method in accordance with the invention, wherein its bumps 1 are immersed in the fluxing agent, an image is recorded with the first camera 14, and after the expiration of a wetting period the flip chip 3 is removed from the cavity 18 and mounted on the substrate 11. The cavity 18 is situated during this phase on a fixed location above the first camera 14 and the field of vision of the first camera 14 is directed to the base of the cavity 18, so that its image shows the bottom side of the flip chip 3 with the bumps 1.

[0012] In a first embodiment, the fluxing agent container 19 is arranged in a stationary manner. In this case, the device 13 comprises a drive for a reciprocating movement of the plate 17. The plate 17 is moved to such an extent for filling the cavity 18 with fluxing agent that the cavity 18 is situated beneath the fluxing agent container 19 or on the opposite side of the fluxing agent container 19, and is then moved back again so that the cavity 18 is situated at the aforementioned location above the first camera 14.

[0013] In a second embodiment, the plate 17 is arranged in a stationary manner, wherein the cavity 18 is located above the first camera 14. In this case, the device 13 comprises a drive for the movement of the fluxing agent container 19 from the one side of the cavity 18 to the opposite side of the cavity 18. The fluxing agent container 19 slides on the plate 17 and fills the cavity 18 with fluxing agent.

[0014] The second camera 15 is fastened to the bonding head 10. The optical axis of the camera 15 extends parallel to the gripping axis of the bonding head 10. The second camera 15 is mechanically fastened to the bonding head 10 in such a way that the orientation of the pixel coordinate system assigned to the images of the second camera 15 is in a fixed geometric relationship to the gripping axis of the bonding head 10. The pixel coordinates of the substrate location, which are determined by means of at least one image of the substrate location or markings on the substrate recorded by the second camera 15, are converted by means of second geometry data into machine coordinates of the bonding head 10.

[0015] The second geometry data comprise a vector B with values (x, y), which designates the direction and distance of a reference point of the pixel coordinate system of the second camera 15 from a reference point of the machine coordinate system of the bonding head 10. The second geometry data further comprise an angle φ, which describes the twisting of these two coordinate systems.

[0016] The first and the second geometry data further comprise scaling factors, which enable the conversion of values in the pixel coordinate system of the respective camera into values in the machine coordinate system of the bonding head 10. The first and second geometry data are determined in a calibration phase which is carried out before the mounting phase. The calibration phase can be carried out at different points in time in order to increase the long-term stability of the apparatus and the method.

[0017] The described embodiments of the apparatus are capable of carrying out the method in accordance with the invention for mounting semiconductor chips as flip chips on the substrate. The

CLAIMS

1. Method for mounting semiconductor chips (2) provided with bumps (1) on substrate locations of a substrate (11), in which in a calibration phase first and second geometry data are determined, wherein the first geometry data serve to convert pixel coordinates of a first camera (14) into machine coordinates of a machine coordinate system of a bonding head (10) and the second geometry data serve to convert pixel coordinates of a second camera (15) into machine coordinates of the machine coordinate system of the bonding head (10), and in a mounting phase the following steps are carried out for each semiconductor chip (2):

either: with a wafer table (4) providing the semiconductor chip (2) at a predetermined location;

with a pickup head (6) of a flip apparatus (5) removing the provided semiconductor chip (2) and twisting the semiconductor chip (2) by 180° in order to provide the semiconductor chip (2) as a flip chip (3);

or: with a feeding device providing the semiconductor chip (2) as a flip chip (3);

with a transport head (8) receiving the flip chip (3) from the pickup head (6) or the feeding device;

filling a cavity (18), which is arranged in a plate (17) and formed with a transparent base, with fluxing agent, wherein the plate (17) is either arranged in a stationary manner or is moved after the filling of the cavity (18) so that the cavity (18) is situated in both cases above the first camera (14), which is arranged in a stationary manner;

depositing the flip chip (3) in the cavity (18), wherein the bumps (1) face the base of the cavity (18);

recording an image of the flip chip (3) with the first camera (14) and determining an actual position of the flip chip (3) with respect to the machine coordinate system of the bonding head (10) on the basis of the image and the first geometry data;

removing the flip chip (3) from the cavity (18) with the bonding head (10);

determining an actual position of the substrate location with respect to the machine coordinate system of the bonding head (10) by means of the second camera (15) which is fastened to the bonding head (10), either by:

moving the bonding head (10) to a position above the substrate location in which the substrate location is in the field of vision of the second camera (15),

recording at least one image with the second camera (15), and

calculating the actual position of the substrate location on the basis of the position of the substrate location in the at least one image and the second geometry data;

or by:

calculating the actual position of the substrate location by means of actual positions of at least two substrate markings, wherein the actual position of each of the at least two substrate markings is determined after the feeding of a new substrate (11) to the support (12) by:

moving the bonding head (10) to a position above the substrate in which the substrate marking is in the field of vision of the second camera (15),

recording an image with the second camera (15), and

determining the actual position of the substrate marking by means of the image and the second geometry data; and

calculating the position to be accessed by the bonding head (10) on the basis of the determined actual position of the flip chip (3) and the determined actual position of the substrate location; and

moving the bonding head (10) to the calculated position and placing the flip chip (3) on the substrate location, wherein

the transport head (8) and the bonding head (10) are at least partly simultaneously in motion.

2. Method according to claim 1, in which the first geometry data comprise a position of a first optical marking (22) and a first fixed vector, which designates a direction of the first optical marking (22) to and a distance from a reference point of the pixel coordinate system of the first camera (14), and in which the position of the first optical marking (22) is updated at least at one predetermined point in time by:

moving the bonding head (10) to a position in which the first optical marking (22) is in the field of vision of the second camera (15);

recording an image with the second camera (15);

determining the position of the first optical marking (22) on the basis of the image and the second geometry data; and

storing the determined position as new position of the first optical marking (22).

3. Method according to claim 2, in which the first geometry data comprise a position of at least one further optical marking (23) and a further fixed vector, which designates a direction of the further optical marking to and a distance from the reference point of the pixel coordinate system of the first camera (14), and in which the position of the further optical marking (23) is updated by:

moving the bonding head (10) to a position in which the further optical marking (23) is in the field of vision of the second camera (15);

recording an image with the second camera (15);

determining the position of the further optical marking (23) on the basis of the image and the second geometry data; and

storing the determined position as new position of the further optical marking (23).

4. Method according to claim 2 or 3, in which the optical marking(s) is/are covered by the plate (17) when the cavity (18) of the plate (17) is situated in the position above the first camera (14), the method further comprising moving the plate (17) to a position in which the optical marking(s) (22, 23) is/are exposed before the position(s) of the optical marking(s) (22, 23) is/are updated.