An Improved Net Table

Field of the Invention

The invention relates to the dicing of integrated circuit units (ICU's) from a substrate. In particular, the invention relates to the process within the dicing procedure, whereby the freshly diced ICU's are moved from the dicing station ready for sorting and further downstream processes.

Background

In the process of dicing ICU's from a substrate into individual units, and moreover, the subsequent treatment of said units, it is necessary to transfer the diced substrate from the dicing table to a net table using a unit picker.

The units are then individually moved to an inspection tray, such as a JEDEC's tray or other downstream process.

An example of such a process is shown in the applicant's prior application, published as WO 2006/022597, the contents of which are incorporated herein by reference.

At each stage, the individual units are held in place using a vacuum source so that alignment is maintained. If the alignment is not maintained, this may lead to

a lack of quality in the finished product, or unreliability in the inspection phase. In either case, this leads to an unnecessarily high rejection rate, which will ultimately have a detrimental effect on economic measures, such as "units per hour" (UPH) of the process.

An example of how this misalignment may affect the UPH of the process is the effect on the required vacuum level for the ICU's whilst on the net table. In this case, the vacuum must maintain a seal of at least 90%. For a typical substrate of 36 pieces, it follows that if 4 units are misaligned, the vacuum will drop below 90%, leading to a rejection of the batch, not through lack of quality, but merely for misalignment.

This misalignment can occur at many different stages, including washing and drying of the units post-dicing. A more direct cause is the release of the units from the unit picker to the net table, just prior to engagement of the vacuum, either through the mere act of transfer, or in the case of inserts, in the translational shift caused by the deformation of the polymer insert.

It would therefore be advantageous to avoid this misalignment during the transfer from the unit picker to the net table.

Summary of Invention

In general terms, the invention comprises a location device having a plurality of apertures, said apertures having peripheral barrier elements, such that the location device may be arranged with a net base plate to form recesses into which integrated circuit units may be placed.

In a first aspect, the invention provides a net table comprising a net base plate having an array of regions, each for receiving an integrated circuit unit (ICU); each of said regions in communication with a vacuum source; a location device having a plurality of apertures, said apertures having peripheral barrier elements, wherein the location device and net base plate are arranged such that each region corresponds to an aperture, and consequently the peripheral barrier elements and regions forming an array of recesses into which the integrated circuit units fit.

In a second aspect, the invention provides a location device for use with a net table, said net table comprising a net base plate having an array of regions, each for receiving an integrated circuit unit (ICU); each of said regions in communication with a vacuum source; the location device having a plurality of apertures, said apertures having peripheral barrier elements, wherein; the location device and net base plate are arranged such that each region corresponds to an aperture, and consequently the peripheral barrier elements

and regions forming an array of recesses into which the integrated circuit units fit.

In a third aspect, the invention provides a method for placing a plurality of ICU's on a net table comprising the steps of providing a net base plate having an array of regions for receiving the ICU's; providing a location device having peripheral barrier elements; engaging the location device and net base plate such that the peripheral barrier elements and regions form recesses; depositing the ICU's from a carrier to the recesses.

Thus, the addition of the location device to the net base plate creates an array of recesses rather than merely regions. Prior to the introduction of a vacuum, the ICU's are held spatially and so avoiding misalignment during transfer.

The invention may be applied to a range of such processes, and it will be understood by the skilled worker that the invention is applicable to different dicing and ICU handling processes. As a purely illustrative example, and referring to the applicant's publication WO 2006/022597, the net table of the present invention may replace that shown in Figure 10a of WO 2006/022597, and in particular, replace the net block 10a sown in this figure.

In a preferred embodiment, the peripheral barrier elements may be selectively lowerable to facilitate placement of the ICU's within the regions. It may be further advantageous if the ICU's could be placed onto a flat surface rather than

dropped into a recess. By having the peripheral barrier elements lowerable, the ICU's may be conveniently lowered onto the flat net base plate so as to avoid interference when the ICU's are first disengaged.

In a more preferred embodiment, the peripheral barrier elements (PBE's) may be lowered through resilient depression of the location device by a depression means. In a further embodiment, one means of lowering the peripheral barrier elements may be through having the unit picker push down onto the location device, and so automatically push the PBE's down, at the right time.

Alternatively, the PBE's may be subject to a mechanism which lowers and/or raises the PBE's at a pre-determined time. Such a mechanism may be include an electric or hydraulic motor which operates one or more levers or projections to move the PBE's, possibly along a rail or conduit, or through use of guide posts, or dowels, such that the location device may be guided along the path of such a dowel.

In a more preferred embodiment, the peripheral barrier elements may then be raised selectively so as to spatially fix the ICU's at the most advantageous moment.

In a preferred embodiment, the location device may be biased against a spring or series of spring, possibly located within the net base plate, such that when the PBE's are lowered, there is a resilient force tending to push the PBE's back

into position. Thus, on release of the PBE's by the unit picker, or other lowering device, the PBE's may resiliently re-position themselves, and so automatically fix the ICU's spatially.

In a preferred embodiment, the location device may include elements integral with the net base plate. Thus, the PBE's may be members within the net base plate which operate integrally with the net base plate. Alternatively, the location device may be a separable item, such as a separate plate that fits onto the net base plate as a separate but engageable layer. In a further alternative, the location device may be a combination of integral members and a separate plate, layer or template. All such permutation will fall within the understanding of the skilled person as being variation within the present invention.

In a preferred embodiment, the regions may include polymer inserts upon which the ICU's are positioned, said inserts having conduits through which the vacuum source is applied to the ICU's. In some instances, polymer, including rubber, inserts are used with the regions of the net base plate. Any such use of inserts will still allow engagement of the ICU's by the vacuum source.

In a preferred embodiment, the peripheral barrier elements may be shaped to permit self-alignment of the ICU's. In some instances, the misalignment of the ICU's may have occurred upstream from the unit picker, possibly through the washing/drying or inspection stages after dicing. In this case, the unit picker may have engaged the ICU's in an already misaligned state. By providing a self-

alignment feature with the PBE's, this misalignment may in fact cure this misalignment, and not merely prevent later stage misalignment. Such self-alignment features may include inclined upper portions, whereby the misaligned ICU may contact this portion and slide/rotate into the recess formed by the PBE's.

Alternatively, projections or non-level upper portion of the PBE's may impact and dislodge the ICU's so as to shift back into alignment. In a still further embodiment, the net table according to one embodiment may include a vibratory device which works with or separately from the self-alignment features of the PBE's to cause the ICU's to be vibrated back into alignment. The skilled person will appreciate the many ways this could be achieved, including, but not limited to a rotational device in communication with the net table, whose offset provides such a vibration.

Brief Description of Drawings

It will be convenient to further describe the present invention with respect to the accompanying drawings which illustrate 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 superseding the generality of the preceding description of the invention.

Figure 1 is an isometric view of the net table according to one embodiment of the present invention;

Figures 2 to 5 are sequential isometric views of the net table of Figure 1, undergoing the ICU transfer process according to a further embodiment of the present invention;

Figure 6 is an exploded isometric view of the net table according to a still further embodiment of the present invention;

Figure 7 is an assembled view of the net table of Figure 6;

Figures 8a to c are elevation views of a further embodiment of the present invention.

Description of Preferred Embodiment

Figure 1 shows a general exploded view of one embodiment of this invention. Here the net table 1 is shown to comprise a net base plate 5 and a location device 10, which fit together to receive a plurality of integrated circuit units (ICU's) 15.

The net base plate 5 comprises a rectangular array of regions 25, each in communication with a vacuum source (not shown) through a conduit 30 in the base of each region 25. In a further embodiment, and as shown in Figure 2, the region may also include a polymer insert which fits into the region so as to avoid damage to the ICU as it is transferred to, and removed from, the net table 1.

In this embodiment, the location device 10 is shown as a separate layer which fits over the net base plate 5. The location device 10 also has a rectangular array, but in this case, being an array of apertures 35, which are arranged such that when the location device 10 is fitted on the net base plate 5, the apertures 35 are positioned directly over the regions 25 of the net base plate 5.

Each aperture 35 is defined by a framework of ridge members 40 which define peripheral barrier elements when the location device 10 is fitted to the net base plate 5. Once in place, each region 25 is surrounded by the ridge members 40, such that in combination, the regions 25 and ridges (or peripheral barrier elements) form recesses 55, which is more clearly shown in Figure 2.

These recesses 55 represent a key feature of the present invention, as once within the recess the ICU 45 cannot easily move laterally, and so maintains its alignment within the recess, the position of which may be manufactured to a very high tolerance. Thus, by incorporating the location device 10, the regions 25 of the net base plate 5 become recesses 55, and so solve many of the problems associated with the mis-alignment of the ICU's 15 as they undergo placement and removal from the net table 1.

In this embodiment, placement of the plurality of ICU's 15 is achieved by a unit picker 20, which engages the recently diced ICU's 15 from the dicing table (not shown) and moves these through the various stages of cleaning and drying before delivery to the net table 1. The unit picker 20 also holds the ICU's 15

using a vacuum source (not shown). The manner in which the unit picker engages the ICU's is such that any misalignment that has occurred upstream of the net table 1 may be transferred to the arrangement on the net table 1. The invention is generally directed to the solving of the problem of misalignment during the process of placement and removal at the net table 1. Nevertheless, as will be described later, in a further embodiment of the present invention, the location device 10, and in particular the arrangement of the ridges 40 may be such so as to correct misalignment of the ICU's which may have occurred upstream from the net table 1, rather than only preventing misalignment during this stage.

The following discussion makes reference to Figures 2 to 5 and shows the sequential steps of placing a plurality of integrated circuit units on to the net table and subsequently taking them off for delivery to a JEDEC tray according to one embodiment of the present invention.

The unit picker 20 moves in a downward direction 50 towards the net table 1 comprising the combination of the net based plate 5 and location device 10. In this case, the regions of the net based plate 5 have therein polymer inserts 60 so as to prevent damage to the ICUs as they are placed. With reference to these regions 25, with the combination of the net based plate 5 and location device 10, the regions 25 in combination with the peripheral barrier elements 40 create a recess 55 into which the ICU 57 can fit.

Figure 3 represents the case when the unit picker 20 has come in contact with the net table 1. However, for clarity it is shown above the net table 1 so that the detail of the location device 10 can be shown. In this embodiment the unit picker 20 bears directly upon the location device 10, pushing the location device downward and so having the barrier elements 45 lowered beneath the surface of the regions 25. Accordingly with the barrier elements 45 so lowered, the face of the net table 1 exposed to the unit picker 20 resembles that of the conventional flat array of regions and so providing a flat surface upon which the ICUs can be placed on the net table 1. It follows that whilst the array of recesses 55 are useful in maintaining alignment of the ICUs, once placed the uneven surface provided by the recesses is not however, ideal for this placement and in fact without due care may lead to misalignment in itself. Thus in a further preferred embodiment the ability of the location device 10 to be lowered below the surface of the net table is particularly advantageous for this placement step.

On depressing the location device 10 so as to lower the barrier elements 45 below the surface of the regions bring the ICU's into contact or virtual contact with the net table. The unit picker 20 may now release the vacuum seal holding the ICUs to the unit picker 20, permitting a disengagement of the ICUs so as to place them conveniently on the net table 1. On disengagement from the unit picker 20, the vacuum source (not shown) of the net table 1 will be activated and so engaging the ICUs in their new position within the regions of the net table.

As shown in Figure 4 with the ICUs well secured by the vacuum source, the unit picker 20 can rise 75 and so release the location device 10. The location device 10 being in resilient engagement with the net based plate 5 permits the location device 10 to automatically move back to the original position and so lift the barrier elements 40 back into place and so secure the ICUs 45 laterally and so preventing any misalignment of said ICUs.

Referring to Figures 8a to c, in a further embodiment, by providing an inclined upper surface 115 of the barrier elements 113, any pre-existing misalignment of the ICUs may be corrected as the barrier elements 113 rise and so shift the ICUs laterally back into alignment. On complete extension of the barrier elements 113, the ICUs will shift laterally and downwards 125 as they follow the inclined face 115. Eventually, the ICU 120 will slide directly downward 135 and fit within a fine tolerance within the recess 130 so maintain alignment or cure any pre-existing misalignment.

The next step in the process is shown in Figure 5 whereby a finger picker 80 is used to transfer individual ICUs 95 to the respective locations such as to a JEDEC tray 90. In so doing the vacuum source maintaining the ICUs in position on the net table 1 is released. As the barrier elements 40 hold the ICUs in position, the release of the vacuum source does not lead to a misalignment and in fact next phase can be achieved with great confidence given the high

tolerance of position of the ICUs due to the use of the location device 10. Thus the individual picker 85 engages the individual ICU 95 through a vacuum, removing it from the net table 1 and delivering it to the JEDEC tray 90 and so completing the transfer process.

Figures 6 and 7 show arrangements of the location device and net based plate 5 and in particular means by which the location device 10 resiliently repositions itself once the unit picker 20 has been released. Thus there is shown a series of spring elements 105 and guide columns 110 so that on release of the unit picker 20, the spring resiliently biased the location device 10 upwards with the guide pillars 110 maintaining the position of the location device 10 as it races to its original position with a very high degree of tolerance.

1. A net table comprising

a net base plate having an array of regions, each for receiving an integrated circuit unit (ICU);

each of said regions in communication with a vacuum source;

a location device having a plurality of apertures, said apertures having peripheral barrier elements;

the location device and net base plate are arranged such that each region corresponds to an aperture, and consequently the peripheral barrier elements and regions forming an array of recesses into which the integrated circuit units fit wherein the peripheral barrier elements are selectively lowerable to permit placement of the ICU's within the regions.

2. The net table according to claim 1, wherein the peripheral barrier elements are selectively raiseable to align the placed ICU's within the regions.

3. The net table according to claim 1, wherein the peripheral barrier elements are lowered through resilient depression of the location device by a depression means.

4. The net table according to claim 3, wherein the resilient depression includes biasing the location device against at least one spring, such that

the peripheral barrier elements at least partially fit into a cavity of the net baseplate, the at least one spring capable of returning the location device to its original position on release of the depression means.

5. The net table according to claim 1 or 2, wherein the peripheral barrier elements are lowerable and/or raisable by a selectively operable biasing device.

6. The net table according to claim 5, wherein said biasing device includes elements engaged with said location device and actuated by any one, or a combination of, electric motor, hydraulic motor and pneumatic device.

7. The net table according to any one of the preceding claims, wherein the depression means includes a unit picker contacting the location device and applying a depression force thereto and consequently lowering the peripheral barrier elements just prior to placing the plurality of ICU's into the respective regions.

8. The net table according to any one of the preceding claims, wherein the location device comprises elements integral with the net base plate.

9. The net table according to any one of claims 1 to 7, wherein the location device comprises a plate detachable from the net base plate.

10. The net table according to any one of the preceding claims, wherein the regions include polymer inserts upon which the ICU's are positioned, said inserts having conduits through which the vacuum source is applied to the ICU's.

11. The net table according to any one of the preceding claims, wherein the peripheral barrier elements are shaped to permit self-alignment of the ICU's.

12. A location device for use with the net table according to any one of claims 1 to 11, said net table comprising

a net base plate having an array of regions, each for receiving an integrated circuit unit (ICU);

each of said regions in communication with a vacuum source;

the location device having a plurality of apertures, said apertures having peripheral barrier elements, wherein;

the location device and net base plate are arranged such that each region corresponds to an aperture, and consequently the peripheral barrier elements and regions forming an array of recesses into which the integrated circuit units fit wherein the peripheral barrier elements are selectively lowerable to permit placement of the ICU's within the regions.

13. A method for placing a plurality of ICU's on a net table comprising the steps of :

providing a net base plate having an array of regions for receiving the ICU's;

providing a location device having peripheral barrier elements;

engaging the location device and net base plate such that the peripheral barrier elements and regions form recesses;

selectively lowering the peripheral barrier elements to permit placement of the ICU's within the regions and;

depositing the ICU's from a carrier to the recesses.

14. The method according to claim 14, wherein the lowering and depositing steps comprise

contacting the location device by moving the carrier into a proximate position with the net base plate;

applying a force to the location device and so depressing the peripheral barrier elements into a cavity of the net base plate so as to provide a flat surface on the net base plate;

disengaging the ICU's from the carrier onto the regions, and;

engaging the ICU's within the recesses.

15. The method according to claim 14, wherein the disengaging step comprises

releasing a vacuum holding the ICU's to the carrier.

16. The method according to claim 14, wherein the engaging step comprises activating a vacuum source to hold the ICU's within the recesses.