

CLAIMS

1. A flip-chip bonding device, comprising:

a supply unit, configured to separate a flip-chip from a carrier and to supply the flip-chip, the supply unit comprising a flipping device for picking up and flipping over the flip-chip separated from the carrier so that the flip-chip is turned downside up;

a transfer unit configured to receive and retain the flip-chip from the flipping device, the transfer unit being able to retain multiple flip-chips;

a position adjustment unit, configured to adjust positions of the flip-chips on the transfer unit;

a bonding unit, configured to bond the flip-chips on the transfer unit onto a substrate;

a transportation unit, configured to transport the transfer unit in a horizontal X-direction; and

a control unit, configured to control movements of the respective units,

wherein the supply unit, the position adjustment unit and the bonding unit are disposed sequentially along the horizontal X-direction.

2. The flip-chip bonding device of claim 1, wherein the supply unit further comprises a jack device configured to raise a flip-chip from the carrier so that the flip-chip is separated from the carrier and is located higher than the carrier, and

wherein the flipping device is able to pick up the raised flip-chip.

3. The flip-chip bonding device of claim 2, wherein the jack device comprises a plunger mechanism, a first absorption mechanism and a first moving mechanism connected sequentially along a vertical Z-direction,

the plunger mechanism configured to raise the flip-chip,

the first absorption mechanism configured to absorb, in a direction which is opposite to a direction in which the flip-chip is raised, the carrier on which the

flip-chips are placed,

the first moving mechanism configured to move the plunger mechanism and the first absorption mechanism.

4. The flip-chip bonding device of claim 1, 2 or 3, wherein the flipping device comprises a motor, a second moving mechanism, a connecting member for connecting the motor to the second moving mechanism, and a second absorption mechanism that is connected to the second moving mechanism in a vertical Z-direction,

the second absorption mechanism configured to absorb the flip-chip,

the second moving mechanism configured to move the second absorption mechanism in the vertical Z-direction,

the motor configured to flip over the second absorption mechanism and the second moving mechanism.

5. The flip-chip bonding device of claim 1, wherein the position adjustment unit comprises a first measurement system and a position adjustment device,

the first measurement system configured to measure the positions of the flip-chips on the transfer unit,

the position adjustment device configured to adjust the positions of the flip-chips on the transfer unit.

6. The flip-chip bonding device of claim 5, wherein the position adjustment device comprises a support mechanism, a third moving mechanism and a third absorption mechanism,

the support mechanism configured to support the third moving mechanism,

the third moving mechanism configured to move the third absorption mechanism to a location corresponding to one of the flip-chips on the transfer unit,

the third absorption mechanism configured to absorb the flip-chip from the transfer unit.

7. The flip-chip bonding device of claim 5, wherein the bonding unit comprises a second measurement system and a third measurement system,

the second measurement system configured to measure a position of the transfer unit,

the third measurement system configured to measure a position of the substrate.

8. The flip-chip bonding device of claim 7, wherein each of the first measurement system, the second measurement system and the third measurement system is configured to obtain a position of an object through measuring a position of a mark provided on the object and comprises a first measure branch and a second measure branch, the first measure branch comprising a first illumination unit and a first detector unit, the first illumination unit configured to serve as an illumination light source for the mark, the first detector unit configured to accordingly image the mark and measure the position of the mark, the second measure branch comprising a second illumination unit and a second detector unit, the second illumination unit being structurally identical to the first illumination unit, the second detector unit being structurally identical to the first detector unit, the mark comprising an X-direction feature and a Y-direction feature that are oriented orthogonal to each other, the first measure branch configured to measure a position of the X-direction feature, the second measure branch configured to measure a position of the Y-direction feature.

9. The flip-chip bonding device of claim 8, wherein a projection of an optical axis of the first measure branch on the mark is parallel to the Y-direction feature, and wherein a projection of an optical axis of the second measure branch on the mark is parallel to the X-direction feature.

10. The flip-chip bonding device of claim 8, wherein the first illumination unit comprises a broadband light source, an illumination lens group and a front imaging lens group, wherein the first detector unit comprises a rear imaging lens group and an

image sensor, wherein broadband light emanated from the broadband light source successively passes through the illumination lens group and the front imaging lens group and is then obliquely incident on the X-direction or Y-direction feature, wherein light reflected from the X-direction or Y-direction feature propagates through the rear imaging lens group, thereby imaging the mark on the image sensor, and wherein after processing an image output from the image sensor, positional information of the mark is obtain.

11. The flip-chip bonding device of any one of claims 1 to 10, wherein the supply unit further comprises a first motion stage, and the bonding unit further comprises a second motion stage,

the first motion stage configured to carry the carrier that is configured to supply the flip-chips to the transfer unit;

the second motion stage configured to carry the substrate that is to be bonded to the flip-chips on the transfer unit.

12. The flip-chip bonding device of claim 11, further comprising a carrier holder unit, a substrate holder unit, a first transfer device and a second transfer device,

the carrier holder unit configured to support multiple carriers for supplying flip-chips to be bonded, the substrate holder unit configured to support multiple substrates that have completed chip bonding,

the first transfer device configured to pick up one of the carriers from the carrier holder unit and transfer the carrier onto the first motion stage, the second transfer unit configured to pick up the substrate from the second motion stage and transfer the substrate to the substrate holder unit.

13. A flip-chip bonding method, comprising the steps of:

S01: separating, by a supply unit, a flip-chip from a carrier and picking up and flipping over the flip-chip by a flipping device;

S02: receiving, by a transfer unit, the flip-chip from the flipping device;

S03: repeating steps S01 and S02 until the transfer unit has received and retained all the flip-chips;

S04: transporting, by a transportation unit, the transfer unit into a measurement field of a position adjustment unit, wherein the position adjustment unit measures and adjusts positions of the flip-chips on the transfer unit; and

S05: transporting, by the transportation unit, the transfer unit to a measurement field of a bonding unit, wherein the bonding unit bonds all the flip-chips on the transfer unit onto a substrate.

14. The flip-chip bonding method of claim 13, wherein in step S01: a first transfer device picks up the carrier from a carrier holder unit and transfers the carrier onto a first motion stage; the first motion stage moves the flip-chips on the carrier to a predefined pick-up position; a jack device raises the flip-chips from the carrier; and the flipping device picks up the flip-chips raised by the jack device and flips over the flip-chips.

15. The flip-chip bonding method of claim 13, wherein in step S04, a first measurement system in the position adjustment unit measures the positions of the flip-chips on the transfer unit, and a position adjustment device in the position adjustment unit adjusts the positions of the flip-chips on the transfer unit based on a measurement result of the first measurement system.

16. The flip-chip bonding method of claim 13, wherein in step S04: a first measurement system in the position adjustment unit carries out a measurement of the positions of the flip-chips on the transfer unit, and the transportation unit transports, based on the measurement, the transfer unit into a fine measurement field of the position adjustment unit, wherein the first measurement system carries out another measurement of the positions of the flip-chips on the transfer unit and a position

adjustment device adjusts the positions of the flip-chips on the transfer unit based on the another measurement.

17. The flip-chip bonding method of claim 13, wherein in step S05: a second measurement system in the bonding unit measures a position of the transfer unit; a third measurement system measures a position of the substrate; based on the measurements, the transportation unit transports the transfer unit to a bonding position of the bonding unit and a second motion stage carries the substrate to the bonding position of the bonding unit to complete bonding of the flip-chips.

18. The flip-chip bonding method of claim 13, further comprising, subsequent to step S05, separating the flip-chips from the transfer unit and transferring the transfer unit back to an initial position by the transportation unit.

19. The flip-chip bonding method of claim 18, further comprising, after completion of bonding for the whole substrate, picking up and transferring the substrate to a substrate holder unit by a second transfer unit.