

Z_{RTA}) of the pad electrode 321, which is a first bonding point, and three-dimensional coordinates (X_{RTB} , Y_{RTB} , Z_{RTB}) of the lead electrode 322, which is a second bonding point, are calculated. The wire bonder 100 takes the three-dimensional coordinates (X_{RTA} , Y_{RTA} , Z_{RTA}) of the pad electrode 321 and the three-dimensional coordinates (X_{RTB} , Y_{RTB} , Z_{RTB}) of the lead electrode 322 as approach targets to drive the head part 110 and the bonding tool 120. For position adjustment in the plane direction, the stage 220 may be driven, or the head part 110 and the stage 220 may be cooperatively driven together.

[0018] FIG. 2 is a system configuration view of the wire bonder 100. A control system of the wire bonder 100 is mainly composed of an arithmetic processing part 170, a storage part 180, an input/output device 190, a first imaging unit 130, a second imaging unit 140, a head drive motor 150, and a tool drive motor 160. The arithmetic processing part 170 is a processor (central processing unit (CPU)) that controls the wire bonder 100 and executes programs. The processor may also be a configuration that cooperates with an arithmetic processing chip such as an application specific integrated circuit (ASIC) or a graphics processing unit (GPU). The arithmetic processing part 170 reads out a bonding program stored in the storage part 180 and executes various processes related to bonding.

[0019] The storage part 180 is a nonvolatile storage medium and is configured by, for example, a hard disk drive (HDD). In addition to programs for executing control and processing of the wire bonder 100, the storage part 180 may further store various parameter values, functions, lookup tables, etc. used for performing control and arithmetic operations. The storage part 180 particularly stores a conversion table 181. The conversion table 181 is a lookup table that converts coordinate values of a first picture and a second picture into three-dimensional coordinates of the bonding point upon input of the coordinate values (details will be described later). Herein, the first picture is a picture of the bonding point captured in a first image outputted by the first imaging unit 130, and the second ~~index~~ picture is a picture of the bonding point

captured in a second image outputted by the second imaging unit 140.

[0020] The input/output device 190 includes, for example, a keyboard, a mouse, and a display monitor, and is a device that receives menu operations of a user and prompts information to the user. For example, the arithmetic processing part 170 may display the first image and the second image side by side on the display monitor, which is one of the input/output devices 190.

[0021] The first imaging unit 130 receives an imaging request signal from the arithmetic processing part 170 and executes imaging, and transmits the first image outputted by the first imaging element 132 as an image signal to the arithmetic processing part 170. Similarly, the second imaging unit 140 receives an imaging request signal from the arithmetic processing part 170 and executes imaging, and transmits the second image outputted by the second imaging element 142 as an image signal to the arithmetic processing part 170.

[0022] The head drive motor 150 receives a drive signal from the arithmetic processing part 170 and moves the head part 110 in the XY directions. The tool drive motor 160 receives a drive signal from the arithmetic processing part 170 and moves the bonding tool 120 in the Z direction.

[0023] The arithmetic processing part 170 also serves as a functional arithmetic part that executes various arithmetic operations according to the processes instructed by the bonding position control program. The arithmetic processing part 170 may function as an image acquisition part 171, a calculation part 172, a drive control part 173, and an evaluation part 174. The image acquisition part 171 transmits imaging request signals to the first imaging unit 130 and the second imaging unit 140, and acquires an image signal of the first image and an image signal of the second image.

[0024] The calculation part 172 calculates three-dimensional coordinates of the bonding point based on a first picture which is a picture of the bonding point captured in the first image, and a second picture which is a picture of the bonding point captured in the second image. Specifically, the three-dimensional coordinates are obtained using the conversion table 181. The drive control part 173 generates a drive signal for driving the head drive motor 150 and a drive signal for driving

CLAIMS:

[Claim 1] (~~Currently amended~~) A bonding apparatus comprising:

a head part provided in a drivable manner with respect to a substrate mounted on a stage;

a bonding tool which is provided at the head part and supplies a bonding wire to bonding

5 points of the substrate;

a first imaging unit and a second imaging unit provided at the head part, each of the first imaging unit and the second imaging unit comprising an optical system and an imaging element arranged to satisfy a Scheimpflug condition such that a plane parallel to a stage surface of the stage becomes a focal plane, the first imaging unit and the second imaging unit being capable of focusing

10 a tip of the bonding wire extended from the bonding tool;

a calculation part which calculates three-dimensional coordinates of a target point to which the bonding wire is to be supplied next among the bonding points, based on a first picture which is a picture of the target point captured in a first image outputted by the first imaging unit, and a second picture which is a picture of the target point captured in a second image outputted by the

15 second imaging unit; and

a drive control part which causes the bonding tool to approach the target point based on the three-dimensional coordinates of the target point calculated by the calculation part.

[Claim 2] The bonding apparatus according to claim 1, wherein the calculation part calculates three-dimensional coordinates of a subsequent point to which the bonding wire is to be supplied subsequently among the bonding points, based on a third picture which is a picture of the subsequent point captured in the first image, and a fourth picture which is a picture of the subsequent point captured in the second image, and

20 after supply of the bonding wire to the target point, the drive control part moves the bonding tool based on the three-dimensional coordinates of the subsequent point calculated by the calculation part.

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[Claim 3] The bonding apparatus according to claim 1 or 2, comprising an evaluation part which evaluates adequacy of a bonding process based on an image outputted by at least one of the first imaging unit and the second imaging unit, wherein

the drive control part changes drive control of the bonding tool based on an evaluation
5 result of the evaluation part.

[Claim 4] ~~(Currently amended)~~ The bonding apparatus according to claim 3, wherein the evaluation part evaluates a tip picture which is a picture of the tip of the bonding wire before contacting the bonding point.

[Claim 5] The bonding apparatus according to claim 3 or 4, wherein the evaluation part
10 evaluates a fixing picture which is a picture of the bonding point after fixing the bonding wire.

[Claim 6] ~~(Currently amended)~~ A bonding method using a bonding apparatus comprising:
a head part provided in a drivable manner with respect to a substrate mounted on a stage;
a bonding tool which is provided at the head part and supplies a bonding wire to bonding
points of the substrate; and

15 a first imaging unit and a second imaging unit provided at the head part, each of the first imaging unit and the second imaging unit comprising an optical system and an imaging element arranged to satisfy a Scheimpflug condition such that a plane parallel to a stage surface of the stage becomes a focal plane, the first imaging unit and the second imaging unit being capable of focusing a tip of the bonding wire extended from the bonding tool,

20 the bonding method comprising:

an imaging step of causing each of the first imaging unit and the second imaging unit to image a target point to which the bonding wire is to be supplied next among the bonding points of the substrate fixed on the stage;

a calculation step of calculating three-dimensional coordinates of the target point based on
25 a first picture which is a picture of the target point captured in a first image outputted by the first

imaging unit, and a second picture which is a picture of the target point captured in a second image outputted by the second imaging unit; and

a driving step of causing the bonding tool which supplies the bonding wire to approach the target point based on the three-dimensional coordinates of the target point.

5 [Claim 7] (~~Currently amended~~) A bonding program which controls a bonding apparatus comprising:

a head part provided in a drivable manner with respect to a substrate mounted on a stage;

a bonding tool which is provided at the head part and supplies a bonding wire to bonding points of the substrate; and

10 a first imaging unit and a second imaging unit provided at the head part, each of the first imaging unit and the second imaging unit comprising an optical system and an imaging element arranged to satisfy a Scheimpflug condition such that a plane parallel to a stage surface of the stage becomes a focal plane, the first imaging unit and the second imaging unit being capable of focusing a tip of the bonding wire extended from the bonding tool,

15 the bonding program causing a computer to execute:

an imaging step of causing each of the first imaging unit and the second imaging unit to image a target point to which the bonding wire is to be supplied next among the bonding points of the substrate fixed on the stage;

a calculation step of calculating three-dimensional coordinates of the target point based on

20 a first picture which is a picture of the target point captured in a first image outputted by the first imaging unit, and a second picture which is a picture of the target point captured in a second image outputted by the second imaging unit; and

a driving step of causing the bonding tool which supplies the bonding wire to approach the target point based on the three-dimensional coordinates of the target point.

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