

orthogonal to the horizontal direction by a Z-axis drive mechanism (not shown). The bonding head 14 is provided with an attachment (not shown in Fig. 1) that adsorbs and holds the semiconductor chip 110 and a heater (not shown in Fig. 1) that heats the attachment. Further, the attachment is selected according to the type of the semiconductor chip 110. The specific configuration of the bonding head 14 will be described later.

[0020]

Further, the bonding head 14 is also provided with a first camera 26. The first camera 26 is attached to the bonding head 14 in a posture in which an optical axis thereof extends downward and captures an image of the substrate 100 or the like loaded on the stage 16. The controller 18 calculates a relative positional relationship between the bonding head 14 and the substrate 100 on the basis of the image captured by the first camera 26 or the like and positions the bonding head 14 on the basis of the calculation result. The stage 16 vacuum-adsorbs and supports the substrate 100 conveyed by a conveying mechanism (not shown). A heater (not shown) is built in the stage 16, and the stage 16 can heat the loaded substrate 100.

[0021]

The controller 18 controls driving of each part of the manufacturing device 10 and includes, for example, a processor that executes various operations and a memory that stores various programs and data. The controller 18 drives the pickup unit 12 and the bonding head 14 to bond a plurality of semiconductor chips 110 onto the substrate 100. At the time of this bonding, the controller 18 controls temperatures of the heaters provided in the bonding head 14 and the stage 16 to appropriately heat the semiconductor chip 110, which will be described later.

[0022]

Next, the semiconductor chip 110 handled by the manufacturing device 10 will be briefly described. Fig. 2 is a schematic view of the semiconductor chip 110 and the substrate 100. A metal protrusion called a bump 116 is formed on the bottom surface of the semiconductor chip 110. The bump 116 is made of a conductive metal and melts at a

predetermined melting temperature. A substrate electrode 102 is formed at a position of the substrate 100 corresponding to the bump 116. When a semiconductor device is manufactured, the bump 116 is melted and joined to the substrate electrode 102.

[0023]

5 A non-conductive film (hereinafter referred to as an “NCF”) 118 is attached to the bottom surface of the semiconductor chip 110 to cover the bump 116. The NCF 118 functions as an adhesive for adhering the semiconductor chip 110 to the substrate 100 or another semiconductor chip 110. The NCF 118 is made of a non-conductive thermosetting resin such as a polyimide resin, an epoxy resin, an acrylic resin, a phenoxy resin, or a polyether sulfone
10 resin. A thickness of the NCF 118 is larger than an average height of the bumps 116, and the bumps 116 are almost completely covered by the NCF 118. The NCF 118 is a solid film at room temperature, but when it exceeds a predetermined softening start temperature, it gradually and reversibly softens to exhibit fluidity, and when it exceeds a predetermined curing start temperature, it begins to irreversibly cure. The softening start temperature is lower than the
15 curing start temperature of the NCF 118 and the melting temperature of the bump 116.

[0024]

When the semiconductor chip 110 is bonded to the substrate 100, a temporary pressure bonding step and a main pressure bonding step are executed. In the temporary pressure bonding step, the semiconductor chip 110 loaded on the substrate 100 is pressurized while being
20 heated at a temporary pressure bonding temperature. The temporary pressure bonding temperature is higher than the softening start temperature of the NCF 118 and lower than the melting temperature of the bump 116 and the curing start temperature of the NCF 118. When the semiconductor chip 110 is heated to the temporary pressure bonding temperature, the NCF 118 softens and has fluidity. As a result, the NCF 118 flows into a gap between the
25 semiconductor chip 110 and the substrate 100, and the gap can be reliably filled.

[0025]

More specifically, the controller 18 inputs a value higher than the area target temperature $Ta1^*$ of the first heating area 32a located inside to the second driver 38b as the area target temperature $Ta2^*$ of the second heating area 32b located outside.

[0042]

5 Fig. 6 is a graph showing a change over time in the area detection temperatures $Ta1$ and $Ta2$ when the semiconductor chip 110 is bonded. In Fig. 6, a horizontal axis represents time and a vertical axis represents an area detection temperature. Further, in Fig. 6, a thick line indicates the first area detection temperature $Ta1$, and a thin line indicates the second area detection temperature $Ta2$. As shown in Fig. 6, in the present example, the drive of the two
10 heat generating resistors 36a and 36b is controlled such that the first area detection temperature $Ta1$ becomes the first area target temperature $Ta1^*$ and the second area detection temperature $Ta2$ becomes the second area target temperature $Ta2^*$ which is higher than the first area target temperature $Ta1^*$.

[0043]

15 It may be difficult to perform delicate temperature control with only energization control of the heat generating resistors 36a and 36b. In that case, the refrigerant may be supplied to the cooling passages 42a and 42b in parallel with the energization of the heat generating resistors 36a and 36b. For example, in a case in which a temperature rise rate of the second area detection temperature $Ta2$ is higher than the target, the controller 18 may increase an
20 opening degree of the valve 46b provided in the second cooling passage 42b and may temporarily increase the refrigerant flow rate flowing through the second cooling passage 42b. By performing the energization control of the heat generating resistors 36a and 36b and the control of the refrigerant flow rate in parallel in this way, it is possible to heat the heating areas 32a and 32b more accurately.

25 [0044]

In any case, since the second heating area 32b located outside has a higher temperature than the first heating area 32a located inside, it is possible to also raise the temperature in the

vicinity of the end portion of the semiconductor chip 110 having a high heat absorption rate as in the vicinity of the center. As a result, according to the present example, the temperature distribution of the semiconductor chip 110 can be made uniform.

[0045]

5 The controller 18 stores the first area target temperature $Ta1^*$ and the second area target temperature $Ta2^*$ in advance in the memory to uniformly heat the semiconductor chip 110. The area target temperatures $Ta1^*$ and $Ta2^*$ are prepared for each step. That is, the controller 18 stores the area target temperatures $Ta1^*$ and $Ta2^*$ to be used in the temporary pressure bonding step and the area target temperatures $Ta1^*$ and $Ta2^*$ to be used in the main pressure
10 bonding step.

[0046]

 Further, since the distribution of the heat absorption rate of the semiconductor chip 110 varies depending on the type of the semiconductor chip 110, the area target temperatures $Ta1^*$ and $Ta2^*$ at which the semiconductor chip 110 can be uniformly heated vary depending on the
15 type of the semiconductor chip 110. Therefore, the area target temperatures $Ta1^*$ and $Ta2^*$ are also prepared for each type of the semiconductor chip 110 to be handled.

[0047]

 To acquire such area target temperatures $Ta1^*$ and $Ta2^*$, the controller 18 may execute a target acquisition process for acquiring the area target temperature prior to manufacturing the
20 semiconductor device. Fig. 7 is a flowchart showing a flow of the target acquisition process.

[0048]

 In the target acquisition process, first, an inside temperature sensor and an outside temperature sensor are attached to a sample chip (S10). Here, the sample chip is a semiconductor chip 110 of the same type as the semiconductor chip 110 used in the manufacture
25 of an actual semiconductor device. The inside temperature sensor is attached in the vicinity of a center of the sample chip, and the outside temperature sensor is attached in the vicinity of an