

【DESCRIPTION】

【Invention Title】

**CHUCK PLATE, CHUCK STRUCTURE HAVING CHUCK PLATE, AND
BONDING DEVICE HAVING CHUCK STRUCTURE**

5 **【Technical Field】**

The present disclosure relates to a chuck plate, a chuck structure having the chuck plate, and a bonding device having the chuck structure, and more particularly to a chuck plate for supporting a wafer, a chuck structure having the chuck plate, and a bonding device having the chuck structure.

10 **【Background Art】**

Recently, it has been required to miniaturize an electronic device including the electronic components like an electric package. Thus, a technology for stacking a plurality of electronic components has been developed to manufacture a stacked chip package.

15 The stacked chip package corresponds to a semiconductor package in which chips are stacked on a package substrate to achieve a high integration. The stacked chip package is manufactured through a chip level process or a wafer level process.

In order to manufacture a stacked chip package by the chip level process or the wafer level process, a bonding process may be performed for bonding a chip and
20 a chip, a wafer and a wafer, or a chip and a wafer to each other by applying heat and pressure to them. It may be required to utilize a bonding device for performing the bonding process. The bonding device includes a chuck structure configured to support the wafer and a bonding head configured to stack the chip on the wafer and heat-press the chip against the wafer in a state where the wafer is supported by the
25 chuck structure.

The chuck structure includes a heating plate having a heating element and a chuck plate being configured to transferr heat generated from the heating plate to the wafer.

5 When the chuck plate is made of an aluminum nitride material having a relatively high thermal conductivity, the wafer may be quickly and easily heated. However, since the thermal conductivity of the chuck plate is high, a soldering material between the wafer and the chip clumps while the wafer is constantly pre-heated for performing the bonding process. Therefore, a bonding failure may occur between the wafer and the chip.

10 Further, the chuck structure includes vacuum holes which provide path for adsorbing the wafer using a vacuum force. Since the vacuum holes are formed radially based on the center of the chuck structure, the distance between the vacuum holes located at the outermost and arranged along an edge portion are relatively wide. Therefore, the vacuum adsorption force which is generated at the edge portion of the
15 chuck structure is relatively low, so that the wafer may not be in close contact with the chuck structure.

【Disclosure】

【Technical Problem】

The present disclosure provides a chuck plate having a relatively low thermal
20 conductivity, and a relatively short distance measured between vacuum holes positioned along the outermost circumferential portion.

The present invention provides a chuck structure having the chuck plate.

The present invention provides a bonding device having the chuck structure.

【Technical Solution】

25 In accordance with an example embodiment, a chuck plate for supporting a

wafer, being positioned on a heating plate configured to generate heat and transferring heat to wafer is provided. The chuck plate includes a plurality of vacuum holes penetrating therethrough to adsorb the wafer using a vacuum force and a vacuum groove pattern formed on a lower surface thereof and being configured to
5 adsorb the heating plate by a vacuum force, the vacuum groove pattern defining a space with an upper surface of the heating plate.

In an example embodiment, the chuck plate may include aluminum oxide and titanium such that the chuck plate has a thermal conductivity lower than that including aluminum nitride.

10 Here, titanium may have 10 to 20 weight % with respect to 100 weight % of aluminum oxide.

Further, the chuck may have a thermal conductivity in a range of 5 to 20 W/m·k.

In an example embodiment, a distance measured between the vacuum holes
15 arranged along an outermost circumferential portion of the chuck plate and adjacent to each other is shorter than the gap between the vacuum holes located inside the outermost circumferential portion and adjacent to each other.

In accordance with an example embodiment, a chuck structure includes a heating plate having a heating element that generates a heat by an external power
20 source, and the heating plate further including a first vacuum line and a second vacuum line extending to an upper surface thereof for providing a vacuum force, respectively, and a chuck plate disposed on the heating plate, the chuck plate being configured to support a wafer and to transfer heat generated in the heating plate to the wafer, the chuck plate including a third vacuum line communicating with the first
25 vacuum line to adsorb the wafer using a vacuum force and a vacuum groove pattern

formed on a lower surface thereof, the vacuum groove communicating with the first vacuum line to adsorb the heating plate by a vacuum force, and defining a space with an upper surface of the heating plate.

5 In an example embodiment, the third vacuum line may include a vacuum groove pattern formed on the lower surface of the chuck plate and communicating to the first vacuum line, the vacuum groove defining a space together with the lower surface of the chuck plate and the upper surface of the heating plate, and a plurality of vacuum holes penetrating through the chuck plate to extend from the lower surface to the upper surface of the chuck plate.

10 In an example embodiment, the first vacuum line may include a vacuum groove communicated to the third vacuum line, the vacuum groove pattern being formed on the upper surface of the heating plate to define a space together with a lower surface of the chuck plate and the upper surface of the heating plate, and a plurality of vacuum holes penetrating through the heating plate to extend from the
15 lower surface to the upper surface of the heating plate.

In an example embodiment, the chuck structure may further include an alignment pin disposed on one of the upper surfaces of the heating plate and the lower surface of the chuck plate, and a receiving groove formed on the other of the upper surfaces of the heating plate and the lower surface of the chuck plate for
20 receiving the alignment pin.

In an example embodiment, the chuck structure may further include a guide ring which hangs on a groove formed along an edge portion of the upper surface of the heating plate to guide a periphery of the heating plate and a clamp being fixed to the guide ring while covering an edge portion of the upper surface of the chuck plate
25 to make the chuck plate in contact with the heating plate for fixing the chuck plate to

the heating plate.

In an example embodiment, the clamp may hang on a groove formed along a peripheral portion of the chuck plate such that an upper surface of the clamp is coplanar with the upper face of the chuck plate.

5 In an example embodiment, each of the guide ring and the clamp may include a material having a thermal conductivity lower than that of the chuck plate to suppress the heat from being dissipated through sides of the heating plate and the chuck plate.

 In accordance with an example embodiment, a bonding device includes a
10 chuck structure including a heating plate having a heating element that generates a heat by an external power source, and the heating plate further including a first vacuum line and a second vacuum line extending to an upper surface thereof for providing a vacuum force, respectively, and a chuck plate disposed on the heating plate, the chuck plate being configured to support a wafer and to transfer heat
15 generated in the heating plate to the wafer, the chuck plate including a third vacuum line communicating with the first vacuum line to adsorb the wafer using a vacuum force and a vacuum groove pattern formed on a lower surface thereof, the vacuum groove communicating with the first vacuum line to adsorb the heating plate by a vacuum force, and defining a space with an upper surface of the heating plate, and a
20 bonding head positioned over the chuck structure, the bonding head being configured to fix and heat the chip and to bond the chip to the wafer.

 In an example embodiment, the bonding head may includes a base block, a heating block disposed on the base block, the heating block including a heating element embedded therein and generating heat using a power provided by a power
25 applied from the outside to heat the chip, a fourth vacuum line and a fifth vacuum

line penetrating therethrough to provide the vacuum force, and an adsorption plate fixed to the heating block by the vacuum force the adsorption plate having a vacuum hole connected to the fifth vacuum line to fix the chip with the vacuum force.

【Advantageous Effects】

- 5 According to example embodiments, the chuck plate may be made of a material having aluminum oxide and titanium. The chuck plate may have a thermal conductivity lower than that of aluminum nitride. Therefore, even if the wafer is pre-heated during the bonding process for bonding the chip to the wafer and the chip, a phenomenon that the pads clumps between the wafer and the chip may be suppressed.
- 10 Therefore, a bonding failure may be prevented between the wafer and the chip.

 In the chuck plate, a distance measured between the vacuum holes arranged along the outermost circumferential portion and adjacent to each other is relatively narrower than a distance measured between the vacuum holes arranged along the inside from the outermost circumferential portion and adjacent to each other.

- 15 Therefore, even at the edge portion of the chuck structure, the wafer can be completely adhered to the chuck structure.

 The chuck plate can be in close contact with the heating plate by the vacuum force. Therefore, the chuck plate can be fixed to the heating plate without a separate fastening member.

- 20 In addition, the heating plate and the chuck plate can be separated and replaced by releasing only the vacuum force. Therefore, it is possible to quickly perform a maintenance process for the chuck structure.

 The chuck structure transfers heat generated from the heating plate to the wafer through the chuck plate. The heating plate may always heat the wafer to be

25 kept at a constant temperature Therefore, the chip can be effectively bonded to the

wafer.

The bonding apparatus according to the present invention can stably bond the chip to the wafer using the chuck structure.

【Description of Drawings】

5 FIG. 1 is a cross-sectional view illustrating a chuck structure in accordance with an example embodiment of the present invention.

FIG. 2 is a plan view of the chuck structure in FIG. 1.

FIG. 3 is a plan view of the chuck plate in FIG. 1.

FIG. 4 is a bottom view of the chuck plate in FIG. 1.

10 FIG. 5 is an enlarged cross-sectional view of the region “A” in FIG. 1.

FIG. 6 is a cross-sectional view illustrating a bonding device in accordance with an example embodiment of the present invention.

FIG. 7 is a cross-sectional view illustrating the bonding head in FIG. 6.

15 FIG. 8 is a plan view of the opening of the heating block included in the bonding head in FIG. 7.

FIG. 9 is a cross-sectional view illustrating opening of a heating block in accordance with an example embodiment of the present invention.

FIG. 10 is a plan view of the openings of the heating block in FIG. 9.

20 FIG. 11 is a cross-sectional view illustrating opening of a heating block in accordance with an example embodiment of the present invention.

【Best Mode for Invention】

A chuck plate according to the present invention supports a wafer. The chuck plate is positioned on a heating plate configured to generate heat and transfers heat to wafer. The chuck plate includes a plurality of vacuum holes penetrating
25 therethrough to adsorb the wafer using a vacuum force, and a vacuum groove pattern

formed on a lower surface thereof and being configured to adsorb the heating plate by a vacuum force, the vacuum groove pattern defining a space with an upper surface of the heating plate.

【Mode for Invention】

5 Hereinafter, specific embodiments on a chuck plate, a chuck structure including the chuck plate and a bonding device including the chuck structure will be described in detail with reference to the accompanying drawings. The present invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are
10 provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present invention to those skilled in the art. Like reference numerals refer to like elements throughout. In the figures, the dimensions of layers and regions are exaggerated for clarity of illustration.

 The terms such as first, second, etc., can be used in describing various
15 elements, but the above elements by the above terms should not be limited. The above terms are one element from the other used only to distinguish. For example, in the present invention without departing from the scope of the first component to the second component may be named similarly, the second component to the first component also can be named.

20 The terminology used herein is for the purpose of describing particular example embodiments only and is not intended to be limiting of the present inventive concept.

 As used herein, the singular forms "a," "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be
25 further understood that the terms "comprises" and/or "comprising," when used in this

specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

5 Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this inventive concept belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant
10 art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

FIG. 1 is a cross-sectional view illustrating a chuck structure in accordance with an example embodiment of the present invention. FIG. 2 is a plan view of the chuck structure in FIG. 1. FIG. 3 is a plan view of the chuck plate in FIG. 1. FIG. 4
15 is a bottom view of the chuck plate in FIG. 1. FIG. 5 is an enlarged cross-sectional view of the region “A” in FIG. 1.

Referring to FIGS. 1 to 5, a chuck structure 100 in accordance with an example embodiment supports a wafer 10. The wafer includes a circuit pattern formed thereon.

20 The chuck structure 100 includes a heating plate 110, a chuck plate 120, a guide ring 130, a clamp 140, a power cable 150 and a temperature sensor 160.

The heating plate 110 may have a substantially disc shape. The heating plate 110 may incorporate a heating element 112 capable of generating heat by a power source applied from outside.

25 The heating element 112 may be provided inside the heating plate 110 of

having a predetermined pattern. Examples of the heating element 112 include an electrode layer, a heating coil, and the like.

The heating plate 110 has a first vacuum line 114 extending to an upper surface thereof and a second vacuum line 115. Each of the first vacuum line 114 and
5 the second vacuum line 115 may extend from a lower surface or side of the heating plate 110 to the upper surface. The first vacuum line 114 and the second vacuum line 115 may not be connected to each other. The first vacuum line 114 is connected to a vacuum pump (not shown) and provides a path through which a vacuum force is transferred for adsorbing the wafer 10. The second vacuum line 115 is connected to
10 a vacuum pump (not shown) and provides a path through which a vacuum force is transferred for adsorbing the chuck plate 120.

The heating plate 110 may include at least one alignment pin 116 formed on the upper surface thereof. The alignment pin 116 is configured to align the heating plate 110 and the chuck plate 120 to each other. Further, a plurality of alignment
15 pins 116 may be provided. The alignment pins 116 may be disposed on an edge portion of the upper surface of the heating plate 110.

Further, the heating plate 110 has a groove 118 formed along an edge portion of the upper surface thereof. The groove 118 may be used to secure the guide ring 130.

20 The chuck plate 120 may have a substantially disc shape. The chuck plate 120 may be positioned on the heating plate 110. Further, the chuck plate 120 supports the wafer 10 on an upper surface thereof.

The chuck plate 120 has a third vacuum line 122 communicating to the first vacuum line 114 for adsorbing the wafer 10 using a vacuum force.

25 The third vacuum line 122 has a vacuum groove pattern 122a and a plurality

of vacuum holes 122b.

The vacuum groove pattern 122a is formed on a lower surface of the chuck plate 120. For example, the vacuum groove pattern 122a includes a plurality of first grooves concentrically formed with respect to the center of the lower surface of the chuck plate 120, and a plurality of second grooves radially extending from the center of the lower surface of the chuck plate. The first and the second grooves are communicated with one another. Alternatively, the vacuum groove pattern 122a may have a circular groove shape as well. The vacuum groove pattern 112a does not extend in a horizontal direction to a lower edge of the chuck plate 120 to prevent leakage of the vacuum force.

The chuck plate 120 is positioned on the heating plate 110 such that the vacuum groove pattern 122a is confined by the upper surface of the heating plate 110 and the lower surface of the chuck plate 120 to form a space. Further, the vacuum groove pattern 122a is communicated with the first vacuum line 114.

The vacuum holes 122b penetrates throughs the chuck plate 120 to extend from the lower surface of the chuck plate 120 where the vacuum groove pattern 122a is formed to the upper surface of the chuck plate 120. The vacuum holes 122b are arranged to be spaced apart from each other. For example, the vacuum holes 122b may be arranged concentrically or radially.

The third vacuum line 122 is communicated with the first vacuum line 114 to be capable of adsorbing the wafer 10 by the vacuum force provided through the first vacuum line 114.

On the other hand, a distance measured between the vacuum holes 122b arranged along an outermost circumferential portion of the chuck plate 120 and adjacent to each other may be relatively shorter than that of the vacuum holes 122b

concentrically arranged inside from the outermost circumferential portion. Specifically, a first angle measured between the vacuum holes 122b arranged along the outermost circumferential portion and adjacent to each other with respect to the center of chuck plate 120 may be half of a second angle measured between the vacuum holes 122b concentrically arranged inside the outermost circumferential portion. For example, the first angle measured between the vacuum holes 122b arranged at the outermost circumferential portion may be about 15 degrees, and the second angle between the vacuum holes 122b arranged inside the outermost circumferential portion may be about 30 degrees.

Therefore, the vacuum force through the vacuum hole 112b can be stably provided even at an edge portion of the chuck plate 120. As a result, even at the edge portion of the chuck plate 120, the wafer 10 may be in close contact with the chuck plate 120, and it is possible to prevent the wafer 10 from being lifted from the chuck plate 120.

In addition, the chuck plate 120 has a vacuum groove 123 provided on the lower surface thereof. The vacuum groove 123 may communicate with the second vacuum line 115 to adsorb the heating plate 110 to chuck plate 120 with a vacuum force.

The vacuum groove 123 is formed on the lower surface of the chuck plate 120. For example, the vacuum groove 123 includes a plurality of third grooves concentrically formed with respect to the center of the lower surface of the chuck plate 120, and a plurality of fourth grooves radially extending from the center of the lower surface of the chuck plate. The third and the fourth grooves are communicated with one another. Alternatively, the vacuum groove 123 may have a circular groove shape as well. The vacuum groove 123 does not extend to the edge of the lower

surface of the chuck plate 120 to prevent leakage of the vacuum force. In addition, as shown in FIG. 4, the vacuum groove 123 may not be connected to the third vacuum line 122.

5 The chuck plate 120 is placed on the heating plate 110 such that the vacuum groove 123 define a space together with the upper surface of the heating plate 110. Further, the vacuum groove 123 is connected to the second vacuum line 115.

The vacuum groove 123 is connected to the second vacuum line 115, and the chuck plate 120 may be fixed in close contact with the heating plate 110 by the vacuum force provided through the second vacuum line 115. Therefore, the chuck
10 plate 120 may flatly support the wafer 10 by refraining the chuck plate 120 from warping or bending thereof.

The heating plate 110 and the chuck plate 120 may maintain a close state by the vacuum force provided through the second vacuum line 115 and the vacuum groove 123. Therefore, a fastening member for fastening the heating plate 110 and
15 the chuck plate 120 to each other may be omitted.

In addition, the heating plate 110 and the chuck plate 120 may be separated and replaced by releasing the vacuum force provided through the first vacuum line 114 and the second vacuum line 115. Therefore, it is possible to quickly substitute the chuck structure 100 from old one to new one.

20 A gap may exist between the heating plate 110 and the chuck plate 120 in case that the upper surface of the heating plate 110 and the lower surface of the chuck plate 120, each has a flatness over about 10 μm . Accordingly, the vacuum force may leak through a fine gap which exists between the heating plate 110 and the chuck plate 120.

25 Each of the upper surface of the heating plate 110 and the lower surface of

the chuck plate 120 may have a flatness of about 10 μm or less, preferably 7 μm or less. In this case, the heating plate 110 and the chuck plate 120 may be in tight contact with each other, and the vacuum force can be prevented from leaking through the gap which exists between the heating plate 110 and the chuck plate 120.

5 The chuck plate 120 may transfer a heat generated in the heating plate 110 into the wafer 10. The wafer 10 may be maintained at a temperature of about 140 to 150 ° C so that bonding process between the chip (not shown) and the wafer 10 is easily performed.

 The heating plate 110 may include a ceramic material. For example, the
10 heating plate 110 is made of aluminum nitride (AlN). Since the aluminum nitride has a relatively high thermal conductivity, the heat generated from the heating element 112 can be uniformly transferred through the heating plate 110. In addition, the heating plate 110 may keep the temperature distribution of the chuck plate 120 uniform to uniformly heat the wafer 10.

15 The chuck plate 120 may further include titanium added to a ceramic material. For example, the chuck plate 120 further include titanium mixed to aluminum oxide (Al_2O_3). When titanium is added to aluminum oxide (Al_2O_3), a thermal conductivity of the chuck plate 120 may be further lowered owing to an increased porosity thereof.

 When chuck plate 120 includes titanium element in a weight percentage of
20 less than about 10 with respect to 100 weight of aluminum oxide, the porosity of the chuck plate 120 is relatively small and the thermal conductivity of the chuck plate 120 is similar to that of pure aluminum oxide.

 When chuck plate 120 includes titanium element in a weight percentage of
more than about 20 with respect to 100 weight of aluminum oxide, the porosity of
25 the chuck plate 120 is excessively increased to lower the thermal conductivity

significantly. In addition, a sintering density of the chuck plate 120 is decreased to deteriorate a strength of the chuck plate 120 such that the vacuum force may be lost through pores of the chuck plate 120.

When chuck plate 120 includes titanium element in a weight percentage of
5 about 10 to 20 with respect to 100 weight of aluminum oxide, the porosity of the chuck plate 120 is increased such that the vacuum force may be uniformly kept, and the thermal conductivity of the chuck plate 120 may be further reduced. In addition, the sintered density of the chuck plate 120 is about 3.8 g/cm^3 , slightly lower than 3.9 g/cm^3 , the sintered density of pure aluminum oxide, such that the strength of the
10 chuck plate 120 is not lowered.

Therefore, the chuck plate 120 includes about 10 to 20 weight percentage of titanium with respect to 100 weight of aluminum oxide

When the thermal conductivity of the chuck plate 120 is less than about $5 \text{ W/m} \cdot \text{k}$, the thermal conductivity of the chuck plate 120 is relatively low. Therefore,
15 the heat generated in the heating plate 110 may not be sufficiently transferred to the wafer 10. Further, it may take a long time to transfer the heat generated in the heating plate 110 to the wafer 10. However, even if a bonding head thermally heat-presses the chip against the wafer 10 at a high temperature of about 450°C for bonding the chip to the wafer 10, the chuck plate 120 can be prevented from being
20 heated rapidly.

When the thermal conductivity of the chuck plate 120 exceeds about $20 \text{ W/m} \cdot \text{k}$, the thermal conductivity of the chuck plate 120 is relatively high. Therefore, the heat generated in the heating plate 110 is excessively transferred to the wafer 10, and the soldering material between the wafer 10 and the chip may be crushed. In
25 addition, when the bonding head heat-presses the chip against the wafer 10 at a high

temperature of about 450 ° C, the chuck plate 120 is heated relatively rapidly, so that the soldering material between the wafer 10 and the chip is significantly crushed.

When the thermal conductivity of the chuck plate 120 is about 5 to 20 W/m · k, the chuck plate 120 may transfer heat generated from the thermal plate 110 to the wafer 10 appropriately to the extent that the soldering material is not crushed. In addition, even if the bonding head heat-presses the chip against the wafer 10 at a high temperature of about 450 ° C while performing the bonding process, the chuck plate 120 may be prevented from being rapidly heated. Therefore, the soldering material between the wafer 10 and the chip may be hindered from being crushed.

Therefore, even if the wafer 10 is constantly preheated for bonding the chip against the wafer 10, a phenomenon in which the soldering material between the wafer 10 and the chip is crushed may be prevented from occurring. Therefore, a bonding defect between the wafer 10 and the chip can be suppressed.

Meanwhile, the chuck plate 120 may include aluminum oxide (Al_2O_3) having a thermal conductivity lower than that of aluminum nitride.

The chuck plate 120 has a receiving groove 124 for receiving the alignment pin 116. The receiving groove 124 may be formed at a position corresponding to the alignment pin 116 of the heating plate 110. For example, the receiving groove 124 may also be disposed at an edge portion of the chuck plate 120.

The alignment pins 116 of the heating plate 110 can be inserted into the receiving grooves 124 of the chuck plate 120 when the chuck plate 120 is placed on the upper surface of the heating plate 110. Accordingly, the heating plate 110 and the chuck plate 120 can be accurately aligned to each other.

Although the aligning pin 116 is provided in the heating plate 110 and the receiving groove 124 is formed in the chuck plate 120, the receiving groove 124 may

be formed in the heating plate 110, alignment pins may be provided with in the chuck plate 120 in accordance with another example embodiment.

The chuck plate 120 also has a groove 126 formed along an upper edge portion thereof. The groove 126 may be used to provide a space for positioning a clamp 140.

The guide ring 130 is fixed on the groove 118 formed along the upper edge portion of the heating plate 110 to guide a periphery of the heating plate 110.

Specifically, the guide ring 130 has a first locking projection 132, and the guide ring 130 is mounted on the heating plate 110 as the first locking projection 132 hangs on the groove 118.

Meanwhile, the upper surface of the guide ring 130 may be coplanar with the upper surface of the heating plate 110. Thus, the chuck plate 120 can be easily placed on the upper surface of the heating plate 110 in a state that the guide ring 130 is mounted on the heating plate 110.

In case that the upper surface of the guide ring 130 is positioned higher than that of the heating plate 110, the guide ring 130 can be used as an alignment reference, when the chuck plate 120 is placed on the upper surface of the heating plate 110.

The clamp 140 is fixed to the guide ring 130 while covering an edge portion of the upper surface of the chuck plate 120. The clamp 140 can be fixed to the guide ring 130 by a fastening screw 142.

In one example, a plurality of clamps 140 may be provided to partially cover the edge portion of the chuck plate 120. In another example, the clamp 140 may have a generally ring shape and may entirely cover the edge portion of the chuck plate 120.

The clamp 140 may be fixed to the guide ring 130 while covering the edge portion of the upper surface of the chuck plate 120 so that the clamp 140 can press the chuck plate 120 downward. Therefore, the clamp 140 can bring the chuck plate 120 into closer contact with the heating plate 110. As a result, it is possible to further prevent the vacuum force from leaking through the gap between the heating plate 110 and the chuck plate 120.

The clamp 140 may include a second locking projection 144. The second locking projection 144 can be placed in the groove 126 of the chuck plate 120. Therefore, the upper surface of the clamp 140 may be coplanar with the upper surface of the chuck plate 120. Therefore, the wafer 10 can be stably transported to the upper surface of the chuck plate 120 without disturbance of the clamp 140.

The guide ring 130 and the clamp 140 may include a material having a thermal conductivity lower than that of the heating plate 110. For example, the guide ring 130 and the clamp 140 are made of aluminum oxide (Al_2O_3). Further, the guide ring 130 and the clamp 140 may include a material identical to that of the chuck plate 120.

Since the thermal conductivity of each the guide ring 130 and the clamp 140 is lower than that of the heating plate 110, the guide ring 130 and the clamp 140 can prevent heat from being lost through the side surface of the heating plate 110.

The power cable 150 extends into inside of the heating plate 110 and is connected to the heating element 112. The power cable 150 may provide the heating element 112 with power for generating heat.

The temperature sensor 160 extends from outside of the heating plate 110 to inside thereof. The temperature sensor 160 measures a temperature of the heating element 112 for controlling the temperature of the heating element 112 to adjust a

temperature of the heating plate 110.

An example of the temperature sensor 160 is a thermocouple.

The chuck structure 110 transfers heat generated in the heating plate 110 to the wafer 10 through the chuck plate 120. The wafer 10 may be maintained at a uniform temperature due to the heat which the chuck plate 120 transfers. Therefore,
5 the chip may be effectively bonded to the wafer 10.

FIG. 6 is a cross-sectional view illustrating a bonding device in accordance with an example embodiment of the present invention.

10 Referring to FIG. 6, a bonding device 300 according to an example embodiment includes a chuck structure 100 and a bonding head 200.

The chuck structure 100 includes a heating plate 110, a chuck plate 120, a guide ring 130, a clamp 140, a power cable 150 and a temperature sensor 160. A detailed description thereof will be omitted because it is substantially the same as the
15 description with reference to Figs. 1 to 5.

The chuck structure 100 transfers heat generated by the heating plate 110 to a wafer 10 through the chuck plate 120 to heat the wafer 10 supported by the chuck structure 110 at a uniform temperature. Therefore, the bonding head 200 may swiftly bond the chip 20 to the wafer 10.

20 FIG. 7 is a cross-sectional view illustrating the bonding head in FIG. 6. FIG. 8 is a plan view of the openings of the heating block included in the bonding head in FIG. 7.

Referring to FIGS. 7 and 8, the bonding head 200 is provided to transfer the chip 20 toward the wafer 10 supported by the chuck structure 100 and to bond the
25 chip 20 to the wafer 10. The bonding head 200 includes a base block 210, a heating

block 220 and an adsorption plate 230. Although not shown, the bonding head 200 may be provided to enable horizontal movement, vertical movement, rotation, and reversion for the transfer of the chip 20.

In addition, the bonding head 200 may be disposed such that the adsorption
5 plate 230 faces the wafer 10 downward for bonding the chip 20 to the wafer 10.

The base block 210 includes a first block 212 and a second block 214.

The first block 212 is made of a metal material. Examples of the metal material may be a stainless-steel material.

The second block 214 is provided on the first block 212. The second block
10 214 may be made of a ceramic material having a lower thermal conductivity than the heating block 220. An example of the ceramic material is aluminum oxide (Al_2O_3). Since the thermal conductivity of the second block 214 is lower than that of the heating block 220, the second block 214 can suppress the heat generated in the heating block 220 from being transferred to the first block 212.

15 Further, the base block 210 may further include a third block 216.

The third block 216 is interposed between the first block 212 and the second block 214. The third block 216 may serve as a buffer block to suppress heat from transferring from the second block 214 to the first block 212. The third block 216 may be made of a ceramic material, and examples of the ceramic material include
20 aluminum oxide.

The heating block 220 is provided on the base block 210, specifically on the second block 214. The heating block 220 contains a heating element 222. The heating element 222 may be made of a metal material. The heating element 222 generates heat by a power applied from outside to heat the chip 20 which the
25 adsorption plate 230 adsorbs. Bumps of the chip 20 may be melted using the heat.

For example, in order to melt the bumps of the chip 20, the heating element 222 may instantaneously heat the chip 20 to about 450 ° C.

The heating block 220 may include a ceramic material having excellent insulating properties and thermal conductivity. For example, the heating block 220
5 consists of aluminum nitride (AlN). In this case, the thermal conductivity may be about 170 W/m·k or more.

Since the thermal conductivity of the heating block 220 is relatively excellent, the chip 20 can be quickly heated by using heat generated from the heating element 222.

10 The heating block 220 has a fourth vacuum line 224 and a fifth vacuum line 226 extending to the top surface to provide paths along which vacuum force flows.

The fourth vacuum line 224 and the fifth vacuum line 226 are not connected to each other. The fourth vacuum line 224 and the fifth vacuum line 226 provide paths along which the vacuum force flows, respectively. For example, the fourth
15 vacuum line 224 penetrates through an edge portion of the heating block 220, and the fifth vacuum line 226 penetrates through a central portion of the heating block 221. In particular, the fourth vacuum line 224 may be connected to a groove 225 formed in a predetermined length on an upper surface of the heating block 220. Therefore, the vacuum force provided through the fourth vacuum line 224 can be applied in a
20 wider range.

For example, as illustrated in FIGS. 7 and 8, the fourth vacuum line 224 and the fifth vacuum line 226 may be provided to extend to the base block 210. As another example, although not illustrated, the fourth vacuum line 224 and the fifth vacuum line 226 may not be extended to the base block 210 and may be provided
25 only in the heating block 220.

The adsorption plate 230 is provided on the heating block 220. The adsorption plate 230 is fixed to the upper surface of the heating block 220 by the vacuum force which flows through the fourth vacuum line 224. The adsorption plate 230 may be exchanged by releasing the vacuum force and providing a vacuum force
5 which flows along the fourth vacuum line 224. Accordingly, when the adsorption plate 230 is damaged or a size of the chip 20 is changed, it is possible to easily respond to damage to the adsorption plate 230 or to a change of the size of the chip 20 by selectively substituting only the adsorption plate 230.

In addition, the adsorption plate 230 includes a vacuum hole 232. The
10 vacuum hole 232 is connected to the fifth vacuum line 226 of the heating block 220. Therefore, the chip 20 placed on the adsorption plate 230 can be fixed with the vacuum force provided through the fifth vacuum line 226.

While the chip 20 is fixed with the adsorption plate 230, the bonding head 200 may be moved to stack the chip 20 on the wafer 10. Further, the adsorption plate
15 230 may press the chip 20 toward the wafer 10.

The bonding head 200 further includes a cooling line 240.

The cooling line 240 provides path which coolant flows to cool the heating block 220 to cool the chip 20. As the chip 20 is cooled, the bumps of the chip 20 are cooled to form pads. The chip 20 may be cooled to about 100 ° C using the cooling
20 line 240.

Specifically, the cooling line 240 includes a first cooling line 242 and a second cooling line 244.

The first cooling line 242 extends from the base block 210 to an upper surface of the second block 214. The coolant is provided to the heating block 220
25 through the first cooling line 242. Examples of the coolant include air and gas, etc.

The coolant is in direct contact with the heating block 220 to cool the heating block 220.

The second cooling line 244 is provided inside the first block 212 included in the base block 210 to cool the first block 212. As the first block 212 is cooled, the
5 third block 216, the second block 214, and the heating block 220 may be cooled through heat conduction. Therefore, the second cooling line 244 may further cool the heating block 220.

The heating block 220 is primarily cooled using the first cooling line 242, and is auxiliaryly cooled using the second cooling line 244. Therefore, the heating block
10 220 can be rapidly cooled using the cooling line 240. As the heating block 220 is cooled, the bumps of the chip 20 fixed to the adsorption plate 230 can be rapidly cooled to form the pads.

Meanwhile, the heating block 220 has an opening 227 partially exposing the cooling line 240, specifically, the first cooling line 242. For example, the opening
15 227 may be a hole which penetrates through the heating block 220 to a side portion thereof.

The opening 227 may selectively expose some of the plurality of first cooling lines 242 extending to the upper surface of the base block 210, or partially expose each of the first cooling lines 242.

20 In particular, when the opening 227 selectively exposes some of the plurality of first cooling lines 242, and the openings 227 are disposed on one side of the heating block 220, temperature distributions of the heating block 220 and the adsorption plate 230 becomes non-uniform. Therefore, the pads formed on the chip 20 may have deteriorated quality.

25 Therefore, when the opening 227 selectively exposes some of the plurality of

first cooling lines 242, the openings 227 may be arranged to be symmetrical with respect to a center of the heating block 220. Thus, the pads formed on the chip 20 may have improved quality by maintaining the temperature distribution between the heating block 220 and the adsorption plate 230 relatively uniform.

5 Some of the coolant provided through the first cooling line 242 is provided to the heating block 220 to cool the heating block 220, and the other of the coolant is provided to the adsorbing plate 230 through the opening 227 to directly cool the adsorption plate 230. That is, the coolant provided through the first cooling line 242 cools the heating block 220 to make the adsorption plate 230 cool while directly
10 cooling the adsorption plate 230. Further, the coolant provided through the first cooling line 242 may be discharged to the outside through the opening 227 after cooling the heating block 220 and the adsorption plate 230.

 Therefore, the bumps of the chip 20 fixed to the adsorption plate 230 can be cooled more quickly. As a result, the bumps of the chip 20 melted by the heating
15 block 220 can be rapidly cooled to form each of good-shaped pads.

 Meanwhile, since the opening 227 has a hole shape penetrating through the the heating block 220 and extending to a side portion, the heating block 220 is machined to form the opening 227 easily.

 In addition, since the opening 227 has a hole shape penetrating through the
20 heating block 220 and extending to a side portion, the adsorption plate 230 may be relatively much exposed by the opening 227. Accordingly, as the coolant provided through the first cooling line 242 is discharged to the outside through the opening 227, a contact area of coolant in contact with the adsorption plate 230 may increase. Therefore, the effect that the adsorption plate 230 is directly cooled by the coolant
25 provided through the first cooling line 242 may be improved.

When the opening 227 exposes less than about 30% of the area of the first cooling line 242, the effect that the coolant which flows through the first cooling line 242 directly cools the adsorption plate 230 may become relatively poor. Therefore, it is difficult for the coolant which flows through the first cooling line 242 to rapidly
5 cool the bumps of the chip 20.

When the opening 227 exposes more than about 70% of the area of the first cooling line 242, the effect that the coolant which flows through the first cooling line 242 directly cools the adsorption plate 230 may become relatively good. However, the effect that the coolant provided through the first cooling line 242 cools the
10 heating block 220 may become relatively poor. Even if the coolant provided through the first cooling line 242 directly cools the adsorption plate 230, the heat generated from the heating block 220 can be transferred to the adsorption plate 230, thereby to be difficult to rapidly cool the bumps of the chip 20. In addition, since the area of the heating block 220 decreases as the area of the opening 227 increases, the amount
15 of heat generated by the heating block 220 may decrease. Therefore, it is difficult to rapidly melt the bumps of the chip 20.

Therefore, the opening 227 may expose about 30% to 70% of the area of the first cooling line 242.

20 FIG. 9 is a cross-sectional view illustrating opening of a heating block in accordance with an example embodiment of the present invention. FIG. 10 is a plan view of the openings of the heating block in FIG. 9.

Referring to FIGS. 9 and 10, the heating block 220 has an opening 228 partially exposing the first cooling line 242. For example, the opening 228 may be a
25 through hole extending vertically. The coolant provided through the first cooling

line 242 circulates along the first cooling line 242. Alternatively, the coolant provided through the first cooling line 242 may flow between the heating block 220 and the adsorption plate 230 or the heating block 220 and the second block 214 of the base block 210 to be discharged to the outside.

5 The opening 228 may expose about 30% to 70% of the area of the first cooling line 242.

FIG. 11 is a cross-sectional view illustrating opening of a heating block in accordance with an example embodiment of the present invention.

10 Referring to FIG. 11, the heating block 220 has an opening 228 partially exposing the first cooling line 242. For example, the opening 228 may be a through-hole penetrating vertically.

Further, a connection groove 229 connected to the opening 228 may be further formed. The connection groove 229 may be provided on at least one of the
15 upper surfaces of the heating block 220 and the lower surface of the adsorption plate 230.

For example, the connection groove 229 may be formed on the upper surface of the heating block 220 as shown in FIG. 5. As another example, the connection groove 229 may be formed on the lower surface of the adsorption plate 230. As
20 further another example, the connecting groove 229 may be formed on the upper surface of the heating block 220 and the lower surface of the adsorption plate 230, respectively.

The coolant provided through the first cooling line 242 may be discharged to the outside through the connecting groove 229.

25 On the other hand, although not shown, the connecting groove 229 may be

provided to be connected to the opening 228 on at least one of the lower surfaces of the heating block 220 and the upper surface of the base block 210.

The bonding head 200 may further include a temperature sensor. The temperature sensor is provided inside the heating block 220 and detects a
5 temperature of the heating block 220. Depending on the detection result of the temperature sensor, it is possible to control on/off power supplied to the heating element 222 and adjust an injection, a temperature, and circulation of coolant which flows in the cooling line 240,

Meanwhile, the temperature sensor may be provided on the adsorption plate
10 230.

The bonding head 200 transfers the chip 20 and heats the chip 20 with the heating block 220 in a state in close contact with the wafer 10 to melt the bumps of the chip 20 and then cools the bumps using the cooling line 240 to form pads. The chip 20 is bonded to the wafer 10 by cooling the chip 20. Since the bonding head
15 200 rapidly heats and cools the chip 20, each of the pads may be formed with excellent quality and a good shape between the wafer 10 and the chip 20.

Since the bonding head 200 can rapidly heat and cool the chip 20, an efficiency of the bonding process for bonding the chip 20 to the wafer 10 may be improved.

20 According to example embodiments of the bonding device 300, the chuck structure 100 fixes the wafer 10 and heats the wafer to a constant temperature, and the bonding head 200 heats the chip 20 to melt the bumps of the chip and then cools the chip 20. Thus, the chip 20 is bonded to the wafer 10. Therefore, each of the pads interposed between the chip 10 and the wafer 10 may be formed with excellent
25 quality and good shape. In addition, since the bonding head 200 may heat and cool

the chip 10 quickly, the bonding device 300 for bonding the chip 20 to the wafer 10 may have improved efficiency of the bonding process.

The bonding head 200 may stack a plurality of chips on the wafer 10 by transferring the chip 10. Therefore, since the bonding device 300 may not be required
5 to install a chip transfer unit additionally, the bonding device 300 can have a simplified structure.

【Industrial Applicability】

As described above, the chuck plate according to the present invention, the chuck structure having the chuck plate, and the bonding device having the chuck
10 structure can close the heating plate and the chuck plate with a vacuum force for adsorbing the wafer. Since it is possible to repair or exchange the heating plate and the chuck plate by releasing only the vacuum force, so that maintenance or replacement of the chuck structure can be performed quickly.

The foregoing is illustrative of the present teachings and is not to be
15 construed as limiting thereof. Although a few exemplary embodiments have been described, those skilled in the art will readily appreciate from the foregoing that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of the present disclosure of invention. Accordingly, all such modifications are intended to be included within the
20 scope of the present teachings. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also functionally equivalent structures.

【CLAIMS】

1. A chuck plate for supporting a wafer, being positioned on a heating plate configured to generate heat and transferring heat to wafer, the chuck plate comprising:

5 a plurality of vacuum holes penetrating therethrough to adsorb the wafer using a vacuum force; and

a vacuum groove pattern formed on a lower surface thereof and being configured to adsorb the heating plate by a vacuum force, the vacuum groove pattern defining a space with an upper surface of the heating plate.

10

2. The chuck plate of claim 1, comprising aluminum oxide and titanium such that the chuck plate has a thermal conductivity lower than that including aluminum nitride.

15 3. The chuck plate of claim 2, wherein titanium has 10 to 20 weight % with respect to 100 weight % of aluminum oxide.

4. The chuck plate of claim 2, having a thermal conductivity in a range of 5 to 20 W/m·k.

20

5. The chuck plate of claim 1, wherein a distance measured between the vacuum holes arranged along an outermost circumferential portion of the chuck plate and adjacent to each other is shorter than the gap measured between the vacuum holes located inside the outermost circumferential portion and adjacent to each other.

25

6. A chuck structure comprising:

a heating plate having a heating element that generates a heat by an external power source, and the heating plate further including a first vacuum line and a second vacuum line extending to an upper surface thereof for providing a vacuum force, respectively; and

a chuck plate disposed on the heating plate, the chuck plate being configured to support a wafer and to transfer heat generated in the heating plate to the wafer, the chuck plate including a third vacuum line communicating with the first vacuum line to adsorb the wafer using a vacuum force and a vacuum groove pattern formed on a lower surface thereof, the vacuum groove communicating with the first vacuum line to adsorb the heating plate by a vacuum force, and defining a space with an upper surface of the heating plate.

7. The chuck structure of claim 6, wherein the third vacuum line comprises:

a vacuum groove pattern formed on the lower surface of the chuck plate and communicating to the first vacuum line, the vacuum groove defining a space together with the lower surface of the chuck plate and the upper surface of the heating plate; and

a plurality of vacuum holes penetrating through the chuck plate to extend from the lower surface to the upper surface of the chuck plate.

8. The chuck structure of claim 6, wherein the first vacuum line comprises:

a vacuum groove communicated to the third vacuum line, the vacuum groove pattern being formed on the upper surface of the heating plate to define a space together with a lower surface of the chuck plate and the upper surface of the heating

plate; and

a plurality of vacuum holes penetrating through the heating plate to extend from the lower surface to the upper surface of the heating plate.

5 9. The chuck structure of claim 6, further comprising:

an alignment pin disposed on one of the upper surfaces of the heating plate and the lower surface of the chuck plate; and

a receiving groove formed on the other of the upper surfaces of the heating plate and the lower surface of the chuck plate for receiving the alignment pin.

10

10. The chuck structure of claim 6, further comprising:

a guide ring which hangs on a groove formed along an edge portion of the upper surface of the heating plate to guide a periphery of the heating plate; and

15 a clamp being fixed to the guide ring while covering an edge portion of the upper surface of the chuck plate to make the chuck plate in contact with the heating plate for fixing the chuck plate to the heating plate.

11. The chuck structure of claim 10, wherein the clamp hangs on a groove formed along a peripheral portion of the chuck plate such that an upper surface of the
20 clamp is coplanar with the upper face of the chuck plate.

12. The chuck structure of claim 10, wherein each of the guide ring and the clamp includes a material having a thermal conductivity lower than that of the chuck plate to suppress the heat from being dissipated through sides of the heating plate and
25 the chuck plate.

13. A bonding device comprising:

a chuck structure including a heating plate having a heating element that generates a heat by an external power source, and the heating plate further including
5 a first vacuum line and a second vacuum line extending to an upper surface thereof for providing a vacuum force, respectively, and a chuck plate disposed on the heating plate, the chuck plate being configured to support a wafer and to transfer heat generated in the heating plate to the wafer, the chuck plate including a third vacuum
10 line communicating with the first vacuum line to adsorb the wafer using a vacuum force and a vacuum groove pattern formed on a lower surface thereof, the vacuum groove communicating with the first vacuum line to adsorb the heating plate by a vacuum force, and defining a space with an upper surface of the heating plate; and
a bonding head positioned over the chuck structure, the bonding head being configured to fix and heat the chip and to bond the chip to the wafer.

15

14. The bonding device of claim 13, wherein the bonding head comprises:

a base block;

a heating block disposed on the base block, the heating block including a heating element embedded therein and generating heat using a power provided by a
20 power applied from the outside to heat the chip, a fourth vacuum line and a fifth vacuum line penetrating therethrough to provide the vacuum force; and

an adsorption plate fixed to the heating block by the vacuum force the adsorption plate having a vacuum hole connected to the fifth vacuum line to fix the chip with the vacuum force.

25