Description

Bonding Device, Bonding Method, and Storage Medium

Technical Field

The disclosure relates to the field of semiconductor device processing, in particular to a bonding device, a bonding method, and a computer-readable storage medium.

Background

The handover between the chip picking assembly and the chip bonding assembly in the bonding device is a key step in the bonding process, which directly affects the accuracy, efficiency, and reliability of the entire bonding process. The chip picking assembly of existing conventional bonding devices usually only installs one suction nozzle. The chip picking assembly needs to perform a lateral movement and alignment with the bonding heads, after picking up chips every time, to complete a handover action, resulting in low bonding efficiency.

In order to improve the bonding efficiency, this field further provided some improved chip picking assembly, which reduce the number of lateral movements of the chip picking assembly, by installing two suction nozzles facing in different directions, and configuring a rotating motor to switch the suction nozzle. However, the design of multiple suction nozzles facing different directions has limitations in space, making it difficult to achieve large-scale integration of suction nozzles. On the other hand, it cannot guarantee an actual position and a posture of each of the plurality of the suction nozzles after switching to a working position. Therefore, it is necessary to perform a new posture correction of the picking head after switching each of the plurality of the suction nozzles, which still cannot meet the efficiency requirements of large-scale bonding.

In order to overcome the above-mentioned shortcomings of existing technology, this field urgently needs an improved bonding device, which can not only effectively reduce the number of times of moving and switching working stations of the picking

head and the bonding head, but also ensure the consistency of the suction nozzle posture of each of the plurality of the picking heads and the bonding heads, thereby eliminating the need to correct the posture of each of the plurality of the picking heads and the bonding heads one by one, to balance the accuracy and efficiency of the pickup and the bonding of the chips.

Summary

A brief overview of one or more aspects is provided below to provide a basic understanding of these aspects. The summary is not an extensive overview of all contemplated aspects, nor is it intended to identify key or decisive elements in all aspects, nor attempt to define the scope of any or all aspects. The sole purpose of the summary is to present some concepts of one or more aspects in a simplified form as a prelude to the more detailed description that is presented later.

In order to overcome the above-mentioned shortcomings of prior art, the present invention provides a bonding device, a bonding method and a computer-readable storage medium, which can not only reduce the number of times of moving and switching working stations of the picking head and the bonding head, by designing a plurality of the picking heads and the bonding heads, but also eliminate the need to correct the posture of each picking head one by one, and support the plurality of picking heads to synchronously hand over the plurality of the chips to the plurality of bonding head, by designing suction surfaces of the plurality of picking heads and the plurality of bonding heads on a same plane, thereby balancing the accuracy and efficiency of chip handover and bonding.

Specifically, the bonding device provided in the first aspect of the present invention comprises a chip picking assembly and a chip bonding assembly. The chip picking assembly comprises a first body and a first rotating motor. The first body is provided with a plurality of picking heads. First suction surfaces for chips of the plurality of picking heads are located on a same plane, and facing a same first direction. The first rotating motor is connected to the first body, for rotating and switching the plurality of picking heads one by one to a preset picking station, to pick up corresponding chips one by one. The chip bonding assembly is located in the first

direction of the chip picking assembly, and comprising a second body. The second body is provided with a plurality of bonding heads. Second suction surfaces for chips of the plurality of bonding heads are located on a same plane, and facing a second direction where the chip picking assembly is located, to simultaneously obtain the corresponding chips from the first suction surfaces of the plurality of picking heads.

Furthermore, in some embodiments of the disclosure, the bonding device further comprises a picking head lateral moving module. The picking head lateral moving module is used to laterally move the chip picking assembly to the picking station where a wafer tray is located, for the plurality of picking heads to pick up the corresponding chips one by one, and then laterally move the chip picking assembly to a handover station where the chip bonding assembly is located, for the plurality of bonding heads of the chip bonding assembly to simultaneously obtain the corresponding chips from the first suction surfaces of corresponding picking heads.

Furthermore, in some embodiments of the disclosure, the bonding device further comprises a wafer tray and a wafer tray lateral moving module. The wafer tray is carrying a plurality of chips thereon. The wafer tray lateral moving module is used to horizontally move the wafer tray, when one of the picking heads of the chip picking assembly completing a pickup of a corresponding chip, and a next picking head is rotated and switched on, to horizontally move a next chip to be picked up to the picking station, to align it with a next picking head.

Furthermore, in some embodiments of the disclosure, the bonding device further comprises a camera and a controller. The camera is used to capture images of the chip picking assembly and the chip bonding assembly, after the chip picking assembly arrives at the handover station. The controller is configured to: analyze the images to determine a translation amount difference and a rotation angle difference between the chip picking assembly and the chip bonding assembly; and control the picking head lateral moving module to laterally move according to the translation amount difference, and control the first rotating motor to rotate according to the rotation angle difference, to align each of the plurality of picking heads of the chip picking assembly with a corresponding bonding head of the chip bonding assembly.

Furthermore, in some embodiments of the disclosure, the first body and/or the

second body is further provided with a levelling module. The controller is further configured to: analyze the images to determine a parallelism between the chip picking assembly and the chip bonding assembly; and control the levelling module to tilt according to the parallelism, to make the first suction surface of each of the plurality of picking heads of the chip picking assembly parallel to the second suction surface of the corresponding bonding head of the chip bonding assembly.

Furthermore, in some embodiments of the disclosure, the chip bonding assembly further comprises a bonding head lifting module. The bonding head lifting module is used to lift and lower the chip bonding assembly in the second direction, after the chip picking assembly arriving at the handover station, for the plurality of bonding heads to simultaneously obtain the corresponding chips from the first suction surfaces of the corresponding picking heads, and to lift and lower the chip bonding assembly in a third direction where a wafer chuck is located, after obtaining the corresponding chips, to bond obtained chips one by one or synchronously to corresponding target positions on a wafer held by the wafer chuck.

Furthermore, in some embodiments of the disclosure, the chip bonding assembly further comprises a flipping module. The flipping module is used to flip the chip bonding assembly after obtaining the chips, for the bonding head lifting module to lift and lower the chip bonding assembly in the first direction, and to bond the obtained chips one by one or synchronously to the corresponding target positions on the wafer.

Furthermore, in some embodiments of the disclosure, the chip bonding assembly further comprises a second rotating motor. The second rotating motor is connected to the second body, for rotating and switching the plurality of bonding heads one by one to a preset bonding station, after obtaining the chips, to bond the chips to the corresponding target positions on the wafer one by one.

Furthermore, in some embodiments of the disclosure, the bonding device further comprises a wafer chuck and a wafer chuck lateral moving module. The wafer chuck holds a wafer to be bonded thereon. The wafer chuck lateral moving module is used to laterally move the wafer chuck, when one of the plurality of bonding heads of the chip bonding assembly completing bonding of a corresponding chip, and a next

bonding head is rotated and switched on, to move a next target position to be bonded to the bonding station, to align it with the next bonding head.

Furthermore, in some embodiments of the disclosure, the chip bonding assembly further comprises a plurality of lateral moving units and a plurality of rotating units. Each of the plurality of bonding heads is respectively provided with one of the lateral moving units and one of the rotating units, which adjust lateral moving amount and rotation amount of the bonding head, according to the target positions on the wafer, to synchronously bond a plurality of chips held by the chip bonding assembly to the target positions on the wafer.

Furthermore, in some embodiments of the disclosure, the first rotating motor and/or the second rotating motor adopt a gas slip ring device, comprising a stator and a rotor. The stator comprises a cavity extending along the first direction, a plurality of gas outlets connected to the cavity, a plurality of annular ventilation grooves respectively connected to each gas outlet, and sealing rings located between every two annular ventilation grooves. The rotor extends along the first direction, and installed inside the cavity through a plurality of bearings, to rotate around the first direction when driven by the stator. An outer wall of the rotor contacts an inner side of each of the plurality of sealing ring, to cooperate with an inner wall of the cavity and the sealing rings to isolate the plurality of annular ventilation grooves. A plurality of gas paths are provided in the rotor, whose first ends are respectively connected to each of the plurality of annular ventilation grooves, to obtain a negative pressure provided by a corresponding gas outlet, and whose second ends are respectively connected to a corresponding picking head or a corresponding bonding head through a corresponding gas inlet, to transmit the negative pressure and hold the chip.

Furthermore, in some embodiments of the disclosure, the first body of the chip picking assembly is provided with six picking heads. Each of the picking heads is distributed around a periphery of the first body at an angle of 60 degrees. The second body of the chip bonding assembly is provided with six bonding heads. Each of the bonding heads is distributed around a periphery of the second body at an angle of 60 degrees, to simultaneously obtain six chips held by the six picking heads of the chip picking assembly.

In addition, according to the above-mentioned bonding method provided in the second aspect of the present invention comprising following steps: horizontally moving a chip picking assembly of a bonding device provided in the first aspect of the present invention to a preset picking station; rotating and switching a plurality of picking heads of the chip picking assembly one by one, to pick up corresponding chips from a wafer tray one by one, through a first rotating motor of the chip picking assembly; horizontally moving the chip picking assembly to a preset handover station; simultaneously obtaining the corresponding chips from first suction surfaces of the plurality of picking heads, by a plurality of bonding heads of a chip bonding assembly of the bonding device; and bonding each of obtained chips one by one or synchronously to corresponding target positions on a wafer held by a wafer chuck, by the plurality of bonding heads.

In addition, according to the above-mentioned non-transitory computer-readable storage medium provided in the third aspect of the present invention stores a computer instruction thereon. The bonding method provided in the second aspect of the present invention is implemented when the computer instruction is executed by a processor.

Brief Description of the Drawings

The above features and advantages of the present invention will be better understood after reading the detailed description of the embodiments of the present disclosure in conjunction with the following figures. In the figures, components are not necessarily drawn to scale, and components having similar related features may have the same or similar reference numerals.

Fig. 1 shows a schematic diagram of a chip picking assembly provided according to some comparative embodiments.

Fig. 2 shows a schematic diagram of a chip picking assembly provided according to some embodiments of the present invention.

Fig. 3 shows a schematic diagram of of a chip bonding assembly provided according to some embodiments of the present invention.

Fig. 4 shows a schematic diagram of a bonding device provided according to

some embodiments of the present invention.

Fig. 5 shows a schematic diagram of a first rotating motor and/or a second rotating motor provided according to some embodiments of the present invention.

Fig. 6 shows a flowchart of a bonding method provided according to some embodiments of the present invention.

Detailed Description of Embodiments

The embodiments of the present invention are described in the following detailed description. Other advantages and effects of the present invention will be readily apparent to those skilled in the art from this disclosure. Although the description of the present invention will be described in conjunction with the preferred embodiments, this is not a limitation of the present invention. On the contrary, the invention is described in connection with the embodiments so as to cover other alternatives or modifications that are possible in the embodiments of the present invention. In order to provide a thorough understanding of the present invention, many specific details are included in the following description. The present invention may also be practiced without these details. In addition, some specific details are omitted in the description in order to avoid confusing or obscuring the present invention.

In the description of the present invention, it should be noted that the terms "installation", "connecting", and "connected" should be understood broadly unless explicitly stated and defined otherwise. For example, the terms "installation", "connecting", and "connected" may be either a fixed connection, a detachable connection, or an integral connection; the terms may be either a mechanical connection or an electrical connection; the terms also may be either a direct connection, an indirect connection through an intermediate medium, or an internal connection between two components. The specific meaning of the above terms in the present invention can be understood in a specific case by those skilled in the art.

In addition, "up", "down", "left", "right", "top", "bottom", "horizontal", "vertical" used in the following description shall be understood as the orientation described in the paragraph and shown in the related figure. The relative term is used

for convenience of description only, and does not mean that the device described therein is to be manufactured or operated in the specific orientation, and therefore should not be construed as limiting the present invention.

Understandably, although the terms "first", "second", "third", etc. may be used to describe various components, regions, layers and/or portions to distinguish different components, regions, layers and/or portions, the order of these components, regions, layers and/or portions described above should not be limited by the terms. Therefore, a first component, region, layer and/or portion mentioned below may be also mentioned as a second component, region, layer and/or portion without departing from some embodiments of the present invention.

As mentioned above, the chip picking assembly of existing conventional bonding devices usually only installs one suction nozzle. The chip picking assembly needs to perform a lateral movement and alignment with the bonding heads, after picking up chips every time, to complete a handover action, resulting in low bonding efficiency. The improved design of multiple suction nozzles facing different directions has limitations in space, making it difficult to achieve large-scale integration of suction nozzles. On the other hand, it cannot guarantee an actual position and a posture of each of the plurality of the suction nozzles after switching to a working position. Therefore, it is necessary to perform a new posture correction of the picking head after switching each of the plurality of the suction nozzles, which still cannot meet the efficiency requirements of large-scale bonding.

In order to overcome the above-mentioned shortcomings of prior art, the present invention provides a bonding device, a bonding method, and a computer-readable storage medium, which can not only effectively reduce the number of times of moving and switching working stations of the picking head and the bonding head, by designing a plurality of the picking heads and the bonding heads, but also eliminate the need to correct the posture of each picking head one by one, and support the plurality of picking heads to synchronously hand over the plurality of the chips to the plurality of bonding head, by designing suction surfaces of the plurality of picking heads and the plurality of bonding heads on a same plane, thereby balancing the accuracy and efficiency of chip handover and bonding.

Please refer to Fig. 1 to Fig. 4. Fig. 1 shows a schematic diagram of a chip picking assembly provided according to some comparative embodiments. Fig. 2 shows a schematic diagram of a chip picking assembly provided according to some embodiments of the present invention. Fig. 3 shows a schematic diagram of of a chip bonding assembly provided according to some embodiments of the present invention. Fig. 4 shows a schematic diagram of a bonding device provided according to some embodiments of the present invention.

As shown in Fig. 1, the existing chip picking assembly only comprises one picking head, which hands a chip over to bonding heads after picking up it, and this method results in low efficiency.

In the embodiment shown in Fig. 2, the bonding device provided in the first aspect of the present invention comprises a chip picking assembly and a chip bonding assembly. Herein, the chip picking assembly comprises a first body 11 and a first rotating motor 12. The first body 11 comprises a plurality of picking heads 111 to 116, first suction surfaces for chips of the plurality of picking heads 111 to 116 are located on a same plane, and facing a same first direction (e.g. below). The first rotating motor 12 is connected to the first body 11, for rotating and switching the plurality of picking heads 111 to 116 one by one to a preset picking station, to pick up corresponding chips one by one.

In the embodiment shown in Fig. 3 and Fig. 4, the chip bonding assembly is located in the first direction of the chip picking assembly, and comprising a second body 21. Herein, the second body 21 is provided with a plurality of bonding heads 211 to 216, and second suction surfaces for chips of the plurality of bonding heads 211 to 216 are located on a same plane, and facing a second direction where the chip picking assembly is located (e.g. above), to simultaneously obtain the corresponding chips from the first suction surfaces of the plurality of picking heads 111 to 116.

In addition, in the embodiment shown in Fig. 4, the bonding device provided in the first aspect of the present invention preferably further comprises a picking head lateral moving module 13. The picking head lateral moving module 13 is used to laterally move the chip picking assembly to the picking station where a wafer tray 30 is located, for the plurality of picking heads 111 to 116 to pick up the corresponding

chips one by one, and then laterally move the chip picking assembly to a handover station where the chip bonding assembly is located, for the plurality of bonding heads 211 to 216 of the chip bonding assembly to simultaneously obtain the corresponding chips from the first suction surfaces of corresponding picking heads 111 to 116.

In addition, in the embodiment shown in Fig. 4, the bonding device provided in the first aspect of the present invention further comprises the wafer tray 30 and a wafer tray lateral moving module 31. Herein, the wafer tray 30 is carrying a plurality of chips thereon. The wafer tray lateral moving module 31 is used to horizontally move the wafer tray 30, when one of the picking heads of the chip picking assembly completing a pickup of a corresponding chip, and a next picking head is rotated and switched on, to horizontally move a next chip to be picked up to the picking station, to align it with a next picking head.

In addition, in some preferred embodiments, the bonding device provided in the first aspect of the present invention further comprises a camera, used to synchronously align the plurality of picking heads 111 to 116 with the plurality of bonding heads 211 to 216. Herein, the camera is used to capture images of the chip picking assembly and the chip bonding assembly, after the chip picking assembly arriving at the handover station.

In addition, in some embodiments, the chip bonding assembly further comprises a bonding head lifting module. The bonding head lifting module is used to lift and lower the chip bonding assembly in the second direction, after the chip picking assembly arriving at the handover station, for the plurality of bonding heads 211 to 216 to simultaneously obtain the corresponding chips from the first suction surfaces of the corresponding picking heads, and to lift and lower the chip bonding assembly in a third direction where a wafer chuck is located, after obtaining the corresponding chips, to bond obtained chips one by one or synchronously to corresponding target positions on a wafer held by the wafer chuck.

In addition, in some embodiments, the chip bonding assembly further comprises a flipping module, to reduce the lateral footprint, which is beneficial for large-scale integration of parallel assembly lines. Herein, the flipping module is used to flip the chip bonding assembly after obtaining the chips, for the bonding head lifting module

to lift and lower the chip bonding assembly in the first direction, and to bond the obtained chips one by one or synchronously to the corresponding target positions on the wafer. At this point, the third direction is equivalent to the first direction (e.g. below).

Those skilled in the art can understand that the embodiment of the bonding device shown in Fig. 4 is only a non-limiting embodiment provided by the disclosure, aiming to clearly demonstrate the main concept of the disclosure and provide a specific solution for public implementation, rather than limiting the scope of protection of the disclosure.

Optionally, in other embodiments, those skilled in the art can also place the wafer chuck above the side of the chip bonding assembly. At this time, the above-mentioned bonding device provided in the first aspect of the present invention horizontally moves the chip bonding assembly to the bonding position below it, through the bonding head lateral moving module, and then lifts the chip bonding assembly in the second direction (e.g. above) through the bonding head lifting module, to bond the obtained chips one by one or synchronously to the target position of the wafer held by the wafer chuck.

Furthermore, in the embodiment shown in Fig. 3, the above-mentioned chip bonding assembly a second rotating motor 22. Herein, the second rotating motor 22 is connected to the second body, for rotating and switching the plurality of bonding heads one by one to a preset bonding station, after obtaining the chips, to bond the chips to the corresponding target positions on the wafer one by one.

In addition, in some embodiments, the bonding device provided in the first aspect of the present invention further comprises the wafer chuck and a wafer chuck lateral moving module. Herein, the wafer chuck holds a wafer to be bonded thereon. The wafer chuck lateral moving module is used to laterally move the wafer chuck, when one of the plurality of bonding heads of the chip bonding assembly completing bonding of a corresponding chip, and a next bonding head is rotated and switched on, to move a next target position to be bonded to the bonding station, to align it with the next bonding head.

In addition, in some preferred embodiments, the chip bonding assembly further

comprises a plurality of lateral moving units and a plurality of rotating units. Herein, each of the plurality of bonding heads is respectively provided with one of the lateral moving units and one of the rotating units, which adjust lateral moving amount and rotation amount of the bonding head, according to the target positions on the wafer, to synchronously bond a plurality of chips held by the chip bonding assembly to the target positions on the wafer.

Please further refer to Fig. 5. Fig. 5 shows a schematic diagram of a first rotating motor and/or a second rotating motor provided according to some embodiments of the present invention.

In the embodiment shown in Fig. 5, the first rotating motor 12 and/or the second rotating motor 22 comprises a stator 51 and a rotor 52. Herein, the stator 51 comprises a cavity extending along the first direction, a plurality of gas outlets 511 connected to the cavity, a plurality of annular ventilation grooves respectively connected to each of the plurality of gas outlets, and sealing rings 512 located between every two annular ventilation grooves. The rotor 52 is extending along the first direction, and installed inside the cavity through a plurality of bearings 521, to rotate around the first direction when driven by the stator 51. An outer wall of the rotor 52 contacts an inner side of each of the plurality of sealing rings 512, to cooperate with an inner wall of the cavity and the sealing rings 512 to isolate the plurality of annular ventilation grooves. A plurality of gas paths are provided in the rotor 52, whose first ends are respectively connected to each of the plurality of annular ventilation grooves, to obtain a negative pressure provided by a corresponding gas outlet 511, and whose second ends are respectively connected to a corresponding picking head or a corresponding bonding head through a corresponding gas inlet 522, to transmit the negative pressure and hold the chip.

Furthermore, in the embodiment shown in Fig. 2, the first body 11 of the chip picking assembly is provided with six picking heads 111 to 116. Each of the picking heads 111 to 116 is distributed around a periphery of the first body 11 at an angle of 60 degrees. Similarly, in the embodiment shown in Fig. 3, the second body 21 of the chip bonding assembly is provided with six bonding heads 211 to 216, and each of the bonding heads 211 to 216 is distributed around a periphery of the second body 21

at an angle of 60 degrees, to simultaneously obtain six chips held by the six picking heads of the chip picking assembly.

In some non-limiting embodiments, the bonding method provided in the second aspect of the present invention can be implemented by the bonding device provided in the first aspect of the present invention. Specifically, the bonding device provided in the first aspect of the present invention comprises a memory and a controller. The memory includes, but is not limited to, the computer-readable storage medium provided in the third aspect of the present invention, on which computer instructions are stored. The controller is connected to the memory and configured to execute the computer instructions stored on the memory to implement the above bonding method provided in the first aspect of the present invention.

The working principle of the above bonding device will be described below in conjunction with some embodiments of some bonding methods. Those skilled in the art can understand that the embodiments of these bonding methods only provide some non-limiting implementations of the present invention, which is intended to clearly display the main idea of the present invention, and provide some specific proposals that are convenient for the public to implement, rather than limiting all working modes or all functions of the bonding device. Similarly, the bonding device is only a non-limiting embodiment provided by the present invention, and does not limit the implementation subject to each step in these bonding methods.

Please refer to Fig. 6. Fig. 6 shows a flowchart of a bonding method provided according to some embodiments of the present invention.

As shown in Figure 6, the controller can horizontally move a chip picking assembly of the bonding method provided in the second aspect of the present invention to a preset picking station.

Afterwards, the controller can rotate and switch a plurality of picking heads 111 to 116 of the chip picking assembly one by one, to pick up corresponding chips from a wafer tray one by one, through a first rotating motor 11 of the chip picking assembly.

Afterwards, the controller can horizontally move the chip picking assembly to a preset handover station, and simultaneously obtain the corresponding chips from first suction surfaces of the plurality of picking heads 111 to 116, by a plurality of bonding

heads 211 to 216 of a chip bonding assembly of the bonding device.

Afterwards, the controller can bond each of obtained chips one by one or synchronously to corresponding target positions on a wafer held by a wafer chuck, by the plurality of bonding heads 211 to 216.

In addition, in some preferred embodiments, the controller can also capture images of the chip picking assembly and the chip bonding assembly through a camera. Then the controller can analyze the images, to determine a translation amount difference and a rotation angle difference between the chip picking assembly and the chip bonding assembly, control the picking head lateral moving module to laterally move according to the translation amount difference, and control the first rotating motor 11 to rotate according to the rotation angle difference, to align each of the plurality of picking heads 111 to 116 of the chip picking assembly with a corresponding bonding heads 211 to 216 of the chip bonding assembly. In this way, the bonding device provided in the first aspect of the present invention can synchronously perform posture correction for the plurality of pickup heads and the plurality of bonding heads.

In addition, in some preferred embodiments, the first body 21 and/or the second body is further provided with a levelling module. Herein, the controller can analyze the above-mentioned images, to determine a parallelism between the chip picking assembly and the chip bonding assembly, and control the levelling module to tilt according to the parallelism, to make the first suction surface of each of the plurality of picking heads of the chip picking assembly parallel to the second suction surface of the corresponding bonding head of the chip bonding assembly. In this way, the bonding device provided in the first aspect of the present invention can synchronously perform posture correction for the plurality of pickup heads and the plurality of bonding heads.

In summary, the above-mentioned bonding device, the above-mentioned bonding method, and the above-mentioned computer-readable storage medium provided in the present invention can reduce the number of times of moving and switching working stations of the picking head and the bonding head, by designing a plurality of the picking heads and the bonding heads, thereby improving the

efficiency of picking and bonding, and eliminate the need to correct the posture of each of the plurality of the picking heads and the bonding heads one by one by designing first suction surfaces of the plurality of picking heads on a same plane, to balance the pickup accuracy and pickup efficiency of the chips. In addition, it can eliminate the need to correct the posture of each of the plurality of the picking heads and the bonding heads one by one, and support a synchronously handover of the plurality of the chips by designing second suction surfaces of the plurality of bonding heads on a same plane, to further balance the handover accuracy and handover efficiency of the chips.

Although the method is illustrated and described as a series of actions for the purpose of simplifying the explanation, it should be understood and appreciated that these methods are not limited by the order of the actions. Those skilled in the art may understand that some actions may occur in different orders and/or concurrently with other actions that are illustrated and described herein or that are not illustrated and described herein, in accordance with one or more embodiments.

Although the controller described in the above embodiments can be implemented through a combination of software and hardware. However, it can be understood that the controller can also be implemented in software or hardware. For hardware implementation, the controller can be implemented on one or more application specific integrated circuits (ASICs), digital signal processors (DSPs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), processors, controllers, microcontrollers, microprocessors, other electronic devices used to perform the above functions, or selected combinations of the above devices. For software implementation, the controller can be implemented through independent software modules such as procedures and functions running on a general-purpose chip, where each module performs one or more of the functions and operations described herein.

The steps of a method or algorithm described in connection with the embodiments disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in RAM memory, flash memory, ROM memory, EPROM memory,

EEPROM memory, registers, hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art. An exemplary storage medium is coupled to the processor so that the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in a user terminal. In the alternative, the processor and the storage medium may reside as discrete components in a user terminal.

In one or more exemplary embodiments, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software as a computer program product, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage media may be any available media that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to carry or store desired program code in the form of instructions or data structures and that can be accessed by a computer. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

The previous description of the disclosure is provided to enable any person skilled in the art to make or use the disclosure. Various modifications to the present

disclosure will be obvious to those skilled in the art, and the general principles defined herein may be applied to other variations without departing from the spirit or scope of the disclosure. Thus, the present disclosure is not intended to be limited to the examples and designs described herein, but is to be accorded the broadest scope of the principles and novel features disclosed herein.

Claims

1. A bonding device, comprising:

a chip picking assembly, comprising a first body and a first rotating motor, wherein the first body is provided with a plurality of picking heads, first suction surfaces for chips of the plurality of picking heads are located on a same plane, and facing a same first direction, and the first rotating motor is connected to the first body, for rotating and switching the plurality of picking heads one by one to a preset picking station, to pick up corresponding chips one by one;

a chip bonding assembly, located in the first direction of the chip picking assembly, and comprising a second body, wherein the second body is provided with a plurality of bonding heads, and second suction surfaces for chips of the plurality of bonding heads are located on a same plane, and facing a second direction where the chip picking assembly is located, to simultaneously obtain the corresponding chips from the first suction surfaces of the plurality of picking heads.

2. The bonding device according to claim 1, further comprising:

a picking head lateral moving module, used to laterally move the chip picking assembly to the picking station where a wafer tray is located, for the plurality of picking heads to pick up the corresponding chips one by one, and then laterally move the chip picking assembly to a handover station where the chip bonding assembly is located, for the plurality of bonding heads of the chip bonding assembly to simultaneously obtain the corresponding chips from the first suction surfaces of corresponding picking heads.

3. The bonding device according to claim 2, further comprising:

the wafer tray, carrying a plurality of chips thereon; and

a wafer tray lateral moving module, used to horizontally move the wafer tray, when one of the picking heads of the chip picking assembly completing a pickup of a corresponding chip, and a next picking head is rotated and switched on, to

horizontally move a next chip to be picked up to the picking station, to align it with a next picking head.

4. The bonding device according to claim 2, further comprising:

a camera, used to capture images of the chip picking assembly and the chip bonding assembly, after the chip picking assembly arriving at the handover station; and

a controller, configured to: analyze the images to determine a translation amount difference and a rotation angle difference between the chip picking assembly and the chip bonding assembly; and control the picking head lateral moving module to laterally move according to the translation amount difference, and control the first rotating motor to rotate according to the rotation angle difference, to align each of the plurality of picking heads of the chip picking assembly with a corresponding bonding head of the chip bonding assembly.

5. The bonding device according to claim 4, wherein the first body and/or the second body is further provided with a levelling module, and the controller is further configured to:

analyze the images to determine a parallelism between the chip picking assembly and the chip bonding assembly; and

control the levelling module to tilt according to the parallelism, to make the first suction surface of each of the plurality of picking heads of the chip picking assembly parallel to the second suction surface of the corresponding bonding head of the chip bonding assembly.

6. The bonding device according to claim 2, wherein the chip bonding assembly further comprises:

a bonding head lifting module, used to lift and lower the chip bonding assembly in the second direction, after the chip picking assembly arriving at the handover station, for the plurality of bonding heads to simultaneously obtain the corresponding chips from the first suction surfaces of the corresponding picking heads, and to lift

and lower the chip bonding assembly in a third direction where a wafer chuck is located, after obtaining the corresponding chips, to bond obtained chips one by one or synchronously to corresponding target positions on a wafer held by the wafer chuck.

7. The bonding device according to claim 6, wherein the chip bonding assembly further comprises:

a flipping module, used to flip the chip bonding assembly after obtaining the chips, for the bonding head lifting module to lift and lower the chip bonding assembly in the first direction, and to bond the obtained chips one by one or synchronously to the corresponding target positions on the wafer.

8. The bonding device according to claim 6, wherein the chip bonding assembly further comprises:

a second rotating motor, connected to the second body, for rotating and switching the plurality of bonding heads one by one to a preset bonding station, after obtaining the chips, to bond the chips to the corresponding target positions on the wafer one by one.

9. The bonding device according to claim 8, further comprising:

the wafer chuck, holding a wafer to be bonded thereon; and

a wafer chuck lateral moving module, used to laterally move the wafer chuck, when one of the plurality of bonding heads of the chip bonding assembly completing bonding of a corresponding chip, and a next bonding head is rotated and switched on, to move a next target position to be bonded to the bonding station, to align it with the next bonding head.

10. The bonding device according to claim 6, wherein the chip bonding assembly further comprises a plurality of lateral moving units and a plurality of rotating units, and each of the plurality of bonding heads is respectively provided with one of the lateral moving units and one of the rotating units, which adjust lateral moving amount and rotation amount of the bonding head, according to the target

positions on the wafer, to synchronously bond a plurality of chips held by the chip bonding assembly to the target positions on the wafer.

11. The bonding device according to claim 8, wherein the first rotating motor and/or the second rotating motor adopt a gas slip ring device, comprising:

a stator, comprising a cavity extending along the first direction, a plurality of gas outlets connected to the cavity, a plurality of annular ventilation grooves respectively connected to each gas outlet, and sealing rings located between every two annular ventilation grooves; and

a rotor, extending along the first direction, and installed inside the cavity through a plurality of bearings, to rotate around the first direction when driven by the stator, wherein an outer wall of the rotor contacts an inner side of each of the plurality of sealing ring, to cooperate with an inner wall of the cavity and the sealing rings to isolate the plurality of annular ventilation grooves, and a plurality of gas paths are provided in the rotor, whose first ends are respectively connected to each of the plurality of annular ventilation grooves, to obtain a negative pressure provided by a corresponding gas outlet, and whose second ends are respectively connected to a corresponding picking head or a corresponding bonding head through a corresponding gas inlet, to transmit the negative pressure and hold the chip.

12. The bonding device according to claim 1, wherein the first body of the chip picking assembly is provided with six picking heads, and each of the picking heads is distributed around a periphery of the first body at an angle of 60 degrees,

the second body of the chip bonding assembly is provided with six bonding heads, and each of the bonding heads is distributed around a periphery of the second body at an angle of 60 degrees, to simultaneously obtain six chips held by the six picking heads of the chip picking assembly.

13. A bonding method, comprising following steps:

horizontally moving a chip picking assembly of a bonding device according to any one of claims 1 to 12 to a preset picking station;

rotating and switching a plurality of picking heads of the chip picking assembly one by one, to pick up corresponding chips from a wafer tray one by one, through a first rotating motor of the chip picking assembly;

horizontally moving the chip picking assembly to a preset handover station;

simultaneously obtaining the corresponding chips from first suction surfaces of the plurality of picking heads, by a plurality of bonding heads of a chip bonding assembly of the bonding device; and

bonding each of obtained chips one by one or synchronously to corresponding target positions on a wafer held by a wafer chuck, by the plurality of bonding heads.

14. A computer-readable storage medium, storing a computer instruction thereon, wherein when the computer instruction is executed by a processor, the bonding method according to claim 13 is implemented.