. In the present disclosure, in addition to a function of washing the upper surface of the semiconductor material SR that is cut, the washing nozzle NZ may perform a function of cooling the semiconductor material SR before the cutting process is performed.

That is, the washing nozzle NZ serves to cool the semiconductor material SR by lowering the temperature of the semiconductor material SR by spraying washing water. In a

state in which the semiconductor material SR is adsorbed on the chuck table, when washing water is sprayed, an environment similar to an environment in which the cutting process of the semiconductor material SR is formed except for the process of performing the cutting. That is, the temperature of the semiconductor material SR is lowered by spraying washing water to the upper surface of the semiconductor material SR. Further, when a gap is formed between the semiconductor material SR and a vacuum adsorption surface of the chuck table, washing water and air are rapidly introduced through the gap, and the temperature of the chuck table is lowered more, so that the temperature of the semiconductor material SR that is transferred to the upper surface of the chuck table may be lowered more.

Specifically, washing water of the washing nozzle NZ may have the same temperature and may have the same configuration of cutting water of the blade that is provided on the cutting unit 120. For example, washing water may be a deionized water so as to prevent a generation of a static electricity, or may be water cooled by a chiller. The washing nozzle NZ is provided such that washing water is independently sprayed to the first semiconductor material SR1 provided on the first chuck table CT1 and to the second semiconductor material SR2 provided on the second chuck table CT2.

Washing water sprayed through the washing nozzle NZ may be

a material that is the same as cutting water which is provided on the cutting unit 120 and which is sprayed to the blade and the upper surface of the semiconductor material SR. When the temperature of washing water is a low temperature that is capable of performing the cooling function, washing water is used as cooling water, and washing water may be sprayed to the semiconductor material SR through the washing nozzle NZ. Meanwhile, when the temperature of cutting water is higher than a temperature capable of performing the cooling function, cooling water having a temperature lower than the temperature of cutting water is provided, and cooling water may be sprayed to the semiconductor material SR through the washing nozzle NZ.

As illustrated in FIGS. 1 and 2, the washing nozzles NZ may be fixed and mounted above the first chuck table CT1 and the second chuck table CT2, respectively. The washing nozzle NZ may include a first washing nozzle NZ1 fixed and mounted above the first chuck table CT1, and may include a second washing nozzle NZ2 fixed and mounted above the second chuck table CT2.

The washing nozzle NZ may be provided with a function of spraying washing water and a function of spraying air. The air spraying function of the washing nozzle NZ may be provided to dry the semiconductor material SR before the scheduled division line is detected by the visual inspection unit 130, the semiconductor material SR having moisture by washing water.

The washing nozzle NZ may selectively spray at least one of washing water and air to the semiconductor material SR. Specifically, when the washing nozzle NZ cools the semiconductor material SR by lowering the temperature of the semiconductor material SR, only washing water may be sprayed or both washing water and air may be sprayed together. Meanwhile, when the washing nozzle NZ dries the semiconductor material SR on which moisture is remained by washing water, only air may be sprayed. The sprayed air may be compressed air or cooled air.

The semiconductor material cutting device 100 according to an exemplary embodiment of the present disclosure may be additionally provided with an air nozzle that only sprays air. In this situation, after the semiconductor material SR is cooled by washing water sprayed from the washing nozzle NZ, the semiconductor material SR may be dried by air sprayed from the air nozzle.

The visual inspection unit 130 may be provided such that the visual inspection unit 130 is movable in the X-axis direction from above the chuck table so as to detect the scheduled division line of the semiconductor material SR. The visual inspection unit 130 may detect the scheduled division line of the first semiconductor material SR1 that is adsorbed on the first chuck table CT1, and may detect the scheduled division line of the second semiconductor material SR2 that is adsorbed on the second chuck table CT2.

The scheduled division line refers to a cutting line on which the semiconductor material SR will be cut. Further, the inspection of the scheduled division line is performed by obtaining an image by sequentially imaging a recognition mark provided on a predetermined position on the semiconductor material SR that is adsorbed on the upper portion of the chuck table, and position information with respect to the scheduled division line of the semiconductor material SR may be calculated on the basis of the obtained image.

By using the cutting unit 120, during the process of cutting the semiconductor material SR, the semiconductor material SR may be cut along the scheduled division line obtained by the visual inspection unit 130.

The temperature sensor 140 may be mounted on one side of the visual inspection unit 130. The temperature sensor 140 may measure the temperature of the semiconductor material SR before the cutting process is performed. Preferably, the temperature sensor 140 may measure the temperature of the semiconductor material SR before the cutting process is performed. More preferably, the temperature sensor 140 may measure the temperature of the semiconductor material SR provided on an inspection position of the visual inspection unit 130 so as to perform inspecting process by using the visual inspection unit 130. The temperature sensor 140 may transmit a measured temperature measurement value to a control unit (not

illustrated). The control unit may determine whether to cut the semiconductor material SR, or whether to additionally perform the cooling process such that the semiconductor material SR has the low temperature, on the basis of the temperature measurement value received from the temperature sensor 140.

Of course, the temperature sensor 140 may be additionally provided, and may measure the temperature at a separate space.

The unit picker 160 may pick up the semiconductor material SR from the chuck table, the semiconductor material SR being cut by the cutting unit 120, and may transfer the semiconductor material SR to a sort loading device (not illustrated) via the washing unit 150.

The washing unit 150 may include a brush and a washing spraying nozzle (not illustrated). By using the brush, the washing unit 150 may wash a lower surface of the semiconductor material SR on which the cutting process is finished. Further, the lower surface of the semiconductor material SR may be washed by spraying washing water to the lower surface of the semiconductor material SR. Furthermore, the lower surface of the semiconductor material SR may be washed by using both the brush and the washing spraying nozzle. The semiconductor material SR that has been cut may be in a state in which the semiconductor material SR is divided into individual semiconductor material units. The washing spraying nozzle is

positioned at the lower surface of the semiconductor material SR that has been cut, so that the washing spraying nozzle may effectively wash the lower surface of the semiconductor material SR that is picked up by the unit picker 160.

Hereinafter, a semiconductor material cutting method of the semiconductor material cutting device as described above will be described.

The semiconductor material cutting method of the present disclosure includes: A) transferring, by the strip picker 110, the semiconductor material SR to the upper portion of any one of the chuck tables among the pair of chuck tables CT1 and CT2; B) detecting, by the visual inspection unit 130, the scheduled division line by imaging the semiconductor material SR transferred to the chuck table, and then cutting, by the cutting unit 120, the semiconductor material SR along the detected scheduled division line; C) during performing the B) process, transferring, by the strip picker 110, the semiconductor material SR to the upper portion of the other remaining chuck table among the pair of chuck tables, and then cooling the semiconductor material SR by spraying washing water on the upper surface of the semiconductor material SR that is vacuum adsorbed to the upper portion of the chuck table by moving the other remaining chuck table to the lower portion of the washing nozzle NZ, and then removing moisture of the semiconductor material by spraying air on the upper surface of

the cooled semiconductor material SR; and D) detecting, by the visual inspection unit 130, the scheduled division line by imaging the semiconductor material SR, and then cutting, by the cutting unit 120, the semiconductor material SR along the detected scheduled division line.

That is, according to the semiconductor material cutting method of the present disclosure, when the process of cutting any one of the chuck tables among the pair of chuck tables is performed, the cooling process and the moisture removing process of the semiconductor material SR that is transferred to the upper portion of the other remaining chuck table may be performed.

At this time, any one of the chuck tables may be the first chuck table CT1 or the second chuck table CT2, and the other remaining chuck table may be the second chuck table CT2 or the first chuck table CT1.

At this time, the first chuck table CT1 and the second chuck table CT2 are separated from each other on the drawings for helping understand of the present disclosure, and are not limited thereto.

The semiconductor material cutting method 1 according to an exemplary embodiment of the present disclosure may be performed by using components of the semiconductor material cutting device 100 according to an exemplary embodiment of the present disclosure.

FIG. 3 is a flowchart illustrating the semiconductor material cutting method 1 according to an exemplary embodiment of the present disclosure. The semiconductor material cutting method 1 according to an exemplary embodiment of the present disclosure may include: a transferring process S10 in which the semiconductor material SR is transferred on the upper surface of the first chuck table CT1; a cutting process S20 in which the scheduled division line is detected by imaging the first semiconductor material SR1 by using the visual inspection unit 130, the first semiconductor material SR1 being transferred to the first chuck table CT1 and then the first semiconductor material SR1 is cut along the detected scheduled division line by using the cutting unit 120; a moisture removing process S30 in which the second semiconductor material SR2 is transferred to the upper portion of the second chuck table CT2 and then washing water is sprayed to the upper surface of the second semiconductor material SR2 that is transferred to the upper portion of the second chuck table CT2 so that the second semiconductor material SR2 is cooled and then moisture of the second semiconductor material SR2 is removed by spraying air on the upper surface of the cooled second semiconductor material SR2; and a cutting process S40 in which the scheduled division line is detected by imaging the cooled second semiconductor material SR2 with the visual inspection unit 130 and then the second semiconductor material SR2 is cut along the detected

scheduled division line by using the cutting unit 120.

Hereinafter, the semiconductor material cutting method of the present disclosure will be described in detail with reference to accompanying drawings.

First, in the S10 process, a process in which the strip picker 110 picks up any one of the semiconductor materials SR supplied from the material supply portion and then the semiconductor material SR is transferred to any one of the chuck tables among the pair of chuck tables may be performed. Here, the any one of the chuck tables may be referred to as the first chuck table CT1. The first semiconductor material SR1 may be vacuum adsorbed on the first chuck table CT1 by the strip picker 110. The first semiconductor material SR1 initially seated on the first chuck table CT1 by the strip picker 110 may be seated in the Y-axis direction in FIG. 1, or may be seated in the X-axis direction in FIG. 1.

However, the strip picker 110 may be provided such that the strip picker 110 has a long length in the X-axis direction in FIG. 1. In this situation, preferably, an initial position of the first chuck table CT1 may be the X-axis direction corresponding to the X-axis direction of the strip picker 110. When the direction of the initial position of the first chuck table CT1 is the same as the direction of the strip picker 110, the semiconductor material SR adsorbed on the strip picker 110 may be transferred to the first chuck table CT1 without

rotation to the Y-axis direction of the first chuck table CT1. Accordingly, an unnecessary rotation process in the Y-axis direction of the first chuck table CT1 is omitted, so that a semiconductor material SR transfer efficiency of the strip picker 110 may be increased.

Then, the S20 process in which the scheduled division line is detected by imaging the semiconductor material SR that is transferred to the chuck table, and then the semiconductor material SR is cut along the detected scheduled division line by the cutting unit 120 may be performed. In the S20 process, the scheduled division line of the semiconductor material SR is firstly inspected by the visual inspection unit 130. At this time, the visual inspection may be performed on the first chuck table CT1 having the initial position in the X-axis direction while the first chuck table CT1 is vacuum adsorbing the first semiconductor material SR1. The visual inspection may be performed by the visual inspection unit 130. In the visual inspection, an image of a recognition mark is obtained by imaging the recognition mark provided at a predetermined position of the first semiconductor material SR1 that is adsorbed on the first chuck table CT1, and position information of the scheduled division line of the semiconductor material SR may be calculated on the basis of the obtained image. Therefore, the visual inspection may be a position inspection of the scheduled division line of the semiconductor material

SR.

Then, a process in which the first semiconductor material SR1 is cut along the detected scheduled division line by the cutting unit 120 may be performed. In a state in which the blade is rotated, the cutting unit 120 may cut the first semiconductor material SR1 by moving the chuck table in the Y-axis direction. At this time, according to an inspection result inspected by the visual inspection unit 130, i.e., according to a position of the scheduled division line of the first semiconductor material SR1, the cutting unit 120 may cut the first semiconductor material SR1.

The cutting unit 120 may cut the first semiconductor material SR1 along the scheduled division line of the first semiconductor material SR1 that is seated on the X-axis direction corresponding to the first chuck table CT1 which has the initial position in the X-axis direction in FIG. 1. At this time, corresponding to the scheduled division line in the Y-axis direction among the scheduled division lines in the X-axis direction and the Y-axis direction of the first semiconductor material SR1 that is seated on the X-axis direction, the cutting unit 120 may be provided above the first semiconductor material SR1. The cutting unit 120 may cut the first semiconductor material SR1 along the scheduled division line of the first semiconductor material SR1 in the corresponding position.

Here, a method of performing cutting without rotating the first chuck table CT1 that has the initial position in the X-axis direction with the cutting direction as the X-axis direction has been described, but is an embodiment. Further, after the first chuck table CT1 where the semiconductor material SR is transferred is rotated and the first semiconductor material SR1 is rotated in the Y-axis direction, i.e., the position misalignment of the semiconductor material SR occurring during cutting a short side of the first semiconductor material SR1 after cutting a major side of the first semiconductor material SR1 may be minimized.

The first chuck table CT1 positioned in the X-axis direction in FIG. 1 may be rotated in the Y-axis direction after the process of cutting the first semiconductor material SR1 in the X-axis direction is finished. FIG. 1 is an example, and illustrates the first chuck table CT1 in a state of being rotated in the Y-axis direction after the process of cutting in the X-axis direction is finished.

After the strip picker 110 transfers the semiconductor material SR to any one of the chuck tables among the pair of chuck tables, the strip picker 110 transfers new semiconductor material SR to the other remaining chuck table. From the material supply portion, the strip picker 110 may adsorb other semiconductor material SR that will be cut, and may transfer the other semiconductor material SR to the second chuck table

CT2. As a result, the second semiconductor material SR2 may be transferred to and adsorbed on the second chuck table CT2.

Therefore, after the first semiconductor material SR1 is transferred to the first chuck table CT1 in the S10 process, or when the process of detecting the scheduled division line is performed by imaging the first semiconductor material SR1 transferred to the first chuck table CT1 in the S20 process, a process in which the strip picker 110 transfers the second semiconductor material SR2 to the other remaining chuck table, i.e., the second chuck table CT2 may be performed. When the second semiconductor material SR2 is transferred to the second chuck table CT2, the second chuck table CT2 is moved to the lower portion of the washing nozzle NZ, and the process of cooling the second semiconductor material SR2 may be performed by spraying washing water on the upper surface of the second semiconductor material SR2 that is vacuum adsorbed on the second chuck table CT2. After then, moisture of the second semiconductor material SR2 may be removed by spraying air on the upper surface of the second semiconductor material SR2.

Specifically, the S30 process may be performed during performing the process of cutting the first semiconductor material SR1, and the transferring process, the cooling process, and the drying process of the second semiconductor material SR2 may be performed in the S30 process. Of course, according to a cutting time of the first semiconductor material

SR1, the transferring process, the cooling process, the drying process, and the visual inspection process of the second semiconductor material SR2 may be performed.

Meanwhile, in the S30 process, the second semiconductor material SR2 may be cooled by washing water sprayed through the washing nozzle NZ. In this situation, the washing nozzle NZ may be the second washing nozzle NZ2 that is fixed and mounted above the second semiconductor material SR2. While the S30 process is performed, the process of cutting the first semiconductor material SR1 that is adsorbed on the upper portion of the first chuck table CT1 may still be performed. Accordingly, the second semiconductor material SR2 may have a lowered temperature by being cooled by washing water sprayed through the washing nozzle NZ while the process of cutting the first semiconductor material SR1 is performed.

At this time, a reason for cooling the semiconductor material SR is to form an environment that is the same as an environment in which the semiconductor material SR is cut. When the semiconductor material SR is cut by the cutting unit 120, the temperature of the semiconductor material SR is lowered since cutting water having the low temperature is sprayed to the semiconductor material SR. Further, when the gap is formed between the semiconductor material SR and the chuck table that vacuum absorbs the semiconductor material SR, cutting water and air are rapidly introduced through the gap,

so that the chuck table is cooled and the temperature of the semiconductor material SR that is adsorbed on the upper surface of the chuck table is lowered more and cooled.

Conventionally, the temperature of the semiconductor material SR on which the visual inspection is performed before the semiconductor material SR is cut was approximately 22℃ to 25℃. However, when the semiconductor material SR is cut, the temperature of the semiconductor material SR was lowered to 12℃ to 15℃. The semiconductor material SR is contracted due to the low temperature, and such a contraction is accumulated throughout the semiconductor material SR. Therefore, when the semiconductor material SR is cut, the scheduled division line of the semiconductor material SR is contracted and the scheduled division line is different from the initial scheduled division line that is vision inspected. However, conventionally, the scheduled division line was detected by directly vision inspecting the semiconductor material SR that is supplied from the material supply portion, and the cutting process was performed along the detected scheduled division line, so that a cutting offset was generated as the semiconductor material SR is contracted.

Therefore, in the present disclosure, before the visual inspection is performed on the semiconductor material SR, the

semiconductor material SR is pre-cooled and contacted so that the semiconductor material SR is in a state at the time of the cutting process, so as to detect the position of the contracted scheduled division line. That is, in order for the semiconductor material SR to be in an environment at the time when the cutting process is performed, the visual inspection is performed when the semiconductor material SR is cooled and contracted, so that the contracted scheduled division line may be detected. Preferably, while the process of cutting is performed on the semiconductor material SR that is transferred to any one of the chuck tables, the semiconductor material SR adsorbed on the other remaining chuck table may wait to be cut while being cooled to the temperature at the time when the cutting process is performed. At this time, by spraying washing water to the upper surface of the semiconductor material SR in the same manner as an environment at the time when the semiconductor material SR is cut, the temperature of the semiconductor material SR may be lowered.

Therefore, in the S30 process, the second semiconductor material SR2 may be cooled and contracted by washing water of the washing nozzle NZ. Accordingly, the position of the scheduled division line of the second semiconductor material SR2 may be changed according to the contracted state of the second semiconductor material SR2. Then, by spraying air to the upper surface of the second semiconductor material SR2,

moisture remaining on the semiconductor material SR may be dried and removed. Spraying of air is a process for removing moisture so as to eliminate noise during performing the visual inspection, and the cooled and contracted state of the semiconductor material SR is not still changed even if air is sprayed.

Meanwhile, before moisture is removed or after moisture is removed, a process of measuring the temperature of the semiconductor material SR on which the cooling process is performed by spraying washing water may be performed by using the temperature sensor 140.

At this time, when the measured temperature reaches a predetermined temperature range, the imaging process is performed on the semiconductor material SR by using the visual inspection unit 130 and the scheduled division line is detected, and the semiconductor material SR may be cut along the detected scheduled division line.

When the measured temperature does not reach the predetermined temperature range, washing water may be additionally sprayed to the upper surface of the semiconductor material SR by the washing nozzle NZ. Since moisture is required to be completely removed by spraying air after washing water is additionally sprayed, it is preferable that the temperature of the semiconductor material SR is measured by the temperature sensor 140 before moisture is removed.

When the measured temperature reaches the predetermined temperature range, it is preferable that the scheduled division line of the cooled semiconductor material SR is detected by the visual inspection unit 130 after moisture of the semiconductor material SR is completely removed.

Meanwhile, after the semiconductor material SR is cooled, the temperature of the cooled semiconductor material SR may be measured by the temperature sensor 140 so as to check whether the semiconductor material SR is sufficiently cooled to the predetermined temperature range. On the contrary, a washing water spraying time or a washing water spraying frequency may be set so that the semiconductor material SR may be sufficiently cooled to the predetermined temperature range.

To this end, in the present disclosure, before the semiconductor material cutting method is performed, correlation data between the washing water spraying time or the washing water spraying frequency according to the type of the semiconductor material SR and the temperature change of the semiconductor material SR may be prepared.

For example, by preparing data of temperature change of the semiconductor material SR such as the washing water spraying time or the washing water spraying frequency to lower the temperature of the semiconductor material SR by 1°C, the washing water spraying time or the washing water spraying frequency to lower the temperature of the semiconductor

material SR by 2°C, or the like, and data of the washing water spraying time or the washing water spraying frequency, the data may be input and stored.

Therefore, in order to cool the temperature of the semiconductor material SR that will be cut, to the predetermined temperature, the washing water spraying time or the washing water spraying frequency may be set on the basis of the correlation data between the washing water spraying time or the washing water spraying frequency and the temperature change of the semiconductor material SR. At this time, the set washing water spraying time or the set washing water spraying frequency may be determined as a reference value for cooling the semiconductor material SR.

Preferably, among the semiconductor materials SR that will be cut, the semiconductor material SR that will be cut first may be selected as a reference material, and the temperature of the reference material may be measured. At this time, as illustrated in FIG. 1, the temperature measurement of the reference material may be performed in the visual inspection area located near the washing nozzle NZ. However, by providing the temperature sensor 140 on an area where the strip picker 110 transfers the semiconductor material SR to the chuck table, the temperature measurement of the reference material may be performed when the chuck table receives the semiconductor material SR, or may be performed in a separate space.

Here, the washing water spraying time or the washing water spraying frequency for cooling the semiconductor material SR to the predetermined temperature may be determined as a reference value of the semiconductor material SR on the basis of the temperature measured through the temperature sensor 140.

Meanwhile, by imaging the cooled semiconductor material SR with the visual inspection unit 130, the scheduled division line of the semiconductor material SR is detected. When the scheduled division line of the semiconductor material SR is checked by the visual inspection unit 130, moisture remaining on the semiconductor material SR may become noise while performing the visual inspection. Therefore, before the scheduled division line of the semiconductor material SR is detected by imaging the semiconductor material SR with the visual inspection unit 130, the washed second semiconductor material SR2 may be dried by the washing nozzle NZ and moisture on the second semiconductor material SR2 may be removed.

The washing nozzle NZ may be provided with the function of spraying washing water and the function of spraying air. Therefore, the process of drying the second semiconductor material SR2 may be performed through the air spraying function of the washing nozzle NZ. Air sprayed through the washing nozzle NZ may include compressed air and cooled air.

The semiconductor material cutting device 100 according to an exemplary embodiment of the present disclosure may spray and

supply both washing water and air together when the semiconductor material SR is cooled through the washing nozzle NZ. Further, after the cooling of the semiconductor material SR by controlling the washing nozzle NZ is finished, supplying of washing water may be blocked and only air may be allowed to be sprayed, so that the semiconductor material SR may be dried. Of course, the semiconductor material SR may be dried by controlling the washing nozzle NZ, but an air nozzle (not illustrated) spraying only air may be added separately from the washing nozzle NZ.

In this situation, in the S30 process, the process of removing moisture of the semiconductor material SR may be performed through the air nozzle. The air nozzle only serves to spray air, so that the washing nozzle NZ does not have to be controlled to be blocked from spraying washing water. Further, during spraying air to the second semiconductor material SR2, there is an advantage that the second semiconductor material SR2 may be dried without having a risk of leakage of residual water inside the washing nozzle NZ.

Air sprayed through the air nozzle may include compressed air and cooled air.

Then, the process of performing the visual inspection of the second semiconductor material SR2 in the S40 process may be performed. The visual inspection in the S40 process may be performed on the second semiconductor material SR2 while the

second semiconductor material SR2 is in the cooled and contracted state by the S30 process. The visual inspection may be performed through the visual inspection unit 130. The visual inspection unit 130 is provided such that the visual inspection unit 130 is movable in the X-axis direction, and the visual inspection unit 130 may inspect the position of the scheduled division line of the second semiconductor material SR2 by being moved in the X-axis direction above the second semiconductor material SR2.

For reference, when the process of detecting the scheduled division line of the second semiconductor material SR2 is performed in the S40 process, the process of cutting the first semiconductor material SR1 in the S20 process may still be performed. That is, when the process of cutting the first semiconductor material SR1 is finished, the process of cutting the second semiconductor material SR2 may be performed. Therefore, when the process of cutting the first semiconductor material SR1 is finished, the cutting unit 120 is moved in the X-axis direction in FIG. 1 after the S20 process is finished, and the cutting unit 120 may cut the second semiconductor material SR2 along the scheduled division line of the second semiconductor material SR2, the scheduled division line being detected by the visual inspection unit 130. Of course, the scheduled division line of the second semiconductor material SR2 detected by the visual inspection unit 130 is the scheduled

division line of the semiconductor material SR that is cooled and contracted by the S30 process. Therefore, since the scheduled division line of the semiconductor material SR is detected by the visual inspection unit 130 while the semiconductor material SR is in the pre-cooled state, the scheduled division line of the semiconductor material SR that will be actually cut may be the same as the scheduled division line of the semiconductor material SR detected by the visual inspection unit 130.

Meanwhile, when the second semiconductor material SR2 is cut, the unit picker 160 picks up the cut first semiconductor material SR1 of the first chuck table CT1 and is moved in the washing unit 150. Further, on the first chuck table CT1, new semiconductor material SR is transferred by the strip picker 110, and the cooling process, the drying process, and the visual inspection process of the new semiconductor material SR may be continuously performed when the first chuck table CT1 is moved to the lower portion of the washing nozzle NZ.

That is, the semiconductor material cutting method of the present disclosure is continuously performed. Further, during performing the process of cutting the semiconductor material SR transferred to the upper portion of any one of the chuck tables among the pair of chuck tables, the semiconductor material SR which is transferred to the other remaining chuck table and which is waiting to be cut is pre-cooled by the washing nozzle

NZ so that the semiconductor material SR is in the environment similar to the environment at the time when the semiconductor material SR is cut, and the inspection of the scheduled division line of the semiconductor material SR may be performed while the semiconductor material SR is in the cooled and contracted state.

In the semiconductor material cutting method 1 according to an exemplary embodiment of the present disclosure, before the process of cutting the semiconductor material SR is performed, the scheduled division line of the semiconductor material SR may be detected by imaging the semiconductor material SR with the visual inspection unit 130 after the semiconductor material SR is cooled and moisture of the cooled semiconductor material SR is removed.

In the process of cutting the semiconductor material SR, since the cutting process is performed along the scheduled division line of the cooled and contracted semiconductor material SR, the cutting unit 120 is in a state in which the position of the scheduled division line of the cooled and contracted semiconductor material SR is input, the semiconductor material being cooled and contracted by sequentially performing the S30 process and the S40 process.

Unlike the semiconductor material cutting method 1 according to an exemplary embodiment of the present disclosure, when the visual inspection of the semiconductor material SR

transferred to the chuck table is performed without performing the cooling and contracting process and then the cutting process is sequentially performed according to the result of the visual inspection, the semiconductor material SR is contracted since the temperature of the chuck table is lowered more due to cutting water which is sprayed to the blade and the semiconductor material SR and which has the low temperature and due to cutting water and air that are rapidly introduced through the gap between the semiconductor material SR and the chuck table when the vacuum adsorbing is performed.

Specifically, since cutting water is provided to have the low temperature so as to perform the function of cooling the blade, cutting water may reduce the temperature of the semiconductor material SR when cutting water is sprayed to the semiconductor material SR. Even if the temperature of cutting water is not low, cutting water takes heat around thereof while cutting water collides with both the semiconductor material SR and the surface of the blade and then scatters, and the temperature of the semiconductor material SR may be reduced, so that the semiconductor material SR may be contracted in the cutting process.

However, when the semiconductor material SR is contracted by cutting water, the position of the scheduled division line according to the result of the visual inspection and the position of the division line during the actual cutting process

may be changed. That is, in a state before the semiconductor material SR is contracted, the visual inspection unit 130 detects the scheduled division line, and the cutting unit 120 performs the process of cutting the semiconductor material SR on the basis of the position of the scheduled division line that is in a state before the semiconductor material SR is contracted. Therefore, the position of the actually cut division line and the scheduled division line that is required to be cut may be changed. This situation not only causes a problem of deteriorating the cutting quality, but also causes a problem of mass production of defective products.

However, in the semiconductor material cutting method 1 according to an exemplary embodiment of the present disclosure, since the cooling process is performed before the cutting process, a contraction environment of the semiconductor material SR by washing water may be formed in the cutting process in advance. Accordingly, the semiconductor material SR may already be contracted before the cutting process.

In addition, since the scheduled division line of the semiconductor material SR is detected by the visual inspection unit 130 while the semiconductor material SR is in the contracted state, the division line to be actually cut and the detected scheduled division line become the same, so that the degree of precision of cutting of the semiconductor material SR may be increased.

Therefore, in the semiconductor material cutting method 1 according to an exemplary embodiment of the present disclosure, unlike the semiconductor material cutting method in which the pre-cooling process is not performed, the scheduled division line of the cooled semiconductor material SR is detected in the process of cutting the semiconductor material SR, and then the cutting unit 120 cut the semiconductor material SR along the position of the scheduled division line, so that the scheduled division line and the position of the actually cut division line may be matched with each other.

The semiconductor material SR on which the cutting process is finished is picked up by the unit picker 160, and may be transferred to the sort loading device after the semiconductor material SR is washed through the washing spraying nozzle.

In the semiconductor material cutting method 1 according to an exemplary embodiment of the present disclosure, during performing the process of cutting the semiconductor material SR transferred to any one of the chuck tables among the pair of chuck tables, the semiconductor material SR transferred to the other remaining chuck table is cooled and is already contracted, and then the cutting process may be performed on the basis of the position of the scheduled division line of the already contracted semiconductor material SR. Accordingly, in the semiconductor material cutting method 1 according to an exemplary embodiment of the present disclosure, during the

process of cutting the semiconductor material SR, misalignment between the scheduled division line obtained through the visual inspection and the position of the division line that will be actually cut by the cutting unit 120 may be prevented. Therefore, in the semiconductor material cutting method according to an exemplary embodiment of the present disclosure, the degree of precision of cutting the semiconductor material SR may be increased, and the cutting quality may be increased.

Meanwhile, during performing the semiconductor material cutting method according to an exemplary embodiment of the present disclosure, the degree of temperature drop of the chuck table may be relatively weak when the semiconductor material SR is firstly cut. Generally, cutting water is sprayed while the process of cutting the semiconductor materials SR is repetitively performed on the chuck table, so that the degree of cooling the chuck table may increase during the cutting process. However, in a situation in which the semiconductor material SR is firstly cut, even if cutting water is sprayed during the cutting process, the cutting time is relatively short, so that the chuck table may not be cooled during the cutting process.

In addition, in the semiconductor material SR that will be firstly cut, since the cutting process may be performed immediately after the visual inspection is performed without having a waiting time, the contraction amount of the firstly

cut semiconductor material SR may be smaller than the contraction amount of the secondly cut semiconductor material SR that is required to wait on the chuck table until the cutting process of the firstly cut semiconductor material SR is finished, so that the firstly cut semiconductor material SR may not have to be cooled already.

Therefore, in the semiconductor material cutting method including: A) transferring, by the strip picker 110, the semiconductor material SR to the upper portion of any one of the chuck tables among the pair of chuck tables CT1 and CT2; B) detecting, by the visual inspection unit 130, the scheduled division line by imaging the semiconductor material SR transferred to the chuck table, and then cutting, by the cutting unit 120, the semiconductor material SR along the detected scheduled division line; C) during performing the B) process, transferring, by the strip picker 110, the semiconductor material SR to the upper portion of the other remaining chuck table among the pair of chuck tables, and then cooling the semiconductor material SR by spraying washing water on the upper surface of the semiconductor material SR that is vacuum adsorbed to the upper portion of the chuck table by moving the other remaining chuck table to the lower portion of the washing nozzle NZ, and then removing moisture of the semiconductor material by spraying air on the upper surface of the cooled semiconductor material SR; and D) detecting, by the

visual inspection unit 130, the scheduled division line by imaging the semiconductor material SR, and then cutting, by the cutting unit 120, the semiconductor material SR along the detected scheduled division line, the method representatively describes a situation in which the cutting process is sequentially performed from the semiconductor material SR that will be firstly cut.

When the size of the semiconductor material SR is small or the cutting path of the semiconductor material SR is short, the cutting time becomes short, so that the time exposed to cutting water may become short. Therefore, when the semiconductor material SR that will be firstly cut is cut, the semiconductor material SR that will be firstly cut may not be contracted by cutting water since the cutting time is short.

Therefore, even if the semiconductor material SR that will be firstly cut is cut on the basis of the result (the position of the scheduled division line) of the visual inspection of the semiconductor material SR in the non-cooled state, the position of the scheduled division line of the semiconductor material SR that will be firstly cut and the position of the division line that will be actually cut by the cutting unit 120 may not cause the misalignment problem.

However, when the size of the semiconductor material SR that will be firstly cut is large or the cutting path is long so that a lot of cutting time is required or a cold fluid is

used as cutting water, the corresponding semiconductor material SR may be cooled and contracted during performing the process of cutting the semiconductor material SR that will be firstly cut.

In addition, when the uniformity of the cut semiconductor material SR is important, it is necessary to keep the cutting environment to be the same from the semiconductor material SR that will be firstly cut since small contraction may affect the size of the cut semiconductor material SR.

In this situation, before the B) process is performed, the process in which the chuck table is moved to the lower portion of the washing nozzle NZ, then the semiconductor material SR is cooled by spraying washing water to the upper surface of the semiconductor material SR that is vacuum adsorbed on the upper portion of the chuck table, and then moisture of the semiconductor material SR is removed by spraying air on the upper surface of the cooled semiconductor material SR may be further performed.

That is, after the strip picker 110 transfers the semiconductor material SR that will be firstly cut to the upper portion of any one of the chuck tables among the pair of the chuck tables, the corresponding chuck table is moved to the lower portion of the washing nozzle NZ, then washing water is sprayed on the upper surface of the semiconductor material SR with the predetermined washing water spraying time or the

predetermined washing water spraying frequency so that the semiconductor material SR that will be firstly cut is cooled, and then moisture of the semiconductor material SR is removed by spraying air to the upper surface of the cooled semiconductor material SR. After then, the scheduled division line of the semiconductor material SR that will be firstly cut may be detected by imaging the cooled semiconductor material SR with the visual inspection unit 130, and the semiconductor material SR that will be firstly cut may be cut along the detected scheduled division line by using the cutting unit 120.

In addition, while the semiconductor material SR that will be firstly cut is cut, the semiconductor material SR that will be secondly cut is transferred to the other remaining chuck table, and the cooling process, the drying process, and the visual inspection process of the semiconductor material SR that will be secondly cut may be performed. When the process of cutting the semiconductor material SR that will be firstly cut is finished, the corresponding chuck table is moved to the position for transferring the semiconductor material SR. Further, during the moving process, cutting of the first semiconductor material SR is completed, and debris remaining on the upper surface of the semiconductor material SR may be washed by using the washing nozzle NZ. While the chuck table on which the semiconductor material SR that will be firstly cut is transferred and is moved to the position for transferring

the cut semiconductor material SR, the cutting unit 120 is moved to the upper portion of the chuck table on which the semiconductor material SR that will be secondly cut is transferred and the cutting process is performed. Further, during cutting the semiconductor material SR that will be secondly cut, the semiconductor material SR that will be firstly cut is removed from the chuck table, and the semiconductor material SR that will be thirdly cut is transferred on the chuck table on which the semiconductor material SR that will be firstly cut is removed, so that the cooling process, the drying process, and the visual inspection process of the semiconductor material SR that will be thirdly cut may be performed.

In other words, the cooling and drying process of the semiconductor material SR that will be firstly cut may be optionally performed. Therefore, before the process of cutting the semiconductor material SR that will be firstly cut is performed, the semiconductor material SR that will be firstly cut may be in the non-cooled state or in the cooled state. Of course, the cooling and drying process may be performed by the washing nozzle NZ in the same manner as the S30 process, and the cooling process may be performed by the washing nozzle NZ and the drying process may be performed by the washing nozzle NZ or the separate air nozzle.

Of course, in the semiconductor material SR that will be

firstly cut, by using the temperature sensor 140 before moisture is removed or after moisture is removed, the process of measuring the temperature of the semiconductor material SR on which the cooling process is performed by spraying washing water may further be performed. At this time, when the temperature measured by the temperature sensor 140 reaches the predetermined temperature range, the process of cutting the semiconductor material SR is performed. Further, when the temperature measured by the temperature sensor 140 does not reach the predetermined temperature range, washing water is additionally sprayed to the upper surface of the semiconductor material SR, and the semiconductor material SR may be cooled to reach the predetermined temperature range.

Although the pair of chuck tables were divided and each process was sequentially divided and described as described above, the cooling process, the moisture removing process, and the visual inspection process are all performed in the same procedure and the same method, so that overlapping description may be omitted.

For reference, the washing nozzle NZ is provided above each of the first chuck table CT1 and the second chuck table CT2, and it is preferable that a washing water spraying period of each washing nozzle NZ is controlled independently according to the operation and the position of each of the chuck tables. That is, washing water is sprayed when semiconductor material

SR transferred to the corresponding chuck table is required to be cooled, and washing water may be controlled to be sprayed during the process of discharging the semiconductor material SR on which the cutting process is finished.

Meanwhile, in the first semiconductor material SR1 as described above, the first semiconductor material SR1 may be the first semiconductor material SR1 (hereinafter, referred to as an initial first semiconductor material) initially seated on the first chuck table CT1 with the start of the operation of the semiconductor material cutting device 100 according to an exemplary embodiment of the present disclosure, or may be the first semiconductor material SR1 newly seated on the first chuck table CT1 while the process of cutting the second semiconductor material SR2 is performed.

Accordingly, in the description with reference to FIG. 3, the semiconductor material SR in the S10 process may preferably be the initial first semiconductor material SR1.

On the other hand, the semiconductor material SR in the S10 process in FIG. 3 may be the first semiconductor material SR1 which is newly seated on the first chuck table CT1 and which is waiting while the second semiconductor material SR2 is cut. In this situation, the cooling process and the drying process may be performed on the first semiconductor material SR1 by the washing nozzle NZ before the cutting process in the S10 process is performed.

The semiconductor material cutting device 100 according to an exemplary embodiment of the present disclosure may include the temperature sensor 140. The temperature sensor 140 may be provided to measure the temperature of the cooled and contracted semiconductor material SR, or may be provided to initially set the washing water spraying time and the washing water spraying frequency of the washing nozzle NZ.

Therefore, before the A) process is performed, the semiconductor material cutting method 1 according to an exemplary embodiment of the present disclosure may further include: A01) preparing correlation data between the washing water spraying time or the washing water spraying frequency according to the type of the semiconductor material SR and the temperature change of the semiconductor material SR; and A02) setting the washing water spraying time or the washing water spraying frequency on the basis of the correlation data such that the semiconductor material SR that will be cut is cooled to the predetermined temperature. In addition, the washing water spraying time or the washing water spraying frequency set in the A02) process is applied when washing water is sprayed in the C) process. That is, in the C) process, washing water is sprayed to the upper surface of the semiconductor material SR with the washing water spraying time or the washing water spraying frequency set in the A02) process.

In the present disclosure, a process of setting the

washing water spraying time or the washing water spraying frequency by selecting the semiconductor material SR that will be firstly cut among the semiconductor materials SR which will be cut as the reference material and then measuring the temperature of the reference material may be further included. At this time, the washing water spraying time or the washing water spraying frequency for cooling the semiconductor material SR to the predetermined temperature on the basis of the measured temperature of the reference material may be set as a reference value of the semiconductor material SR that will be cut.

Specifically, the temperature of the semiconductor material SR may be measured by using the temperature sensor 140. After then, the cooling temperature required to cool to the temperature of the semiconductor material SR at the time when the cutting process is performed may be calculated.

At this time, in the present disclosure, according to the type of the semiconductor material SR, the correlation data between the washing water spraying time and the temperature change of the semiconductor material SR or the correlation data between the washing water spraying frequency and the temperature change of the semiconductor material SR is already prepared.

Therefore, the washing water spraying time or the washing water spraying frequency may be set on the basis of the

correlation data. Further, when the difference in the temperature that is required to be cooled is large, washing water may be sprayed to the upper surface of the semiconductor material SR by increasing the washing water spraying time or by increasing the washing water spraying frequency.

At this time, in order to minimize the time required for performing the semiconductor material cutting method, the temperature before cutting of the semiconductor material SR that will be firstly cut among the semiconductor materials SR is measured, then a conventional cooling temperature when the semiconductor material SR is cut, or the washing water spraying time or the washing water spraying frequency for cooling to a predetermined target temperature is set, and then the set washing water spraying time or the set washing water spraying frequency is set as a default value. Therefore, in the cooling process, the comprehensively set default value (the washing water spraying time or the washing water spraying frequency) may be applied to the remaining semiconductor materials SR.

In addition, in another embodiment of the present disclosure, by measuring the temperature of the cooled semiconductor material SR with the temperature sensor 140, the temperature of the cooled semiconductor material SR may be individually checked to determine whether the temperature of the cooled semiconductor material SR reaches the predetermined temperature range. Of course, such a temperature check may be

performed individually for each semiconductor material SR, but may be performed for checking a cooling state according to a setting value whenever a predetermined number of semiconductor materials SR is cut.

Of course, the temperature sensor 140 may also measure the temperature of the cooled and contracted semiconductor material SR. Preferably, in a state in which washing water is sprayed in the cooling process, the temperature of the semiconductor material SR may be measured before moisture of the semiconductor material SR is removed or after moisture of the semiconductor material SR is removed. The temperature sensor 140 may transmit the measured temperature value to the control unit (not illustrated). When the temperature of the semiconductor material SR measured by the temperature sensor 140 reaches the predetermined temperature range, the process of inspecting the cooled semiconductor material SR with the visual inspection unit 130 and the process of cutting the cooled semiconductor material SR along the inspected scheduled division line are sequentially performed. When the temperature of the semiconductor material SR is measured before moisture is removed, the process of removing moisture of the semiconductor material SR and then inspecting, by the visual inspection unit 130, the semiconductor material SR on which moisture is removed, and the process of cutting the semiconductor material SR along the inspected scheduled division line may be

sequentially performed.

Meanwhile, when the temperature of the semiconductor material SR is measured by the temperature sensor 140 and the temperature of the semiconductor material SR does not reach the predetermined temperature range, washing water may be additionally sprayed so that cooling of the corresponding semiconductor material SR is further performed. After washing water is additionally sprayed, the process of removing moisture and then inspecting, by the vision inspection unit 130, the semiconductor material SR on which moisture is removed, and the process of cutting the semiconductor material SR along the inspected scheduled division line may be performed.

For reference, the predetermined temperature range may be set by the control unit. The predetermined temperature range may vary according to the type of the semiconductor material SR, the temperature of washing water, and so on. As an example, the predetermined temperature range may be 12℃ to 15℃.

When the temperature measurement value transmitted from the temperature sensor 140 is within the 12℃ to 15℃ that is the predetermined temperature range, the control unit determines that the cooling state of the semiconductor material SR is in the sufficiently cooled state, and the visual inspection for the scheduled division line of the corresponding semiconductor material SR that is cooled may be performed.

Referring to FIG. 1, the temperature sensor 140 is provided at the one side of the visual inspection unit 130, and may be movable in the X-axis direction together with the visual inspection unit 130.

Of course, when the visual inspection in the S40 process is performed, the temperature sensor 140 may check the temperature of the semiconductor material SR at the same time when the visual inspection is performed by the visual inspection unit 130 that is provided at the one side of the temperature sensor 140. In this situation, the temperature of the semiconductor material SR may be measured while the temperature measurement time is reduced, and the washing water spraying frequency or the washing water spraying time may vary in the process of cooling the next semiconductor material SR.

For reference, the temperature sensor 140 may measure the temperature of the semiconductor material SR by measuring the temperature of a specific position in a form of a point among the entire area of the upper surface of the semiconductor material SR. As an example, the temperature sensor 140 may measure the temperature at three positions on the semiconductor material SR in a three-point form. In contrast, the temperature sensor 140 may measure the temperature at five positions on the semiconductor material SR in a five-point form.

The temperature sensor 140 may measure the temperature at

three positions on the entire area of the upper surface of the semiconductor material SR. The three positions may be positioned at a virtual center point of the semiconductor material SR and positioned at outer points which are on the same horizontal line on the virtual center point and which are provided at opposite sides of the virtual center point.

Alternatively, the temperature sensor 140 may measure the temperature at five positions on the entire area of the upper surface of the semiconductor material SR. The five positions may be the point at the virtual center point of the semiconductor material SR and points respectively positioned at four corners of the semiconductor material SR.

When the temperature of a plurality of areas is measured by the temperature sensor 140, the temperature of the corresponding semiconductor material SR may be specified as the average temperature value of the plurality of areas, and the temperature measurement position and the temperature measurement number of the semiconductor material SR may vary. However, the specified position as described above may be the position on which the center potion and the outer periphery portion of the semiconductor material SR so as to increase the accuracy of the temperature measurement value of the semiconductor material SR.

When the temperature measurement value of the semiconductor material SR measured by the temperature sensor

140 reaches the predetermined temperature value that is set by the control unit, the semiconductor material cutting method 1 may be performed such that the process of drying the cooled semiconductor material SR is performed and then the visual inspection for the scheduled division line of the semiconductor material SR is performed by the visual inspection unit 130. After then, the semiconductor material SR may be cut according to the result (the scheduled division line) of the visual inspection.

On the other hand, when the temperature measurement value of the semiconductor material SR measured by the temperature sensor 140 does not reach the predetermined temperature range that is set by the control unit, the semiconductor material cutting method 1 may be performed such that the cooling process or both the cooling process and the drying process is performed again. When the temperature measurement value of the semiconductor material SR received from the temperature sensor 140 does not reach the predetermined temperature range, the control unit may determine that the cooled and contracted state of the semiconductor material SR is not sufficient to perform the cutting process.

In addition, when the semiconductor material SR is not sufficiently cooled and contracted, the semiconductor material SR may be further cooled and contracted by additionally spraying washing water. When the semiconductor material SR is

not sufficiently cooled and contracted, the result (scheduled division line) of the visual inspection and the position of the division line may be changed. Due to this situation, the misalignment between the position of the scheduled division line of the semiconductor material SR and the position of the division line that is actually cut by the cutting unit 120 may occur, and the cutting quality may be deteriorated.

Therefore, the control unit may perform the washing water spraying process again so as to sufficiently cool and contract the semiconductor material SR.

When the process of additionally spraying washing water is finished, the visual inspection may be performed by the visual inspection unit 130 after the semiconductor material SR on which washing water is additionally sprayed is dried. After then, the semiconductor material SR may be cut by the cutting unit 120 according to the result (the scheduled division line) of the visual inspection.

Meanwhile, when the temperature measurement value of the semiconductor material SR measured by the temperature sensor 140 exceeds the predetermined temperature range that is set by the control unit, the washing water spraying time or the washing water spraying frequency may be reduced in order to prevent super cooling situation and to reduce the time required for the cooling process and the moisture removing process.

In the semiconductor material cutting method 1 according

to an exemplary embodiment of the present disclosure, a sufficiently cooled state of the semiconductor material SR may be checked by including the process of measuring the temperature by using the temperature sensor 140, and the optimal washing water spraying time or the optimal washing water spraying frequency for cooling the semiconductor material SR may be set. Therefore, in a state in which the semiconductor material SR is sufficiently cooled, the cutting process is performed, so that the change in the position of the scheduled division line by cutting water may be prevented and the degree of precision of performing the cutting process and the cutting quality may be increased.

As such, in the semiconductor material cutting method 1 according to an exemplary embodiment of the present disclosure, the cooling process of the washing nozzle NZ is performed before the cutting process. Further, while the process of cutting the semiconductor material SR that is transferred to any one of the chuck table among the pair of chuck tables is performed and while the semiconductor material SR transferred to the other remaining chuck table is waiting to be cut, the cooling process of the washing nozzle NZ and the process of vision inspecting the cooled semiconductor material SR may be performed.

Therefore, before the cutting process is performed, the process of cooling the semiconductor material SR may be more

rapidly performed by using the washing nozzle NZ. The washing nozzle NZ may cool the semiconductor material SR while spraying washing water. The environment in which washing water is sprayed is similar to the environment in which cutting water is sprayed. Therefore, while the semiconductor material SR is waiting to be cut, the semiconductor material SR may be pre-cooled and contracted in the environment in which washing water is sprayed.

That is, in the semiconductor material cutting method according to an exemplary embodiment of the present disclosure, during the cooling process that is before the cutting process, the semiconductor material SR may be pre-cooled by forming the environment similar to the environment in which washing water is sprayed in the cutting process. Then, after providing the result (the position of the scheduled division line) of the visual inspection of the contracted semiconductor material SR, the cutting process may be performed on the basis of the position of the scheduled division line of the contracted semiconductor material SR. Therefore, the misalignment between the scheduled division line of the semiconductor material SR and the position of the division line that will be actually cut is prevented, so that the cutting quality may be improved.

CLAIMS

[Claim 1]

A semiconductor material cutting method of a semiconductor material cutting device, the device comprising: a pair of chuck tables configured to vacuum adsorb a semiconductor material on each upper portion thereof and provided such that the pair of chuck tables is movable in a Y-axis direction and is rotatable; a strip picker configured to transfer the semiconductor material to the chuck table; a cutting unit configured to cut the semiconductor material while spraying cutting water on an upper surface of the semiconductor material that is adsorbed on each of the pair of chuck tables; and a washing nozzle provided on an upper portion of a movement path of the pair of chuck tables, the method comprising:

A) process: transferring, by the strip picker, the semiconductor material to the upper portion of any one of the chuck tables among the pair of chuck tables;

B) process: detecting, by a visual inspection unit, a scheduled division line by imaging the semiconductor material transferred to the any one of the chuck tables, and then cutting, by the cutting unit, the semiconductor material along the detected scheduled division line;

C) process: during performing the B) process, transferring, by the strip picker, another semiconductor

material to the upper portion of other remaining chuck table among the pair of chuck tables, and then cooling the another semiconductor material by spraying washing water on an upper surface of the another semiconductor material that is vacuum adsorbed to the upper portion of the other remaining chuck table by moving the other remaining chuck table to a lower portion of the washing nozzle, and then removing moisture of the another semiconductor material by spraying air on the upper surface of the another semiconductor material that is cooled; and

D) process: detecting, by the visual inspection unit, the scheduled division line by imaging the cooled semiconductor material, and then cutting, by the cutting unit, the cooled semiconductor material along the detected scheduled division line.

[Claim 2]

The method of claim 1, wherein, before the B) process is performed, the method further comprises:

B0) process: cooling the semiconductor material by spraying washing water to the upper surface of the semiconductor material that is vacuum adsorbed on the upper portion of any one of the chuck tables among the pair of chuck tables by moving the any one of the chuck tables to the lower portion of the washing nozzle, and then removing moisture on

the semiconductor material by spraying air on the upper surface of the cooled semiconductor material.

[Claim 3]

The method of claim 2, wherein, in the B0) process or the C) process, the method further comprises:

a measuring process in which a temperature of the semiconductor material that is cooled by spraying washing water is measured by using a temperature sensor before moisture is removed or after moisture is removed,

wherein the B) process or the D) process is performed when the measured temperature reaches a predetermined temperature range, and washing water is additionally sprayed on the upper surface of the semiconductor material when the measured temperature does not reach the predetermined temperature range.

[Claim 4]

The method of claim 1, wherein, before the A) process is performed, the method further comprises:

A01) process: preparing correlation data between a washing water spraying time or a washing water spraying frequency according to a type of the semiconductor material and a temperature change of the semiconductor material; and

A02) process: setting the washing water spraying time or the washing water spraying frequency on the basis of the

correlation data such that the semiconductor material that will be cut is cooled to a predetermined temperature,

wherein, in the C) process, washing water is sprayed to the upper surface of the semiconductor material with the washing water spraying time or the washing water spraying frequency set in the A02) process.

[Claim 5]

The method of claim 4, wherein, in the A02) process, the method further comprises:

a process in which the semiconductor material that will be firstly cut among the semiconductor materials that will be cut is selected as a reference material and then a temperature of the reference material is measured,

wherein the washing water spraying time or the washing water spraying frequency for cooling the semiconductor material to a predetermined temperature is set as a reference value of the semiconductor material that will be cut, on the basis of the measured temperature.