

WAFER SEPARATION METHOD AND WAFER PROCESSING APPARATUS

[0001] The present application claims the priority to Chinese Patent Application No. 202311751680.6, titled "WAFER SEPARATION METHOD AND WAFER PROCESSING APPARATUS", filed with the China National Intellectual Property Administration on December 18, 2023, which is incorporated herein by reference in its entirety.

FIELD

[0002] The present application relates to the technical field of wafer processing and, in particular, to a wafer separation method and a wafer processing apparatus.

BACKGROUND

[0003] With the continuous promotion of the adjustment of industrial structure and energy structure in China, renewable energy has vigorously developed. It aims to achieve carbon-peaking before 2030 and carbon-neutrality before 2060. In new energy industry, there is a strong demand for semiconductor devices based on third-generation semiconductor materials (e.g., SiC, GaN, etc.), which poses new challenges to the dicing and separation of the semiconductor devices, while promoting the layout of third-generation semiconductor devices in chip industry.

[0004] As a metal conductive film is coated on the back side of a wafer, two methods are usually adopted for dicing the wafer in the related art. One method is to use conventional mechanical dicing. The mechanical dicing mainly involves grinding the wafer with a diamond tool. During such wafer separation process, there are mechanical deformation, stress concentration release, tool wear and other issues, which causes dust or debris contamination and requires additional cleaning and polishing steps. The other method includes: firstly removing the metal conductive film from the back side of the wafer by laser ablation, which is benefit to completely cleave the wafer more easily without being interference by the metal conductive film in a subsequent cleaving; reversing the wafer so that the front side of the wafer faces upward; and separating dies by a laser internal focusing and dicing, and then performing separation by a cleaving device. For the latter method, there is a need to provide a device for removing the metal conductive film from the back side of the wafer by laser

ablation, resulting in demand for a large space and a high cost. In addition, there is a need to provide a device for treating contaminated water because a protective adhesive is added during laser ablation and the wafer is cleaned by pure water before and after dicing.

5 SUMMARY

[0005] In view of this, there is provided in the present application a wafer separation method, which avoids mechanical deformation and stress concentration release caused by dicing a wafer through machining, and avoids tool wear as well as dust or debris contamination, so that there is no need for pure water to clean the wafers and no contaminated water to be generated, saving cost.

[0006] To achieve the above objects, the following technical solutions are provided in this application.

[0007] In a first aspect of the present application, a wafer separation method is provided, including:

15 [0008] supporting, on a supporting platform, a wafer to be processed in which a pre-crack has been formed, with a first end surface of the wafer facing upward, and processing the wafer by a cutting tool along a first predetermined position of the first end surface of the wafer; and

20 [0009] adjusting a height of the supporting platform and supporting the wafer on the supporting platform again, with a second end surface of the wafer facing upward, and processing the wafer by the cutting tool along a second predetermined position of the second end surface of the wafer, so as to complete processing of the wafer.

[0010] In a possible implementation, the first end surface is a back side of the wafer, and the second end surface is a front side of the wafer.

25 [0011] A first film is applied to the first end surface, and a second film is applied to the second end surface.

[0012] In a possible implementation, the supporting platform includes a bearing platform configured to support a middle portion of the wafer and a holder configured to support an edge portion of the wafer and hold the wafer. The bearing platform includes two sub-bearing

platforms arranged facing each other with an adjustable gap formed between the two sub-bearing platforms. The adjustable gap has a width that may be adjusted as needed.

[0013] Before the wafer to be processed, in which the pre-crack has been formed, is supported on the supporting platform, the method includes adjusting the wafer such that the pre-crack is parallel to the adjustable gap and is suspended above the adjustable gap.

[0014] In a possible implementation, the width of the adjustable gap between the two sub-bearing platforms is 0.3 to 1.99 times a die size.

[0015] In a possible implementation, the pre-crack in the wafer to be processed is formed by a laser being incident along the second predetermined position of the second end surface of the wafer and internally focused inside the material of the wafer.

[0016] In a possible implementation, in the case where the cutting tool processes the wafer along the first predetermined position of the wafer, the tool edge of the cutting tool physically contacts the first predetermined position of the first end surface of the wafer, with a depth being controlled to be 0 μ m to 200 μ m; and

[0017] in the case where the tool edge of the cutting tool contacts the first film disposed on the first end surface of the wafer and exerts a pressing force on the first predetermined position of the wafer, a hammer is used to vibrate and strike the cutting tool, so as to enable the cutting tool to cleave the wafer.

[0018] In a possible implementation, in the case where the cutting tool processes the wafer along the second predetermined position of the wafer, the tool edge of the cutting tool physically contacts the second predetermined position of the second end surface of the wafer, with a depth being controlled to be 0 μ m to 200 μ m; and

[0019] in the case where the tool edge of the cutting tool contacts the second film disposed on the second end surface of the wafer and exerts a pressing force on the second predetermined position of the wafer, a hammer is used to vibrate and strike the cutting tool, so as to separate a metal coating from the first end surface of the wafer.

[0020] In a possible implementation, the height of the supporting platform is adjusted by a holder. The holder includes a supporting and adjusting mechanism and a pressing plate that are arranged to cooperate with each other. The supporting and adjusting mechanism includes a first elastic member, a first movable assembly that is movable in a first direction, and a second

movable assembly that is movable in a second direction different from the first direction. Two ends of the first elastic member are connected to the first movable assembly and the second movable assembly, respectively. The first movable assembly is in transmission connection with the second movable assembly such that is driven by the first movable assembly and the first elastic member to move in the second direction so as to adjust the height of the supporting platform.

[0021] In a possible implementation, the first movable assembly includes a lifting rod having a lifting bevel, and the second movable assembly includes a rotating member slidably connected to the lifting bevel.

[0022] It can be seen from the above technical solutions that, in the wafer separation method according to the present application, a tool edge of the cutting tool physically contacts and cleaves the first predetermined position of the first end surface of the wafer; and then the height of the supporting platform is adjusted, and the tool edge of the cutting tool also physically contacts and cleaves the second predetermined position of the second end surface of the wafer. By performing two cleaving operations at different end surfaces, the cleavage of the wafer is completed. In the wafer separation method according to the present application, the cleavage is performed in two stages with adjustment of the height of the supporting platform. Thus, there is no need to process a metal coating on a back side of the wafer in advance. As a result, it can simplify the processing of the wafer with the metal coating on the back side, and there is no need to provide a device for removing a metal conductive film from the back side of the wafer by laser ablation, thereby saving space and cost. In the wafer separation method according to the present application, the wafer is separated by the physical contact and cleavage on both end surfaces of the wafer, which avoids mechanical deformation and stress concentration release caused by dicing the wafer through machining, and avoids tool wear as well as dust or debris contamination so that there is no need for pure water to clean the wafer and no contaminated water to be generated and no need to provide a device for processing contaminated water, thereby saving costs.

[0023] In a second aspect of the present application, there is provided a wafer processing apparatus, applicable to the wafer separation method described above. The wafer processing apparatus includes the supporting platform.

[0024] The wafer processing apparatus according to the present application is applicable to

the wafer separation method described above, and therefore has the advantages of the wafer separation method described above, which are not repeated here.

BRIEF DESCRIPTION OF THE DRAWINGS

- 5 **[0025]** For more clearly illustrating the technical solutions in embodiments of the present application or in the related art, drawings referred to describe the embodiments or the related art will be briefly described hereinafter. Apparently, the drawings in the following description relate only to some examples of the present application, and for those skilled in the art, other drawings may be obtained based on these drawings without any creative efforts.
- 10 **[0026]** FIG. 1 is a schematic diagram showing steps of a wafer separation method according to an embodiment of the present application;
- [0027]** FIG. 2 is a schematic structural diagram showing a front side of a wafer according to an embodiment of the present application;
- [0028]** FIG. 3 is a schematic diagram showing a dicing street on a front side of a wafer
15 according to an embodiment of the present application;
- [0029]** FIG. 4 is a schematic structural diagram showing a back side of a wafer according to an embodiment of the present application;
- [0030]** FIG. 5 is a schematic structural diagram showing a wafer according to an embodiment of the present application when a back side of the wafer is cleaved;
- 20 **[0031]** FIG. 6 is a schematic structural diagram showing a wafer according to an embodiment of the present application when a front side of the wafer is cleaved;
- [0032]** FIG. 7 is a schematic structural diagram showing separation of dies of a wafer according to an embodiment of the present application when a back side of the wafer is cleaved;
- 25 **[0033]** FIG. 8 is a schematic structural diagram showing a die separated from a wafer according to an embodiment of the present application;
- [0034]** FIG. 9 is another schematic structural diagram showing a die separated from a wafer according to an embodiment of the present application;
- [0035]** FIG. 10 is a schematic structural diagram showing a cutting tool and a wafer which

come into contact according to an embodiment of the present application;

[0036] FIG. 11 is a schematic structural diagram showing a cutting tool and a wafer which are in contact according to an embodiment of the present application when the cutting tool is downwardly moved by a depth d ; and

5 **[0037]** FIG. 12 is a schematic structural diagram showing a supporting and adjusting mechanism according to an embodiment of the present application.

[0038] List of reference numerals:

	1. cutting tool,	101. tool edge,
	2. bearing platform,	3. pressing plate,
10	4. first film,	5. second film,
	6. wafer,	601. straight edge,
	602. die,	603. electrode circuit,
	604. metal coating,	7. pre-crack,
	8. support frame,	9. dicing street,
15	10. supporting and adjusting mechanism,	1001. first movable assembly,
	1002. second movable assembly.	

DETAILED DESCRIPTION OF THE EMBODIMENTS

20 **[0039]** In an aspect of the present application, a wafer separation method is disclosed, which avoids mechanical deformation and stress concentration release caused by dicing a wafer through machining, and avoids tool wear as well as dust or debris contamination so that there is no need for pure water to clean the wafer and no contaminated water to be generated, thereby saving cost.

25 **[0040]** In another aspect of the present application, a wafer processing apparatus is further disclosed.

[0041] Hereinafter, technical solutions in embodiments of the present application will be described clearly and completely with reference to the drawings in embodiments of the

present application. Apparently, the described embodiments are only some rather than all embodiments of the present application. Based on the embodiments of the present application, all other embodiments obtained by those skilled in the art without any creative work fall into the scope of protection of the present application.

5 **[0042]** Referring to FIGS. 1 to 11, the wafer separation method 100 according to the present application includes a first end surface cleaving process S110 and a second end surface cleaving process S120. The first end surface cleaving process S110 includes: supporting, on a supporting platform, a wafer 6 to be processed which has been formed with a pre-crack 7, with a first end surface of the wafer 6 facing upward; and processing the wafer 6 by a cutting
10 tool 1 along a first predetermined position of the first end surface of the wafer 6. The second end surface cleaving process S120 includes: adjusting a height of the supporting platform and supporting the wafer on the supporting platform again, with a second end surface of the wafer 6 facing upward; and processing the wafer 6 by the cutting tool 1 along a second predetermined position of the second end surface of the wafer 6 to complete the processing of
15 the wafer 6, specifically to complete the cleavage of the wafer 6.

[0043] In the wafer separation method according to the present application, a tool edge 101 of the cutting tool 1 physically contacts and cleaves the first predetermined position of the first end surface of the wafer 6; and then the height of the supporting platform is adjusted, and the tool edge 101 of the cutting tool 1 also physically contacts and cleaves the second
20 predetermined position of the second end surface of the wafer 6. By performing two cleaving operations at different end surfaces, the cleavage of the wafer is completed. In the wafer separation method according to the present application, the cleavage is performed in two stages with adjustment of the height of the supporting platform. Thus, there is no need to process a metal coating on a back side of the wafer 6 in advance. As a result, it can simplify
25 the processing of the wafer with the metal coating on the back side, and there is no need to provide a device for removing a metal conductive film from the back side of the wafer 6 by laser ablation, thereby saving space and cost. In the wafer separation method according to the present application, the wafer 6 is separated by the physical contact and cleavage on both end surfaces of the wafer 6, which avoids mechanical deformation and stress concentration release
30 caused by dicing the wafer 6 through machining, and avoids tool wear as well as dust or debris contamination so that there is no need for pure water to clean the wafer and no contaminated water to be generated and no need to provide a device for processing

contaminated water, thereby saving costs.

[0044] In an embodiment, the first end surface is the back side of the wafer 6, and the second end surface is a front side of the wafer 6. The first predetermined position of the back side of the wafer 6 is determined by a CCD, and the second predetermined position of the front side of the wafer 6 is a dicing street 9 on the wafer 6. As shown in FIGS. 2 and 3, the dicing street 9 extending in an X direction is parallel to a straight edge 601 of the wafer 6, and the dicing street 9 extending in a Y direction is perpendicular to the straight edge 601 of the wafer 6.

[0045] The supporting platform includes a bearing platform 2 for supporting a middle portion of the wafer 6, and a holder for supporting an edge portion of the wafer 6 and holding the wafer 6. The bearing platform 2 includes two sub-bearing platforms arranged facing each other with an adjustable gap formed between the two sub-bearing platforms. The adjustable gap has a width that may be adjusted by those skilled in the art as needed. Before the wafer 6 to be processed in which the pre-crack 7 has been formed is supported on the supporting platform, the method comprises adjusting the wafer 6 such that the pre-crack 7 is arranged in parallel with the adjustable gap and is above the adjustable gap, facilitating subsequent cleaving process. Generally, the width of the adjustable gap between the two sub-bearing platforms is 0.3 to 1.99 times a die size. Dies are obtained after separation of the wafer 6.

[0046] Further, the pre-crack 7 in the wafer 6 to be processed is formed by a laser being incident along the second predetermined position of the second end surface of the wafer 6 and internally focused inside the material of the wafer 6. Specifically, the laser is incident on the dicing street 9 on the front side of the wafer 6, and is internally focused inside the material to form micro-nano explosion points and to generate cracks extending in a dicing direction of the wafer 6. In multi-layer or multi-focus dicing modes, the cracks are extended and connected together in the up-down direction to form a pre-crack 7 visible from the front side of the wafer 6.

[0047] In the case where the cutting tool 1 processes the wafer 6 along the first predetermined position of the wafer 6, the tool edge 101 of the cutting tool 1 physically contacts the first predetermined position of the first end surface of wafer 6, as shown in FIG. 5. The cutting tool 1 is moved downwardly by a depth d that is controlled to be $0\mu\text{m}$ to $200\mu\text{m}$, as shown in FIG. 11. The tool edge 101 is at a distance H from the bearing platform 2, and the

adjustable gap between the sub-bearing platforms has a width L. In the case where the tool edge 101 of the cutting tool 1 contacts a first film 4 disposed on the first end surface (the back side) of the wafer 6 and exerts a pressing force on the first predetermined position of the wafer 6, a hammer is used to vibrate and strike the cutting tool 1, enabling the cutting tool to cleave the wafer, as shown in FIG. 7. The first film 4 is applied to the back side (the first end surface) of the wafer 6, and a second film 5 is applied to the front side (the second end surface) of the wafer 6. The first film 4 is an adhesive and stretchable film, which may be a blue film or UV film. The second film 5 is an anti-static transparent film, which may be a Mylar film. The first film 4 is used to protect the metal coating 604 on the back side of the wafer 6, and the second film 5 is used to protect an electrode circuit 603 on the front side of the wafer 6. It can be understood that the wafer 6 further includes a die 602 provided with the metal coating 604 on its back side and the electrode circuit 603 on its front side.

[0048] In the above-described steps, after the tool edge 101 contacts and presses against the first film 4 of the wafer 6 and exerts a force on the first predetermined position of the wafer 6, the cutting tool 1 is vibrated by the kinetic energy transmitted from the hammer. With the lever principle formed by three support points of the bearing platform 2 and the cutting tool 1, the pre-crack 7 on the front side of the wafer 6 is extended to the metal coating 604 on the back side of the wafer 6, completing the cleavage of the wafer by the cutting tool. During this process, the metal coating 604 on the back side of the wafer 6 is not completely separated.

[0049] Further, the following steps are also included. In the case where the cutting tool 1 processes the wafer 6 along the second predetermined position of the wafer 6, the tool edge 101 of the cutting tool 1 physically contacts the second predetermined position of the second end surface of the wafer 6, with the depth d of the cutting tool 1 being controlled to be 0 μ m to 200 μ m. In the case where the tool edge 101 of the cutting tool 1 contacts the second film 5 coated on the second end surface of the wafer 6 and exerts a pressing force on the second predetermined position of the wafer 6, the hammer is used to vibrate and strike the cutting tool 1, so as to separate the metal coating 604 from the first end surface of the wafer 6. Following the above-described steps, the wafer 6 is placed on a film expansion device for separating the wafer 6 into dies at equal spacing, as shown in FIGS. 8 and 9.

[0050] In the method as described, the height of the supporting platform is adjusted by means of the holder. The holder includes the supporting and adjusting mechanism 10 and a

pressing plate 3 that are arranged to cooperate with each other. A support frame 8 is arranged on the supporting and adjusting mechanism 10 to support the wafer 6. The supporting and adjusting mechanism 10 includes a first elastic member, a first movable assembly 1001 that is movable in a first direction, and a second movable assembly 1002 that is movable in a second direction different from the first direction. As shown in FIG. 12, two ends of the first elastic member are respectively connected to the first movable assembly 1001 and the second movable assembly 1002. The first movable assembly 1001 is in transmission connection with the second movable assembly 1002, such that the second movable assembly 1002 is driven by the first movable assembly 1001 and the first elastic member to move in the second direction to adjust the height of the supporting platform. The first movable assembly 1001 includes a lifting rod having a lifting bevel. The second movable assembly 1002 includes a rotating member slidably connected to the lifting bevel. The movement of the first movable assembly 1001 drives the lifting rod to move, so as to cause the height of the rotating member to change, which in turn drives the second movable assembly 1002 to move upwards or downwards, thereby adjusting the height of a support surface to meet the demand for changing the support height of the wafer 6.

[0051] The wafer separation method according to the present application includes the following steps.

[0052] At step 1, the first film 4 is applied to the front side of the wafer 6 facing upward;

[0053] At step 2, the laser is incident on the dicing street 9 on the front side of the wafer 6, and is internally focused inside the material to form micro-nano explosion points and to generate cracks extending in the dicing direction of the wafer. In multi-layer or multi-focus dicing mode, the cracks are extended and connected together in the up-down direction so that pre-cracks 7 are formed and visible from the front side of the wafer 6.

[0054] At step 3, a back-side cleaving process is performed, which includes the following sub-steps.

[0055] The orientation of the wafer 6 is adjusted horizontally by means of a lower CCD such that the dicing street 9 of the wafer is parallel to the cutting tool 1.

[0056] The width L of the adjustable gap between the two sub-bearing platforms is determined. For example, in the case of a square die of 2 mm × 2 mm, the width L of the

adjustable gap is determined to be 1.2 times the size of the die, i.e., 2.4 mm.

[0057] The cutting tool 1 is moved downward, so that the tool edge 101 physically contacts the first predetermined position of the back side of the wafer 6 via the first film 4. The first film 4 has certain flexibility. The interaction force between the tool edge 101 and the die is positively proportional to the depth d of the cutting tool 1 moving downward. When the tool edge 101 presses against the first film 4 and applies a force to the first predetermined position, the hammer applies the kinetic vibration to the cutting tool 1, so that the pre-crack 7 on a surface of the wafer is extended from the surface to the metal coating 604 on the back side of the wafer 6, thereby cleaving the wafer with the cutting tool.

[0058] At step 4, a front-side cleaving process is performed, which includes the following sub-steps.

[0059] The wafer 6 is reversed so that the front side of the wafer 6 faces upward. The height of the supporting platform is adjusted by means of the holder.

[0060] The orientation of the wafer 6 is adjusted horizontally by means of an upper CCD such that the dicing street 9 on the front side of the wafer 6 is parallel to the cutting tool 1.

[0061] The width L of the adjustable gap between the two sub-bearing platforms is determined. For example, in the case of a square die of 2 mm × 2 mm, the width L of the adjustable gap is determined to be 0.8 times the size of the die, i.e., 1.6 mm.

[0062] The cutting tool 1 is moved downward, so that the tool edge 101 physically contacts the dicing street 9 on the front side of the wafer 6 via the second film 5. The second film 5 has certain flexibility. The interaction force between the tool edge 101 and the die is positively proportional to the depth d of the cutting tool 1 moving downward. When the tool edge 101 presses against the second film 5 and applies a force the dicing street 9, the hammer applies a kinetic vibration to the cutting tool 1. With the leverage formed by three support points of the bearing platform 2 and the cutting tool 1, the metal coating 604 on the back side of the wafer 6 is separated.

[0063] Following the above-described steps, the wafer 6 is placed on the film expansion device for separating the wafer 6 into dies at equal spacing.

[0064] With the wafer separation method according to the present application, by utilizing a non-contact laser processing, there are advantages of no contact contamination and no

mechanical deformation for the processed material. This method generates the pre-crack through stealth dicing, so that a modified area may be controlled within 10 μ m, thereby causing little loss to the material. For example, a street of a wafer chip can be designed to have a minimized size. Thus, there is an advantage of saving material costs. When the back-side cleaving process is performed, the wafer 6 and the cutting tool 1 are separated by the stretchable first film 4, which has a protective effect on the wafer 6, thereby providing an advantage of transmitting the pressing force by soft contact. When the front-side cleaving process is performed, the wafer 6 and the cutting tool 1 are separated by an anti-static transparent film, namely the second film 5, which has a protective effect on the front side of the wafer 6. By the soft contact, the vibration and force of the cutting tool 1 are transmitted to the back side of the wafer 6, thereby realizing complete separation of the metal coating 604 under the force. With the wafer separation method according to the present application, there is no need to process the metal coating 604 on the back side of the wafer 6 in advance, which can simplify the processing of the wafer with the metal coating on the back side, thereby optimizing production consumption. By performing the cleaving processing from both sides to separate the die 602 and the metal coating 604 of the wafer 6 in steps respectively, the wafer separation method according to the present application can effectively improve the production yield after wafer separation, thereby improving production efficiency and reducing energy consumption.

[0065] There is also provided a wafer processing apparatus in the present application, which is applicable to the wafer separation method described above. The wafer processing apparatus includes a supporting platform. The supporting platform includes a bearing platform for supporting a wafer 6 and a holder for holding the wafer 6.

Example:

[0066] Example 1: a wafer separation method, comprising:

[0067] supporting, on a supporting platform, a wafer 6 to be processed in which a pre-crack 7 has been formed, with a first end surface of the wafer 6 facing upward, and processing the wafer 6 by the cutting tool 1 along a first predetermined position of the first end surface of the wafer 6; and

[0068] adjusting a height of the supporting platform and supporting the wafer 6 on the supporting platform again, with a second end surface of the wafer 6 facing upward, and

processing the wafer 6 by the cutting tool 1 along a second predetermined position of the second end surface of the wafer 6, so as to complete the processing of the wafer 6.

[0069] Example 2: the wafer separation method according to Example 1, wherein the first end surface is a back side of the wafer 6, and the second end surface is a front side of the wafer 6; and

[0070] a first film 4 is applied to the first end surface, and a second film 5 is applied to the second end surface.

[0071] Example 3: the wafer separation method according to Example 1 or 2, wherein the supporting platform includes a bearing platform 2 for supporting a middle portion of the wafer 6 and a holder for supporting an edge portion of the wafer 6 and holding the wafer 6, and the bearing platform 2 includes two sub-bearing platforms 2 arranged facing each other with an adjustable gap formed between the two sub-bearing platforms 2; and

[0072] before the wafer 6 to be processed, in which the pre-crack 7 has been formed, is supported on the supporting platform, the method includes adjusting the wafer 6 such that the pre-crack 7 is parallel to the adjustable gap and is suspended above the adjustable gap.

[0073] Example 4: the wafer separation method according to any one of Examples 1 to 3, wherein a width of the adjustable gap between the two sub-bearing platforms 2 is 0.3 to 1.99 times a die size.

[0074] Example 5: the wafer separation method according to any one of Examples 1 to 4, wherein the pre-crack 7 in the wafer 6 to be processed is formed by a laser being incident along the second predetermined position of the second end surface of the wafer 6 and internally focused inside the material.

[0075] Example 6: the wafer separation method according to any one of Examples 1 to 5, wherein, in the case where the cutting tool 1 processes the wafer 6 along the first predetermined position of the wafer 6, a tool edge 101 of the cutting tool 1 physically contacts the first predetermined position of the first end surface of the wafer 6, with a depth being controlled to be 0 μ m to 200 μ m; and

[0076] in the case where the tool edge 101 of the cutting tool 1 contacts the first film 4 disposed on the first end surface of the wafer 6 and exerts a pressing force on the first predetermined position of the wafer 6, a hammer is used to vibrate and strike the cutting tool

1, so as to enable the cutting tool 1 to cleave the wafer 6.

[0077] Example 7: the wafer separation method according to any one of Examples 1 to 6, wherein, in the case where the cutting tool 1 processes the wafer 6 along the second predetermined position of the wafer 6, a tool edge 101 of the cutting tool 1 physically contacts the second predetermined position of the second end surface of the wafer 6, with a depth being controlled to be 0 μ m to 200 μ m; and

[0078] in the case where the tool edge 101 of the cutting tool 1 contacts the second film 5 disposed on the second end surface of the wafer 6 and exerts a pressing force on the second predetermined position of the wafer 6, the hammer is used to vibrate and strike the cutting tool 1, so as to separate a metal coating 604 from the first end surface of the wafer 6.

[0079] Example 8: the wafer separation method according to any one of Examples 1 to 7, wherein the height of the supporting platform is adjusted by means of a holder, the holder includes a supporting and adjusting mechanism 10 and a pressing plate 3 that are arranged to cooperate with each other, the supporting and adjusting mechanism 10 includes a first elastic member, a first movable assembly 1001 that is movable in a first direction, and a second movable assembly 1002 that is movable in a second direction different from the first direction, two ends of the first elastic member are respectively connected to the first movable assembly 1001 and the second movable assembly 1002, the first movable assembly 1001 is in transmission connection with the second movable assembly 1002, such that the second movable assembly 1002 is driven by the first movable assembly 1001 and the first elastic member to move in the second direction so as to adjust the height of the supporting platform.

[0080] Example 9: the wafer separation method according to any one of Examples 1 to 8, wherein the first movable assembly 1001 includes a lifting rod having a lifting bevel, and the second movable assembly 1002 includes a rotating member slidably connected to the lifting bevel.

[0081] Example 10: a wafer processing apparatus, applicable to the wafer separation method according to any one of Examples 1 to 9, the wafer processing apparatus including the supporting platform.

[0082] It should be understood that in the description of the present application, orientations or positional relationships indicated by the terms "upper", "lower", "vertical", "inside",

"outside", and the like, are based on the drawings. These terms are merely intended for the convenience of describing the present application and simplifying the description, rather than indicating or implying that devices or elements defined by the terms must comply with the designated orientation, or must be constructed and operated according to the designated orientation. Therefore, such terms should not be construed as a limitation to the present application.

[0083] In addition, the terms "first", "second" and the like are for purpose of description, and should not be interpreted as indicating or implying relative importance or implying the number of the indicated technical features. Therefore, the features defined by "first" and "second" may explicitly or implicitly include one or more such features. In the description of the present application, the term "plurality of" means two or more, unless specifically defined otherwise.

[0084] The embodiments in the specification are described in a progressive manner, and each embodiment focuses on the difference from other embodiments. Same and similar parts among various embodiments may be referred to each other.

[0085] The above description of the disclosed embodiments is intended to enable those skilled in the art to implement or use the present application. Various modifications to these embodiments will be readily apparent to those skilled in the art. The general principle defined herein may be implemented in other embodiments without departing from the spirit and scope of the present application. Therefore, the present application should not be limited to the embodiments disclosed herein, but has the widest scope in accordance to the concept and the novel features disclosed herein.

CLAIMS

1. A wafer separation method, comprising:

supporting, on a supporting platform, a wafer to be processed in which a pre-crack has
5 been formed, with a first end surface of the wafer facing upward, and processing the wafer by
a cutting tool along a first predetermined position of the first end surface of the wafer; and

adjusting a height of the supporting platform and supporting the wafer on the supporting
platform again, with a second end surface of the wafer facing upward, and processing the
wafer by the cutting tool along a second predetermined position of the second end surface of
10 the wafer, so as to complete processing of the wafer.

2. The wafer separation method according to claim 1, wherein the first end surface is a
back side of the wafer, and the second end surface is a front side of the wafer; and

a first film is applied to the first end surface, and a second film is applied to the second
15 end surface.

3. The wafer separation method according to claim 1 or 2, wherein the supporting
platform comprises a bearing platform configured to support a middle portion of the wafer
and a holder configured to support an edge portion of the wafer and hold the wafer, and the
20 bearing platform comprises two sub-bearing platforms arranged facing each other with an
adjustable gap formed between the two sub-bearing platforms; and

before the wafer to be processed, in which the pre-crack has been formed, is supported
on the supporting platform, the method comprises adjusting the wafer such that the pre-crack
is parallel to the adjustable gap and is suspended above the adjustable gap.

4. The wafer separation method according to claim 3, wherein a width of the adjustable
gap between the two sub-bearing platforms is 0.3 to 1.99 times a die size.

5. The wafer separation method according to any one of claims 1 to 4, wherein the pre-crack in the wafer to be processed is formed by a laser being incident along the second predetermined position of the second end surface of the wafer and internally focused inside material of the wafer.

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6. The wafer separation method according to any one of claims 1 to 5, wherein, in a case where the cutting tool processes the wafer along the first predetermined position of the wafer, a tool edge of the cutting tool physically contacts the first predetermined position of the first end surface of the wafer, with a depth being controlled to be $0\mu\text{m}$ to $200\mu\text{m}$; and

10 in a case where the tool edge of the cutting tool contacts the first film disposed on the first end surface of the wafer and exerts a pressing force on the first predetermined position of the wafer, a hammer is used to vibrate and strike the cutting tool, so as to enable the cutting tool to cleave the wafer.

15 7. The wafer separation method according to any one of claims 1 to 6, wherein, in a case where the cutting tool processes the wafer along the second predetermined position of the wafer, a tool edge of the cutting tool physically contacts the second predetermined position of the second end surface of the wafer, with a depth being controlled to be $0\mu\text{m}$ to $200\mu\text{m}$; and

20 in a case where the tool edge of the cutting tool contacts the second film disposed on the second end surface of the wafer and exerts a pressing force on the second predetermined position of the wafer, a hammer is used to vibrate and strike the cutting tool, so as to separate a metal coating from the first end surface of the wafer.

25 8. The wafer separation method according to any one of claims 1 to 7, wherein the height of the supporting platform is adjusted by a holder,

the holder comprises a supporting and adjusting mechanism and a pressing plate that are arranged to cooperate with each other,

the supporting and adjusting mechanism comprises a first elastic member, a first movable assembly that is movable in a first direction, and a second movable assembly that is

movable in a second direction different from the first direction,

two ends of the first elastic member are connected to the first movable assembly and the second movable assembly, respectively, and

5 the first movable assembly is in transmission connection with the second movable assembly such that the second movable assembly is driven by the first movable assembly and the first elastic member to move in the second direction so as to adjust the height of the supporting platform.

10 9. The wafer separation method according to claim 8, wherein the first movable assembly comprises a lifting rod having a lifting bevel, and the second movable assembly comprises a rotating member slidably connected to the lifting bevel.

15 10. A wafer processing apparatus, applicable to the wafer separation method according to any one of claims 1 to 9, wherein the wafer processing apparatus comprises the supporting platform.