WAFER POSITION CALIBRATION METHOD AND APPARATUS, READABLE STORAGE MEDIUM AND DEVICE

TECHNICAL FIELD

[0001] The present invention relates to the technical field of semiconductors, and particularly relates to a wafer position calibration method and apparatus, a readable storage medium and a device.

BACKGROUND

[0002] In related technologies, wafers are positioned manually or by a robotic arm using a pre-alignment apparatus. However, this method cannot meet high accuracy requirements, and causes large errors in position and angle of the wafer, thereby affecting the accuracy of subsequent test. Especially when a mobile unit is automatically navigated to the position of each test component, if the wafer is not accurately righted, test errors will be caused.

SUMMARY OF THE INVENTION

Technical Problems

[0003] A main objective of the present invention is to provide a wafer position calibration method and apparatus, a readable storage medium and a device to solve the technical problem of high errors in position and angle of a wafer.

Solutions to Problems

Technical Solutions

[0004] In order to achieve the above object, the first aspect of the present invention provides a wafer position calibration method.

[0005] The wafer position calibration method comprises the following steps:

[0006] scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark;

[0007] based on the two actual positions , determining a righting angle for the object to be manipulated; and

[0008] based on the righting angle, controlling the object to be manipulated to rotate.

[0009] In one of the embodiments, the step of scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark comprises:

[0010] navigating a mobile unit to the standard position, the standard position being a position of the alignment mark of the object to be manipulated in the righting state; and

[0011] performing preset pixel scanning by taking the standard position as a starting point until the alignment mark is scanned, so as to obtain the actual position of the alignment mark.

[0012] In one of the embodiments, the step of based on the two actual positions , determining a righting angle for the object to be manipulated comprises:

[0013] acquiring a first actual position of a first alignment mark on the object to be manipulated; and acquiring a second actual position of a second alignment mark on the object to be manipulated, wherein the positions of the first alignment mark and the second alignment mark on the object to be manipulated are different; and

[0014] calculating to obtain the righting angle based on the first actual position and the second actual position.

[0015] In one of the embodiments, the object to be manipulated is circular, and the first alignment mark and the second alignment mark are on the same diameter and are located on two sides of the circle center respectively.

[0016] In one of the embodiments, before the step of scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark, the method comprises:

[0017] acquiring an image of the alignment mark of the object to be manipulated in the righting state;

[0018] performing screen-shooting on the image of the alignment mark with a rectangular box and saving; and

[0019] setting starting point coordinates in the rectangular box, and treating the starting point coordinates as starting point coordinates of a mask area in a design drawing of the object to be manipulated.

[0020] In one of the embodiments, before scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark, the method comprises:

[0021] performing scanning and shooting on the object to be manipulated to obtain a plurality of images of object to be manipulated;

[0022] identifying the plurality of images of object to be manipulated, and finding out two longest straight lines; and

[0023] preliminarily righting the object to be manipulated according to the two longest

perpendicular straight lines.

[0024] In one of the embodiments, after the step of based on the righting angle, controlling the object to be manipulated to rotate, the method further comprises:

[0025] binding the position of the object to be manipulated after righting to the coordinates in the design drawing of the object to be manipulated; and

[0026] calculating the center position of the object to be manipulated according to the coordinates in the design drawing of the object to be manipulated.

[0027] The second aspect of the present invention provides a wafer position calibration system, implementing the calibration method abovementioned, comprising:

[0028] a mobile unit configured to scan an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark;

[0029] a calculation apparatus configured to: based on the two actual positions, determine a righting angle for the object to be manipulated; and

[0030] a calibration apparatus configured to: based on the righting angle, control the object to be manipulated to rotate.

[0031] The third aspect of the present invention provides a computer-readable storage medium thereon a computer program is stored, wherein the computer program is executed by a computer processor to implement the wafer position calibration method abovementioned.

[0032] The fourth aspect of the present invention provides a computer device, executing the wafer position calibration method abovementioned.

Beneficial Effects of the Invention

Beneficial Effects

[0033] The wafer position calibration method includes the following steps: scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark; acquiring a standard position of the alignment mark of the object to be manipulated in a righting state; based on the two actual positions , determining a righting angle for the object to be manipulated; and based on the righting angle, controlling the object to be manipulated to rotate. With adoption of the calibration method, that current manual placement or pre-aligning by a robotic arm cannot meet high-precision requirement can be solved, the angle error of the object to be manipulated is reduced, and therefore the precision of subsequent test of the object to be manipulated is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] FIG. 1 is a flowchart of a wafer position calibration method according to an embodiment of the present invention.

[0035] The implementation of the objective, the functional characteristics and the advantages of the present invention will be further described with reference to the accompanying drawings in combination with embodiments.

DETAILED DESCRIPTION

[0036] It should be understood that the specific examples described herein are only used to explain the present invention, not to pose a limitation on the present invention.

[0037] In the description of the present invention, it shall be understood that the orientation or position relationship indicated by the terms "center", "longitudinal", "transverse", "length", "width", "thickness", "up", "down", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inside", "outside", "clockwise", "anticlockwise", and the like is based on the orientation or position relationship shown in the accompanying drawings, it is only for the convenience of description of the present invention and simplification of the description, and it is not to indicate or imply that the indicated device or element must have a specific orientation, and be constructed and operated in a specific orientation. Therefore, the terms shall not be understood as limiting the present invention. Moreover, the terms "first" and "second" are used for descriptive purposes only and cannot be understood as indicating or implying relative importance, or implicitly indicating the number of technical features indicated thereby. Therefore, the feature defined by "first" and "second" may explicitly or implicitly include one or more of the features. In the description of the present invention, the meaning of "multiple" is two or more than two, unless otherwise specifically defined.

[0038] In the present invention, the terms "installation", "connected", "connection", "fixing", and the like shall be understood in a broad sense unless otherwise specified and defined. For example, they may be fixed connection, removable connection or integrated connection; may be mechanical connection or electrical connection; and may be direct connection, or indirect connection through an intermediate medium, and connection inside two elements. The specific meanings of the above terms in the present invention may be understood in a specific case by those of ordinary skills in the art.

[0039] In the present invention, unless otherwise specified and limited, the first feature "on" or "under" the second feature may include direct contact between the first feature and

the second feature, and may also include the contact between the first feature and the second feature through another feature therebetween instead of the direct contact. Furthermore, the first feature "on", "above" and "over" the second feature includes that the first feature is directly above and obliquely above the second feature, or only indicates that the first feature is higher than the second feature in a horizontal height. The first feature "under", "below" and "underneath" the second feature includes that the first feature is directly below and obliquely below the second feature, or only indicates that the first feature is lower than the second feature in a horizontal height.

[0040] As shown in FIG. 1, in some embodiments, a wafer position calibration method includes the following steps:

[0041] S100, scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark;

[0042] S200, based on the two actual positions , determining a righting angle for the object to be manipulated; and

[0043] S300, based on the righting angle, controlling the object to be manipulated to rotate.

[0044] With adoption of the calibration method, that current manual placement or pre-aligning by a robotic arm cannot meet high-precision requirement can be solved, the angle error of the object to be manipulated is reduced, and therefore the precision of subsequent test of the object to be manipulated is improved. The object to be manipulated can be a wafer. The wafer is accommodated on a chuck. The chuck is connected to a movable table.

[0045] In some embodiments, step S100 of scanning an object to be manipulatedan object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark includes:

[0046] S110, navigating a mobile unit to the standard position, the standard position being a position of the alignment mark of the object to be manipulated in the righting state; and

[0047] S120, performing preset pixel scanning by taking the standard position as a starting point until the alignment mark is scanned, so as to obtain two actual positions of the alignment mark.

[0048] In some embodiments, before step S100 of scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark, the method includes:

[0049] S130, acquiring an image of the alignment mark of the object to be manipulated in the righting state;

[0050] S140, performing screen-shooting on the image of the alignment mark with a rectangular box and saving; and

[0051] S150, setting starting point coordinates in the rectangular box, and treating the starting point coordinates as starting point coordinates of a mask area in a design drawing of the object to be manipulated.

[0052] It is to be noted that a specific point is selected in the rectangular box to serve as the starting point coordinates. For example, the vertex of the upper left corner of the rectangular box can be selected as the starting point coordinates. In a coordinate setting interface of software, corresponding coordinates of the point are manually inputted (the unit of the coordinates is generally set according to the overall unit of the design drawing, like mm and μm). If the coordinate system of the image takes the upper left corner of the image as the original point, takes the right direction as a positive direction of an X axis and takes the downward direction as a positive direction of a Y axis, and the coordinates of the vertex of the upper left corner of the rectangular box in this coordinate system are displayed as (10, 20) (the unit is assumed to be mm) through measurement or automatic detection by software, X=10 and Y=20 are respectively inputted into the coordinate setting interface to serve as the starting point coordinates.

[0053] The set starting point coordinates are used as the starting point coordinates of the mask area in the design drawing of the object to be manipulated, corresponding setting operation can be carried out in the software, and thus the system can define a correspondence relationship between the starting point coordinates of the rectangular box and the starting point coordinates of the mask area. Through this setting, whether in the operation of detecting two actual positions of the alignment mark on the object to be manipulated, or the operation of planning a machining process path related to the mask area, comparison and calculation can be carried out according to the unified coordinate reference, so that whether the position of the manipulated object meets the design requirement or not can be accurately determined, and deviation can be found and adjusted in time.

[0054] Specifically, the scanning range is rectangular. More specifically, the scanning range can be 1mm x 1mm.

[0055] In some embodiments, before step S100 of scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark, the method includes:

[0056] S160, performing scanning and shooting on the object to be manipulated to obtain a plurality of images of the object to be manipulated;

[0057] S170, identifying the plurality of images of the object to be manipulated, and finding out two longest straight lines; and

[0058] S180, preliminarily righting the object to be manipulated according to the two longest perpendicular straight lines.

[0059] It is to be noted that before finding the straight line, the plurality of collected images can be preprocessed. The preprocessing includes de-noising. Noise points in the images can be removed by median filtering, Gaussian filtering and other methods, thus the smoothness of the images is improved, which facilitates subsequent characteristic extraction. The images can also be subjected to gray processing to convert color images into grayscale images, which reduce data volume and facilitates subsequent application of an analysis algorithm based on grayscale characteristics. The images can also be subjected to image enhancement operation such as histogram equalization, thus the contrast ratio of the images is enhanced, and lines and other characteristics in the images can be more obvious.

[0060] In addition, an included angle between the straight lines is calculated to determine whether the straight lines are perpendicular or not, it is generally to set an angle threshold close to 90°to determine the perpendicular relationship, then the length of the straight lines is compared, and two longest straight lines are selected as the straight lines which meet the requirement. In this process, all straight line combinations can be detected, and the two straight lines which meet the requirement are finally determined through comparison and determination.

[0061] In the preliminary righting step, rough angle righting can be performed on the object to be manipulated, so that the object to be manipulated is close to an ideal righting state, a good basic angle reference is provided for subsequent accurate angle adjustment, the angle range of subsequent accurate adjustment is reduced, and the efficiency and the precision of angle adjustment of the object to be manipulated can be improved.

[0062] In some embodiments, controlling the object to be manipulated to navigate with the position of the alignment mark as the target, so that the object to be manipulated moves in a direction close to the position of the alignment mark. Specifically, the movable table navigates according to the calculated position of the alignment mark, so as to move to the position of the alignment mark.

[0063] It is to be noted that a movement control unit in an automatic machining device will transmit a control signal to a mechanism (such as a motor and a screw rod) which drives

the object to be manipulated to move according to the calculated direction vector. If the motor is used for driving, the control system will adjust the rotation direction and rotation speed of the motor according to the direction and preset speed parameters.

[0064] In the moving process of the movable table and the object to be manipulated, the position information of the object to be manipulated can be fed back in real time through a position sensor. The movement control unit will continuously receive the feedback information from the position sensor, and continuously adjust the control signal according to the deviation between two actual positions and the position of the alignment mark, so that the movable table and the object to be manipulated are ensured to move to the direction close to the position of the alignment mark.

[0065] the object to be manipulated actively moves close to the position of the alignment mark, and when two actual positions of the alignment mark is scanned and identified subsequently, the scanning range can be reduced. Because the object to be manipulated is located near the alignment mark, it is not needed to scan the whole surface of the object to be manipulated in a large range, the scanning time and calculation amount are reduced, and the scanning efficiency is improved.

[0066] Specifically, the standard position of the alignment mark of the object to be manipulated in the correcting state is acquired through an overlooking microscope camera.

[0067] It is to be noted that the standard position of the alignment mark is the basis and reference standard for all subsequent operations related to the alignment mark. The original position, shape, size, relationship with the surrounding area and other information of the alignment mark of the object to be manipulated in the correcting state are recorded in the image of the alignment mark. For example, in subsequent alignment mark position recognition and angle calculation processes, the image of the alignment mark can be used as a template. Because the image is acquired in the correcting state, the shape and position of the alignment mark are in ideal states, which facilitates the alignment mark characteristic extraction by an image recognition algorithm. The characteristics include geometric shapes (such as circles, squares and crosses), edge contours, textures, colors and the like. By identifying and analyzing the characteristics, a mathematical model of the alignment mark can be established to provide data support for subsequent high-precision positioning and angle adjustment.

[0068] In some embodiments, step S200 of based on the two actual positions , determining a righting angle for the object to be manipulated includes:

[0069] S210, acquiring a first actual position of a first alignment mark on the object to

be manipulated; and acquiring a second actual position of a second alignment mark on the object to be manipulated, in which, the positions of the first alignment mark and the second alignment mark on the object to be manipulated are different;

[0070] S320, calculating to obtain the righting angle based on the first actual position and the second actual position.

[0071] Specifically, the object to be manipulated is circular, and the first alignment mark and the second alignment mark are on the same diameter and are located on two sides of the circle center respectively.

[0072] calculating an included angle between alignment mark line sections on the leftmost edge and the rightmost edge of the object to be manipulated and the horizontal direction, in which, the included angle is the righting angle of the object to be manipulated.

[0073] Specifically, the alignment mark positions on the leftmost side and the rightmost side of the wafer are positioned by utilizing the repeatability of the alignment marks on the mask area.

[0074] It is to be noted that the repeatability of the alignment marks on the mask area refers to that the alignment marks have a certain distribution rule on the wafer. For example, the alignment marks may be distributed on the circumference of the wafer at equal intervals, or distributed in a specific area of the wafer in a certain matrix form. The repeatability is determined by the design and requirements of the photoetching process, and it is to accurately align in different process steps or different layers.

[0075] It is to be noted that the alignment marks on the leftmost side and the rightmost side are positioned from a plurality of identified marks according to the known alignment mark distribution rule. If the alignment marks are distributed at equal intervals along the circumference, the circle center position of the wafer can be determined (possibly determined through other algorithms or based on the shape characteristics of the wafer), and then the marks on the leftmost side and the rightmost side are found out by taking the circle center as a reference point and comparing the angles and positions of the marks. If the matrix distribution is adopted, the leftmost position and the rightmost position can be determined by comparing horizontal coordinates of the marks (it is assumed that the X-axis direction of the coordinate system is the left-right direction).

[0076] In the process of determining the marks on the edges, it can be performed in combination with geometric calculation and logic determination. For example, for the matrix distribution, a group of marks with the minimum horizontal coordinates can be firstly found out to serve as possible candidates of the mark on the leftmost edge, and then the alignment

mark on the leftmost side is finally determined by comparing the longitudinal coordinates or other characteristics (such as relative position relationship with the surrounding marks) of the group of candidate marks. The same method is used for determining the alignment mark on the rightmost side. By determining the positions of the alignment marks on the leftmost side and the rightmost side of the object to be manipulated, the included angle between the line section formed by the two marks and the horizontal direction (or other reference directions) can be calculated to determine the righting angle of the wafer.

[0077] It is needed to definitely position the coordinates of the alignment marks on the leftmost edge and the rightmost edge of the to-be-processed workpiece to calculate the included angle between the alignment mark line section on the leftmost edge and the rightmost edge of the object to be manipulated and the horizontal direction. The coordinates can be coordinates based on image pixels, and can also be converted actual physical size coordinates. It is assumed that the coordinates of the alignment mark on the leftmost edge are (X_1, Y_1), and the coordinates of the alignment mark on the rightmost edge are (X_2, Y_2). Through a formula $\tan(\theta)=(Y_2-Y_1)/(X_2-X_1)$, the angle of θ can be calculated with an arc tangent function, which is the righting angle of the object to be manipulated. The righting angle for the object to be manipulated can be accurately calculated by this step. In the high-precision machining process, such as semiconductor manufacturing and precision optical element machining, the accurate angle is crucial to product quality. By this step, the angle deviation of the object to be manipulated can be quantitatively controlled, thus it is ensured that the wafer reaches the high precision of $\tan(\theta)= \pm 0.001/250$.

[0078] In some embodiments, after step S300 of based on the righting angle, controlling the object to be manipulated to rotate further includes:

[0079] S310, comparing the position of the object to be manipulated after righting with the coordinates in the design drawing of the object to be manipulated;

[0080] S320, binding the position of the object to be manipulated after righting to the coordinates in the design drawing of the object to be manipulated; and

[0081] S330, calculating the center position of the object to be manipulated according to the coordinates in the design drawing of the object to be manipulated.

[0082] Specifically, after the object to be manipulated is righted, the movable table and the object to be manipulated will be returned to the initial position of the alignment mark, and the position will be confirmed. The position of the object to be manipulated after righting is compared with coordinates in the design drawing of the object to be manipulated. The system binds the position to the coordinates in the design drawing, then the center position of the

object to be manipulated can be reversely calculated, and thus a reference point is provided for automatic navigation of the mobile unit.

[0083] It is to be noted that the coordinates of two actual positions of the object to be manipulated after righting and the corresponding ideal coordinates in the design drawing of the object to be manipulated are acquired. The coordinates of two actual positions can be obtained by previous scanning, positioning and other operations and are represented by a proper coordinate system, including the coordinates of the alignment mark and the edge point. The coordinates in the design drawing are determined in the product design stage, are generally represented by a coordinate system in design software and also contain the coordinates of corresponding key positions.

[0084] Because the coordinates of two actual positions and the coordinates in the design drawing may not be completely consistent due to the difference of the coordinate system, unit conversion and other factors, it is needed to establish a unified comparison rule. For example, the coordinates of two actual positions are converted into the same unit and coordinate system direction as the coordinates in the design drawing. Generally, comparison is carried out point by point for the coordinates of the key positions, for example, for the coordinates of the alignment mark, the X-axis coordinate difference value and the Y-axis coordinate difference value of the alignment mark at two actual positions and in the design drawing are compared. By comparing the coordinates, the position deviation of the object to be manipulated in the machining process can be visually discovered. It is of great importance for guaranteeing the machining precision, especially in the high-precision manufacturing field such as semiconductor manufacturing. Any tiny position deviation may make the product fail to meet design requirement, problems can be found in time by comparison, and measures can be taken for adjustment or correction to ensure the product quality.

[0085] The calculated central position of the object to be manipulated is an important reference point of the object to be manipulated. In subsequent machining process, for example, when testing a chip, the mobile unit can take the central position as a reference to accurately position a test point in combination with the layout of the chip on the wafer. When cutting, grinding and other operations are carried out, the central position can help to determine the symmetry center for machining, thus ensuring the balance and precision of machining. The central position has important significance for planning of a machining path. For example, in some processes needing rotary symmetry machining around the center, or in a process of carrying out uniform treatment (such as surface coating) on the whole object to be manipulated. The central position of the object to be manipulated can be used as a starting

point or a reference point for planning a reasonable machining path, thereby improving the machining efficiency and the product quality.

[0086] In some embodiments, before step S330 of calculating the center position of the object to be manipulated according to the coordinates in the design drawing of the object to be manipulated, the method further includes:

[0087] S331, binding the central position of the object to be manipulated to a path coordinate system of the mobile unit.

[0088] It is to be noted that an accurate navigation target can be provided for the mobile unit by binding the central position of the object to be manipulated to the path coordinate system of the mobile unit. When the mobile unit is subjected to test operation, it is needed to make accurate contact with a specific test point on the surface of the object to be manipulated, the movement path of the probe can be planned more conveniently and accurately by taking the central position as the reference point, it is ensured that the probe can quickly and accurately reach the target test point, and thereby the test efficiency and the accuracy of a test result are improved.

[0089] In the whole machining and testing system, binding the center position of the object to be manipulated to the path coordinate system of the mobile unit is one of key steps for achieving system integration and automatic operation. It makes a machining device and a testing device cooperatively work better, and information transmission and operation control can be conducted based on a unified coordinate standard. For example, on an automatic production line, when the object to be manipulated is transferred to the mobile unit from the machining device to be tested, this binding can ensure seamless butt joint in the testing process, thus reducing manual intervention, and improving the production efficiency and product quality stability.

[0090] By means of the calibration method, it can be ensured that the wafer can be placed on the chuck with high-precision alignment, and the rotation error and the center positioning error of the wafer can be controlled within +/-1 μm and +/-0.1 mm correspondingly. According to the calibration method, the position and angle of the wafer are detected and adjusted through the automatic system, the mobile unit can precisely navigate to each to-be-tested component, and therefore the testing efficiency and reliability are improved. The calibration method is applied to a wafer testing system which needs high-precision automatic alignment to achieve automatic alignment and center positioning of the wafer. By means of the calibration method, the mobile unit navigation precision is effectively improved, and manual operation error and alignment time are reduced. The calibration method can be

applied to the fields of single-chip testing, wafer-level testing and other photoelectric and electronic testing fields needing micron-level precision alignment.

[0091] In some embodiments, a wafer position calibration system is used for implementing the abovementioned calibration method, and includes a mobile unit, an acquisition apparatus, a calculation apparatus and a calibration apparatus. The mobile unit is configured to scan the object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark. The acquisition apparatus is configured to acquire a standard position of the alignment mark of the object to be manipulated in a righting state. The calculation apparatus is configured to: based on the two actual positions, determine a righting angle for the object to be manipulated. The calibration apparatus is configured to: based on the righting angle, control the object to be manipulated to rotate.

[0092] In some embodiments, a computer-readable storage medium on which a computer program is stored, and the computer program is executed by a computer processor to implement the abovementioned wafer position calibration method.

[0093] A computer-readable storage medium in this embodiment can be a computer-readable signal medium or a computer-readable storage medium or any combination thereof. The computer-readable storage medium can be, for example, an electrical, magnetic, optical, electromagnetic, infrared or semiconductor system, device, or apparatus, or any combination thereof. More specifically, the computer-readable storage medium can include, but are not limited to, for example, electrical connection by one or more wires, laptop disks, hard disks, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or flash), optical fibers, a portable compact disk read-only memory (CD-ROM), an optical storage apparatus, a magnetic storage apparatus, or any suitable combination thereof. In this embodiment, the computer-readable storage medium can be any tangible medium containing or storing a program that can be used by or in combination with an instruction execution system, device, or apparatus. In this embodiment, the computer-readable signal medium may include a data signal propagated in a baseband or as part of a carrier wave, which carries a computer-readable program code. This propagating data signal can take many forms, including, but not limited to, electromagnetic signals, optical signals, or any suitable combination thereof. The computer-readable signal medium may also be any computer-readable storage medium other than the computer-readable storage medium that may send, disseminate, or transmit programs intended for use by or in combination with the

instruction-executing system, device, or apparatus. Program code contained on the computer-readable storage medium may be transmitted on any appropriate medium, including, but not limited to, wireless, wire, cable, RF, etc., or any appropriate combination thereof.

[0094] In some embodiments, a computer device performs the abovementioned wafer position calibration method.

[0095] The above is only a preferred embodiment of the present invention, and does not limit the patent scope of the present invention, and all equivalent structural or equivalent process transformations made by using the contents of the description and drawings of the present invention, or directly or indirectly used in other related technical fields, are similarly included in the patent protection scope of the present invention.

CLAIMS

We claim:

1. A wafer position calibration method, comprising the following steps:

scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark;

based on the two actual positions, determining a righting angle for the object to be manipulated; and

based on the righting angle, controlling the object to be manipulated to rotate.

2. The calibration method according to claim 1, wherein the step of scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark comprises:

navigating a mobile unit to the standard position, the standard position being a position of the alignment mark of the object to be manipulated in the righting state; and

performing preset pixel scanning by taking the standard position as a starting point until the alignment mark is scanned, so as to obtain two actual positions of the alignment mark.

3. The calibration method according to claim 1, wherein the step of based on the two actual positions, determining a righting angle for the object to be manipulated comprises:

acquiring a first actual position of a first alignment mark on the object to be manipulated; and acquiring a second actual position of a second alignment mark on the object to be manipulated, wherein the positions of the first alignment mark and the second alignment mark on the object to be manipulated are different;

calculating to obtain the righting angle based on the first actual position and the second actual position.

4. The calibration method according to claim 3, wherein the object to be manipulated is circular, and the first alignment mark and the second alignment mark are on the same diameter and are located on two sides of the circle center respectively.

5. The calibration method according to claim 1, wherein before the step of scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark, the method comprises:

acquiring an image of the alignment mark of the object to be manipulated in the righting state;

performing screen-shooting on the image of the alignment mark with a rectangular box and saving; and

setting starting point coordinates in the rectangular box, and treating the starting point coordinates as starting point coordinates of a mask area in a design drawing of the object to be manipulated.

6. The calibration method according to claim 1, wherein before scanning an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark, the method comprises:

performing scanning and shooting on the object to be manipulated to obtain a plurality of images of object to be manipulated;

identifying the plurality of images of object to be manipulated, and finding out two longest straight lines; and

preliminarily righting the object to be manipulated according to the two longest perpendicular straight lines.

7. The calibration method according to claim 1, wherein after the step of based on the righting angle, controlling the object to be manipulated to rotate, the method further comprises:

binding the position of the object to be manipulated after righting to the coordinates in the design drawing of the object to be manipulated; and

calculating the center position of the object to be manipulated according to the coordinates in the design drawing of the object to be manipulated.

8. A wafer position calibration system, implementing the calibration method according to any one of claims 1 to 7, comprising:

a mobile unit configured to scan an object to be manipulated to identify an alignment mark on the object to be manipulated, so as to obtain two actual positions of the alignment mark;

a calculation apparatus configured to: based on two actual positions, determine a righting angle for the object to be manipulated; and

a calibration apparatus configured to: based on the righting angle, control the object to be manipulated to rotate.

9. A computer-readable storage medium thereon a computer program is stored, wherein the computer program is executed by a computer processor to implement the wafer position calibration method according to any one of claims 1 to 7.

10. A computer device, executing the wafer position calibration method according to any one of claims 1 to 7.