PROCESSING METHOD FOR WAFER

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a processing method for a WL-CSP wafer.

Description of the Related Art

A WL-CSP (Wafer-level Chip Size Package) wafer is a technology for sealing, after a re-wiring layer and electrodes (metal posts) are formed while the WL-CSP wafer is in a state of a wafer, a front surface side of the wafer with resin and dividing the wafer into packages by a cutting blade or the like. Since a size of the packages obtained by individualizing the wafer is equal to a size of semiconductor device chips, the technology is widely adopted from a point of view of downsizing and reduction in weight.

In a fabrication process of the WL-CSP wafer, a re-wiring layer is formed on a device face side of a device wafer on which a plurality of devices are formed and metal posts connected to electrodes in devices are formed through the re-wiring layer, and then the metal posts and the devices are sealed with resin.

Then, a sealing member is thinned such that the

metal posts are exposed to the front surface of the sealing member, and then external terminals called electrode bumps are formed at an end face of the metal posts. Thereafter, the WL-CSP wafer is cut by a cutting apparatus or the like to divide the WL-CSP wafer into individual CSPs.

In order to protect semiconductor devices from an impact, moisture or the like, it is important to seal the semiconductor devices with a sealing member. Normally, a sealing material formed by mixing filler composed of SiC into epoxy resin is used as a sealing member such that the coefficient of thermal expansion of the sealing member comes close to that of the semiconductor device chips and breakage of the packages upon heating caused by a difference in coefficient of thermal expansion is prevented.

A WL-CSP wafer is divided into individual CSPs generally using a cutting apparatus. In this case, since, in the WL-CSP wafer, a device utilized to detect a scheduled division line is covered with resin, a target pattern of the device cannot be detected from the front surface side.

Therefore, alignment of the scheduled division line and the cutting blade has been performed by indexing the

scheduled division line setting electrode bumps formed on the resin of the WL-CSP wafer as a target, or by printing a target for alignment on the upper face of the resin.

However, the electrode bumps or the target printed on the resin is not formed with high accuracy in comparison with devices, there is a problem that the target is low in accuracy as a target for alignment. Accordingly, in the case where a scheduled division line is indexed on the basis of electrode bumps or a printed target, there is the possibility that the cutting location may be displaced from the scheduled division line, resulting in cutting of a device portion. Therefore, for example, in Japanese Patent Laid-Open No. 2013-74021, a method is proposed according to which alignment is performed on the basis of a pattern of the device wafer exposed on an outer periphery of a wafer.

SUMMARY OF THE INVENTION

However, generally a device accuracy is low on an outer periphery of the wafer, and, if alignment is performed on the basis of a pattern exposed on the outer periphery of the wafer, then there is the possibility that the wafer may be divided at a position displaced from a scheduled division line, and besides, depending

upon a wafer, a pattern of the device wafer is not exposed on the outer periphery.

Therefore, it is an object of the present invention to provide a processing method for the wafer by which an alignment step can be performed through a sealing member that covers the front surface of the wafer and contains carbon black.

In accordance with an aspect of the present invention, there is provided a processing method for a wafer in which a front surface of the wafer on which a device is formed in each of chip regions partitioned by a plurality of scheduled division lines formed in a crossing relationship on the front surface of the wafer is sealed with a sealing member and a plurality of bumps are formed individually in the chip regions of the sealing member, the processing method including an alignment step of picking up an image of a front surface side of the wafer through the sealing member by visible light image pickup means from the front surface side of the wafer to detect alignment marks and detecting a scheduled division line to be laser processed based on the alignment marks, and a division step of irradiating, after the alignment step is carried out, a laser beam of a wavelength, which is absorbed by the sealing member and

the wafer, along the scheduled division line from the front surface side of the wafer to divide the wafer into individual device chips sealed at the front surface thereof with the sealing member by ablation processing. The alignment step is carried out while light is irradiated in an oblique direction upon a region, whose image is to be picked up by the visible light image pickup means, by oblique light means.

According to the processing method for the wafer of the present embodiment, since it is made possible to detect the alignment marks formed on the wafer through the sealing member by the visible light image pickup means while light is irradiated in an oblique direction by the oblique light means and carry out alignment on the basis of the alignment marks, it is possible to carry out the alignment step simply without removing the sealing member at an outer peripheral portion of the surface of the wafer as in the prior art.

Therefore, it is possible to irradiate the laser beam of a wavelength, which can be absorbed by the sealing member and the wafer, along a scheduled division line from the front surface side of the wafer to divide the wafer into individual device chips by ablation processing.

The above and other objects, features and advantages of the present invention and the manner of realizing them will become more apparent, and the invention itself will best be understood from a study of the following description and appended claim with reference to the attached drawings showing a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is an exploded perspective view of a WL-CSP wafer;

FIG. 1B is a perspective view of the WL-CSP wafer;

FIG. 2 is an enlarged sectional view of the WL-CSP wafer;

FIG. 3 is a perspective view depicting a manner in which the WL-CSP wafer is pasted to a dicing tape whose outer periphery portion is mounted on an annular frame;

FIG. 4 is a sectional view depicting an alignment step;

FIG. 5A is a sectional view depicting a division step; and

FIG. 5B is an enlarged sectional view depicting the division step.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the following, an embodiment of the present invention is described in detail with reference to the drawings. Referring to FIG. 1A, there is depicted an exploded perspective view of a WL-CSP wafer 27. FIG. 1B is a perspective view of the WL-CSP wafer 27. As depicted in FIG. 1A, devices 15 such as LSIs (Large Scale Integrations) are formed in regions partitioned by a plurality of scheduled division lines (streets) 13 formed in a grid pattern on a front surface 11a side of a device wafer 11.

The device wafer (hereinafter sometimes referred to merely as wafer in abbreviation) 11 is ground at a reverse face 11b thereof in advance so as to be thinned to a predetermined thickness (approximately 100 to 200 μm). Thereafter, as depicted in FIG. 2, a plurality of metal posts 21 electrically coupled to electrodes 17 in the devices 15 are formed and then the front surface 11a side of the wafer 11 is sealed with a sealing member 23 such that the metal posts 21 are embedded therein.

The sealing member 23 has a composition containing epoxy resin or epoxy resin + phenolic resin by 10.3%, silica filler by 8.53%, carbon black by 0.1% to 0.2% and some other components by 4.2% to 4.3% by mass percent. As

some other component, for example, metal hydroxide, antimony trioxide, silicon dioxide or the like is contained.

If the front surface 11a of the wafer 11 is covered and sealed with the sealing member 23 having such a composition as described above, then the sealing member 23 has a black color arising from carbon black contained by a very small amount in the sealing member 23, and thus normally it is difficult to see the front surface 11a of the wafer 11 through the sealing member 23. Here, the reason why carbon black is mixed into the sealing member 23 is that it is mainly intended to prevent electrostatic breakdown of a device 15 and a sealing material that does not contain carbon black is not available at present on the market.

As another embodiment, after a re-wiring layer is formed on the front surface 11a of the device wafer 11, metal posts 21 electrically coupled to the electrodes 17 in the devices 15 may be formed on the re-wiring layer.

Thereafter, the sealing member 23 is thinned using a surface cutting apparatus (surface planer) having a cutting tool formed from a single crystal diamond or a grinding apparatus called grinder. After the sealing member 23 is thinned, an end face of the metal post 21 is

exposed, for example, by plasma etching.

Then, metal bumps 25 of solder or the like are formed on the exposed end face of the metal post 21 by a well-known method to complete the WL-CSP wafer 27. In the WL-CSP wafer 27 of the present embodiment, the thickness of the sealing member 23 is approximately 100 μm.

When the WL-CSP wafer 27 is to be laser processed by a laser processing apparatus, preferably the WL-CSP wafer 27 is pasted to a dicing tape T as an adhesive tape whose outer periphery portion is pasted to an annular frame F as depicted in FIG. 3. Consequently, the WL-CSP wafer 27 is placed into a state in which it is supported on the annular frame F through the dicing tape T. However, when the WL-CSP wafer 27 is to be laser processed by the laser processing apparatus, a mode in which an adhesion tape is pasted to the reverse face of the WL-CSP wafer 27 may be applied without using the annular frame F.

In the processing method for a wafer of the present invention, an alignment step for picking up an image of the front surface 11a of the device wafer 11 through the sealing member 23 from a front surface side of the WL-CSP wafer 27 by the visible light image pickup means, detecting at least two alignment marks such as target patterns formed on a front surface of the device wafer 11

and then detecting a scheduled division line 13 to be processed on the basis of the alignment marks.

This alignment step is described in detail with reference to FIG. 4. Before the alignment step is carried out, the reverse face 11b side of the wafer 11 is pasted to a dicing tape T whose outer periphery portion is mounted on an annular frame F.

At the alignment step, the WL-CSP wafer 27 is sucked to and held by a chuck table 10 of the laser processing apparatus with the dicing tape T interposed therebetween such that the sealing member 23 that seals the front surface 11a of the device wafer 11 is exposed upwardly as depicted in FIG. 4. Then, the annular frame F is clamped by and fixed to a clamp 12.

At the alignment step, an image of the front surface of the WL-CSP wafer 27 is picked up by an image pickup element such as a CCD (Charge-Coupled Device) element of visible light image pickup unit 26. However, since such components as silica filler, carbon black and so forth are contained in the sealing member 23 and besides the surface of the sealing member 23 is uneven, light of vertical illumination of the visible light image pickup unit 26 passes through the sealing member 23, and even an image of the surface 11a of the wafer 11 is

picked up with the vertical illumination, the picked up image obtained is in an out-of-focus state and it is difficult to detect alignment marks such as target patterns from the picked up image.

Therefore, at the alignment step of the present embodiment, in addition to the vertical illumination of the visible light image pickup unit 26, different light is irradiated in an oblique direction upon an image pickup region from oblique light means 28 to improve the picked up image from an out-of-focus state thereby to make it possible to detect alignment marks.

Light to be irradiated from the oblique light means 28 preferably is white light, and the incidence angle of light to the surface of the WL-CSP wafer 27 preferably is within the range of 30 to 60 degrees. Preferably, the visible light image pickup unit 26 includes an exposure by which the exposure time and so forth can be adjusted.

Then, the chuck table 10 is rotated by θ degrees such that a straight line interconnecting the alignment marks is positioned in parallel to a processing feeding direction, and the chuck table 10 depicted in FIG. 5A is further moved in a direction orthogonal to the processing feeding direction X1 by a distance equal to a distance between the alignment marks and the center of the

scheduled division line 13 to detect the scheduled division line 13 to be laser processed.

After the alignment step is carried out, a laser beam LB of a wavelength (for example, 355 nm), which can be absorbed by the sealing member 23 and the device wafer 11, from a laser head (condenser) 16 of the laser processing apparatus is irradiated along the scheduled division line 13 from the front surface side of the WL-CSP wafer 27 to form such a laser processed groove 29 as depicted in FIG. 5B by ablation processing, and the WL-CSP wafer 27 is divided into individual device chips (CSPs) 31 whose front surface is sealed with the sealing member 23.

After this division step is successively carried out along the scheduled division lines 13 extending in a first direction, the chuck table 10 is rotated by 90 degrees, whereafter the division step is successively carried out along the scheduled division lines 13 extending in a second direction orthogonal to the first direction. By this, as depicted in FIG. 5B, the WL-CSP wafer 27 can be divided into individual device chips (CSPs) 31 whose front surface is sealed with the sealing member 23.

Each device chip (CSP) 31 fabricated in this manner

is reversed upside down and can be mounted on a mother board by flip chip bonding for connecting the bumps 25 to conductive pads of the mother board.

The present invention is not limited to the details of the above described preferred embodiment. The scope of the invention is defined by the appended claim and all changes and modifications as fall within the equivalence of the scope of the claim are therefore to be embraced by the invention.

WHAT IS CLAIMED IS:

1. A processing method for a device wafer in which a front surface of the device wafer on which a device is formed in each of chip regions partitioned by a plurality of scheduled division lines formed in a crossing relationship on the front surface of the device wafer is sealed with a sealing member and a plurality of bumps are formed individually in the chip regions of the sealing member, the processing method comprising:

an alignment step of picking up an image of a front surface side of the device wafer through the sealing member by visible light image pickup means from the front surface side of the device wafer to detect alignment marks and detecting a scheduled division line to be laser processed among the plurality of scheduled division lines based on the alignment marks; and

a division step of irradiating, after the alignment step is carried out, a laser beam of a wavelength, which is absorbed by the sealing member and the device wafer, along the scheduled division line from the front surface side of the device wafer to divide the device wafer into individual device chips sealed at the front surface thereof with the sealing member by ablation processing; wherein

the alignment step is carried out while light is irradiated in an oblique direction upon a region, whose image is to be picked up by the visible light image pickup means, by oblique light means,

the sealing member contains carbon black,

the content of the carbon black is 0.1% by mass or more and 0.2% by mass or less, and

in the alignment step, the vertical illumination of visible light image pickup means and the light from oblique illumination means are applied to the region to be imaged by visible light image pickup means.