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AN APPARATUS and METHOD FOR DICING AN IC SUBSTRATE

Field of the Invention

The invention relates to integrated circuits which are fabricated as multiple units within a substrate. Specifically, the invention relates to the efficient separation of said units through dicing the said substrate into discrete individual units. Said units include, but limited to QFN, BGA and Micro SD Card packages.

Background

With increasing pressure to reduce the costs of manufacturing integrated circuits, each step in the process is subject to improvement so as to maintain the end product at an acceptable price.

One such area is in the dicing of substrates containing multiple integrated circuits and subsequently delivering the integrated circuits ready for packaging.

In addition to improvements in speeding the dicing process, it would be advantageous to maintain multiple dicing machines in parallel so as to increase output. It follows that a key determinant in the ability to maintain multiple machines is the limitation on space within the factory environment that is suitable for the dicing of integrated circuits. To this end, the manufacturing space must be of a "clean room" standard which in turn dramatically increases the cost per square foot in maintaining the factory space. It is, therefore, an important consideration to balance the cost of suitable factory space with the need to increase output by having several machines operating in parallel.

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Summary of Invention

In a first aspect, the invention provides [to be confirmed on approval of the client].

In a second aspect, the invention provides [to be confirmed on approval of the claims].

Accordingly, the invention provides an arrangement such that the substrate and subsequently diced IC units follow a non linear path. Being a non linear path, the machine can be constructed with a smaller footprint as compared to conventional devices.

Brief Description of Drawings

It will be convenient to further describe the present invention with respect to the accompanying drawings that illustrates possible arrangements of the invention. Other arrangements of the invention are possible and consequently the particularity of the accompanying drawings is not to be understood as superceding the generality of the preceding description of the invention.

Figure 1 is a plan view of a device according to first embodiment of the present invention:

Figure 2 is a plan view of a second embodiment according to the present invention and;

Figure 3 is a plan view of a third embodiment according to the present invention;

Figure 4 is an isometric view of the loader according to one embodiment of the present invention;

Figure 5 is a flow diagram indicating the stations associated with a device accordingly to the present invention;

Figure 6 is a schematic of the direction followed by a substrate and IC units according to a further embodiment of the present invention.

Description of Preferred Embodiment

Figure 1 to 6, as will be described, provide various embodiments of the present invention. In particular, figures 1 to 3 show different devices embodying aspects of the invention with figure 4 showing one component of a particular device accordingly to a further embodiment.

Figures 5 and 6 are directed to the process aspects of the invention whereby figure 5 shows an embodiment of the stages involved with process according to an embodiment of the present invention. Figure 6 provides a graphical representation of an embodiment of the invention being the directions followed by the substrate, and subsequent singulated IC units, and how this differs from the conventional linear path adopted by prior art devices, and so providing a smaller footprint for a device falling within the broader invention.

Figures 1 shows a plan view of a device according to one embodiment of the present invention which embodies the process of figure 1 and the directional flow of Figure 2. The apparatus 5 is seamlessly divided into four sections being a loading area 10, a dicing section 15, a sorting section 20 and an unloading section 25. Travel between the sections is achieved variously through "carrying" the substrate or singulated units on

blocks located on rails. Where the substrate or units are engaged and lifted using various forms of pickers, said devices engage the substrate/units through a vacuum engagement, as would be appreciated by the skilled reader.

The process begins by placing a substrate onto the loading area in this case a cassette magazine 30. The substrate is placed to be in contact with a ridge in the cassette magazine 30 so as to align the substrate at the left most position, and thus automatically align the substrate ready for processing by the apparatus 5. This is shown in more detail in figure 4. The substrate is delivered 280 in a first direction to an inlet rail 35 which controls its passage through the dicing section 15 and subsequently to further down stream processes.

The inlet rail 35 is strategically placed centrally and so may be subsequently referred to as the central position. From this central position, the substrate is delivered 285 in a direction orthogonal to the first direction 280 of loading, and subsequently mounted to a first block, which in this case is a dry block 40, said dry block engaged with a ball vision device 45. This orthogonal movement compares with the linear arrangement of prior art devices, such devices consequently having a greater plan area than a device according to the present invention.

The ball vision device 45 represents the first inspection point whereby the ball vision device, located beneath the substrate, determines the orientation of the substrate by locating and verifying the orientation based on fiduciary marks printed onto substrate.

The ball vision device is arranged to move with the dry block 40, and so permitting the inspection during the motion.

At the end of travel 285, the substrate is engaged by a strip picker 55 which delivers the substrate in a desired orientation to the chuck table 60 which is arranged to deliver the substrate to dicing saws 30 so as to singulate the integrated circuit units from the substrate. It should be noted that, whilst figures 1 to 3 indicate a single chuck table, the invention may includes embodiments having a twin chuck table, and consequently benefiting form the increased yield, measured in Units per hour (UPH), this will provide. Further, the chuck table, or twin chuck table, may further include a cooling unit and self cleaning systems, so as to minimise clogging and subsequent maintenance issues.

On completion, the chuck table returns to its original position as shown in Figure 1 whereupon a unit picker 65 engages the singulated units for delivery 290 to the dry block and subsequently return to the inlet rail 35. Said delivery further includes travel through the cleaning phase 50, which includes brushing/cleaning stages 245 followed by blowing and drying 250 of the units prior to ball and pad inspection 255.

The ball vision device may include a camera so as to identify any missing or misaligned balls within the substrate. A further embodiment the ball vision device 45 may include a light or laser which is directed to the substrate and in particular the location of the solder balls. Any missing or misaligned solder balls will be indicated by the detection of light passing through the substrate at the various locations. In any event, the ball vision

device 45 will determine whether the substrate is to undergo further processing or be rejected. The Mark Inspection stage 260, performed by the Mark Vision device 77 further inspects the orientation of the units before final sorting. In the case of figure 3, this Mark Inspection 260 may be preceded by a flipper unit so as to orient the solder balls upward for better inspection and packaging.

The net block picker 75 then engages the singulated units and delivers 270 these to the net block 80 in a direction 300 parallel to that of the first direction 280 of loading of the substrate. The net block 80 which carries the units to the sorting section 20 whereupon the net block 80 is rotated 85 and passed down the rails 90 to the various stations within the sorting section 20. Vision captured by the mark vision device 77 determines whether the singulated units are of sufficient quality for packaging or whether they need to be either reworked or rejected. Accordingly, the sorting pickers 95, 100 using information gained from the mark vision device 77 determine whether the units are dropped in the reject bin 105 or subsequently delivered to the rework tray 115 or the "good" tray 110 for subsequent packaging.

In this embodiment the arrangement of the apparatus 5 is such that the unloading section 25 in which is located in the rework tray in "good" tray is proximate to the loading section 10. Thus an operator responsible for the apparatus 5 can be conveniently packed in a position proximate to the loading section 10 and unloading section 25 without having to move significantly. In this embodiment not only is the "footprint" also reduced by the arrangement but further "bottleneck" issues are improved through reduced movement of the relevant operator.

Figures 2 and 3 show variations of the device of figure 1, differing in some aspects. For instance, figure 2 further includes a tube off loader 120 whereby an alternative means of unloading of singulated units includes delivering said units along a rail 121 which are subsequently pushed through a channel 126 into the tube off loader 120. These are consequently packaged and removed for delivery to customers.

Figure 3 shows a further alternative arrangement to that of figure 1 whereby a flipper 130, 135 is provided so as to permit vision of the solder balls from above and also to prevent damage and other associated advantages with the inverted orientation.

Figure 4 shows a further embodiment of the substrate on loader 140 whereby the substrate 150 is placed upon the platform 30 ready for on loading. The substrate 150 is aligned 155 against a left most block 145 and thus ensuring the orientation of the substrate 150 during the entire process. The plate 30 further includes a slot 151 whereby the substrate 150 can be engaged by grippers (not shown). The grippers draw the substrate 150 into the device which represents the first movement 280 as shown in figure 6.

Figures 5 and 6 provide schematic views of the invention according to further embodiments of the present invention. Reading figures 5 and 6 together, the process begins with a magazine being loaded to 20 which leads to the loading of a strip or substrate 225 which involves movement in a first direction 280. The substrate then undergoes orientation 230 and loaded to the saw 235 through a changing direction 285

which is octagonal to the first direction 280. The substrate is subsequently diced or sawed 240 into singulated units. These units are then brushed and cleaned 245 and moved in a third direction 290 being parallel but opposed in direction to the previous movement 285. The units are then blown and dried 250 and undergo a ball and pad inspection 255. They are further moved 295 to the flipper 265 where upon they are loaded to a net block 270 which move them in a further direction 300 for sorting 275. The units are subsequently unloaded individually or in packs.

Claims:

1. Apparatus for dicing an integrated circuit substrate comprising

a loader for loading the substrate to the apparatus, said substrate loaded in a first direction corresponding to a loading axis;

an inlet rail;

said inlet rail including a first block, movable along said inlet rail to which is loaded the substrate from said loader, wherein

said inlet rail is arranged to deliver the first block and substrate towards a chuck table in a second direction orthogonal to the loading axis.

2. The apparatus according to claim 1, wherein the inlet rail includes a first inspection device for verifying the orientation of the substrate positioned on the first block.

3. The apparatus according to claim 1, wherein the first block is arranged to receive diced integrated circuits from the chuck table, said inlet rail arranged to deliver the first block and diced integrated units to a first inspection station in a direction parallel, and opposed, to the second direction.

4. The apparatus according to claim 2 or 3, further including a strip picker arranged to remove the substrate from the first block and deliver said substrate to the chuck table.

5. The apparatus according to any one of claim 2 to 4, further including a unit picker arranged to remove diced integrated circuits from the chuck table and deliver said integrated circuits to the first block.

6. The apparatus according to any one of the preceding claims, further including a net block picker and a net block such that the net block picker engages the integrated circuits at the inspection station and delivers said integrated circuits to the net block.

7. The apparatus according to claim 6, wherein said net block is arranged to move along a net block rail in a third direction parallel to the loading axis so as to deliver the integrated circuits to a sorting station.

8. The apparatus according to claim 7, further including a second inspection station located adjacent to said net block rail wherein said integrated circuits are inspected at said second inspection station whilst traveling along said net block rail.

9. The apparatus according to claim 7 or 8, wherein said sorting station including means for sort said integrated circuits by category, said category

based on data received from either, or both, of the first or second inspection stations.

10. A method for dicing an integrated circuit substrate comprising the steps of:

loading the substrate to a loader, said substrate loaded in a first direction corresponding to a loading axis;

loading said substrate from the loader to a first block mounted on an inlet rail;

moving said first block and consequently the substrate along said inlet rail towards a chuck table in a second direction orthogonal to the loading axis.

11. The method according to claim 10, further including the step of verifying the orientation of the substrate positioned on the first block.

12. The method according to claim 10 or 11, further including the steps of:

The first block receiving the diced integrated circuits from the chuck table;

delivering the first block and diced integrated units to a first inspection station in a direction parallel, and opposed, to the second direction;

inspecting the diced units for ball misalignment.

13. The method according to any one of claims 10 to 12, further including the steps of removing the substrate from the first block and deliver said substrate to the chuck table using a strip picker.

14. The method according to any one of claims 10 to 13, further including the steps of removing the diced units from the chuck table and deliver said integrated circuits to the first block using a unit picker.

15. The method according to any one of claims 12 to 14, further including the steps of engaging the integrated circuits at the first inspection station and delivering said integrated circuits to the net block using a net block picker.

16. The method according to claim 15 including the steps of delivering the net block to a sorting station via a second inspection station, and;
inspecting the units on the net block during the delivering step.

17. The apparatus according to claim 16, further including the steps of: sorting said integrated units by category, said category based on data received from at least one of said inspection stations.