Improved chuck table for an integrated circuit dicing device

Field of the Invention

The invention relates to the storing and sorting of integrated circuit devices from a larger substrate containing several of said devices.

Background of Invention

Conventionally a plurality of integrated circuits are formed simultaneously on a semiconductor substrate, and the substrate is then diced to form individual integrated circuits. Apparatus is known for feeding substrates into such a dicing machine, and for sorting the diced integrated circuits.

One type of integrated circuit which is becoming increasingly popular is one having an array of multiple electrical contacts (typically solder balls, known as a ball grid array packages, and pads in non-leaded packages, known as a Quad Flatpack Non-Leaded (QFN) packages) in an array on one of its major faces. The dicing of a substrate having a ball grid array on one of its surfaces is typically performed with the surface of the substrate carrying the balls facing upwards. It is known to perform a limited number of sorting operations on the singulated integrated circuit units to detect abnormal (faulty) units. This is performed using cameras under which the singulated units pass. The level of sophistication of such techniques is presently limited. In particular, it tends to be performed on the basis of a batch of units produced from the same substrate, and that batch of units is rejected as a whole if a fault is identified (e.g. because it is discovered that the alignment of the substrate with the lines cut by the dicing machine is not sufficiently accurate). Similarly for the QFN package, though having no external leads, for the dicing process, the packages are oriented so as to have the corresponding pads face upwards.

In either case, during this process, the units are handled by devices which touch the integrated circuits at the edges of their upper surfaces, at the margins which are outward of the area of the upper surfaces covered by the ball grid array, or pads as the case may be. Contacting the circuits there reduces the risk of damage. However, this handling operation is a difficult one, and is becoming increasingly more difficult as the size of the integrated circuits falls and the margin around the ball grid array, or pads, shrinks.

Statement of Invention

In a first aspect, the invention provides a substrate delivery and chuck system for co-operation with a dicing machine, the system including:

a chuck table having two chuck sections;

a drive mechanism for moving the chuck sections between a first location and a second location; and

a lifting assembly for substantially simultaneously (i) depositing a first substrate onto a first of said chuck sections when the first chuck section is in the first location, and (ii) picking up singulated units of a previously diced substrate from a second of the chuck sections when the second chuck section is in the second location;

the chuck table and drive mechanism being operable (i) to co-operate with the dicing machine to dice the first substrate placed on the first chuck section at the first location, and (ii) to move the first chuck section to the second location.

In a second aspect, the invention provides a support device for supporting a set of integrated circuit units, the device comprising:

a support frame, said frame having an array of recesses;

a soft material insert, adapted to fit within the support frame, said insert having an array of apertures placed so as to correspond with the recesses of the frame when said insert is fit within said frame;

a vacuum means in communication with each of said recesses and apertures;

wherein each unit of the set corresponds to an aperture of the insert and is held in place by the vacuum.

In a preferred embodiment, the substrate may comprise one or more discreet panels, whereby each panel comprises a plurality of said units ready to be diced and singulated by the system. Thus, system according to the invention is adaptable for use for substrates having several panels or for a substrate, which in itself, may be a single panel. The system may embrace both a batch process whereby a substrate may have several panels, each containing many units or approximating a continuous process whereby the system processes a single panel and thus reducing the residence time of the substrate within the system.

The system may be applicable to a range package sizes, from the smallest of QFN package design 1x1 to the largest available packages of 15x15. This should not restrict the scope of the invention for future available packages which may be equally suited to the system of the present invention, but are yet to be made commercially available.
In a preferred embodiment, the system may further include a separating device upstream from the chuck table. Said separating device may be adapted to receive a substrate of many panels and, based upon a predetermined number of panels to be entered into the chuck table for dicing, separate the predetermined number of panels from the original substrate.

In a more preferred embodiment, the separating device may have an optical identification system, whereby the system identifies when the predetermined number of panels have passed a cutting portion of the separating device, which controls the system to receive the information from the identification system and instruct the cutter to cut the original substrate, thus create a new substrate having the predetermined number of panels. Said predetermined number may be anywhere from one upwards and may be a function of the size of the chuck table or other physical parameters. Alternatively, the number may be influenced by the economics of the numbers of units per hour that are required.

In an preferred embodiment where the substrate may be a single panel or at least a small number of panels, there may be distinct advantages in handling the smaller number of panels. For instance, for a given vacuum arrangement, the smaller the number of

panels, the greater the available suction which may be of particular use during the cutting action. In any event, smaller number of panels may be more stable and so increase the quality of the cutting activity, particularly in relation to the packaging size or if an offset cut is required.

For a system adapted for use with a smaller number of panels such as a single panel, the cost of converting an existing arrangement is reduced and therefore a conversion kit may become economically viable in order to maintain the system.

For a continuous process or where the system emulates a continuous process by processing a smaller number of panels at one time, may minimize wastage should a cutting mistake occur. For instance, if a cutting mistake occurs as a result of a one-off event, then the losses involved with one panel will be less than if a substrate of many panels were involved.

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.

Fig. 1(a) is a top view of an integrated circuit sawing and sorting system according to one embodiment of the invention;

Fig. 1(b) is a side view of a part of the embodiment of Fig. 1 looking in the direction Y shown in Fig. 1(a);

Fig 2(a) is a plan view of a panel of singulated units;

Fig 2(b) is an elevation sectional view of the support device according to an embodiment of the present invention;

Fig 2(c) is a detail view of the support device of Fig 2(b);

Fig 3 is a schematic view of a separating device according to another embodiment of the present invention;

Description of Preferred Embodiment

Figs. 1(a) shows the overall construction of an integrated circuit sawing and sorting system which is an embodiment of the invention. In Fig. 1(a) the system is viewed from above. It is composed of two sections, a dicing section and a sorting section. Two horizontal directions are marked X and Y.

The sawing and sorting system is for sawing and sorting substrates which include a plurality of integrated circuits. The system is particularly suitable for integrated circuits each of which is provided with an array of contacts on a side of the substrate which is initially facing upwards (however the system may be modified for other sorts of integrated circuits, and thus not limiting the invention to any one type of integrated circuit). The substrates are inserted into the system from cassettes using a loader assembly 1. From the loader assembly 1 the substrates are carried to an inlet rail assembly 2. At this stage the substrates are examined using a first camera 3, mainly to check that the substrates are of a type suitable for use in the sawing and sorting system.

The substrates pass to a twin chuck table 4, from which they are carried into a dicing machine indicated generally as Z. This dicing machine Z can be formed according to known designs, and so will not be described here in detail.

The diced substrates pass via a brush unit 5 where the singulated units are brushed, and a cleaner unit 6, to a heating block assembly 7. From there, the units pass to a flipper unit 8, where, as described in detail below, the units are turned over so that each ball grid array faces downwards. The singulated units are then received by an idle unit assembly 9, including a second camera. Subsequently, the singulated units pass to a net block assembly 10.

Fig. 1(b) shows the portions 2 to 10 of this system from the direction marked A in Fig. 1(a). A frame lifter assembly indicated having portions Ay and Ax is shown in two different positions which it successively adopts during the use of the system.

The singulated units are picked up from the net block assembly 10 by a lifter assembly 11A. They are then inspected by a ball vision inspection camera assembly 11B which examines them from beneath. A computer system uses the data obtained at this step to make a determination of the quality of the units, and accordingly controls the lifter assembly 11A to place them into one of two trays 12d, 12e. A vacant tray is kept at position 12c. Once filled, the trays 12d, 12e are moved (in the direction which is downwards in Fig. 1(a)) respectively into a normal unit tray stacking assembly 13 and an abnormal unit tray stacking assembly 14. A tray lifter assembly 12 moves a vacant tray from position 12c to replace whichever of trays 12d, 12e has been removed. A new vacant tray is moved to position 12c from a vacant tray stacking assembly 15.

In general, the substrate comprises panels of units, each unit representing an integrated circuit, or possibly a package of such circuits, for instance 2x2 (1x1), 4x4 packages and so forth. The substrates may comprise one or more such panels, depending on the operational requirements. For instance, if the economic requirements of the process require a batch process, the substrate may comprise several panels. Alternatively, if the economics indicate a more "continuous" process is required, that is less number of units and/or residence time of the substrate in the system, then the substrate may comprise fewer or as few as one panel.

Figure 2(a) is a plan view of a panel 16 of singulated integrated circuit units 18. The units 18 are held in place upon a support device 17, which is used to fix the panel 16 in place during dicing of the panel 16 and subsequently to hold the individual units 18 in place ready for transfer to the next station.

Figure 2(b) is a side elevation view of the panel 16 showing the vacuum arrangement, which maintains the units 18 in place.

The vacuum system comprises a vacuum recess or manifold 20, which is maintained at a suitable negative pressure. The manifold 20 is in communication through a holding frame 19 via recesses 21. The support device 17, which is typically made of a soft material such as any suitable elastomeric material including, but not restricted to silicon rubber or polyurethane further has apertures 23, which correspond to the recesses 21 of the support frame. The apertures 23 within the support device 17 correspond to each individual unit 18. Thus, the vacuum manifold 20 is in direct communication with the units 18 through the recesses of the support frame and the apertures of the support device.

This is shown in better detail in Figure 2(c) being a detailed view of a support device. Here it can be shown that the units 18 cover the apertures 23 in the support device 17. The vacuum pressure 22 applied through the apertures hold the units in place until ready for release at the next station.

Figure 3 shows, in one embodiment of the present invention, an upstream process whereby substrate 24 may not be ideal for use within the system and is therefore selectively reduced in size before delivery to chuck table. Thus, the original substrate 24 is moved 25 to a separating device. The separating device, under the control of the operator, is instructed as to a predetermined number of panels, which are to be processed at one time. In this case, the predetermined number is one panel 26, which is singulated 27 from the remainder of the original substrate 24. The single substrate, being a single panel 26, is then rotated and moved into a convenient orientation for delivery to the chuck table. Subsequently, the single panel 26 is diced so as to create an array of singulated units 16 ready for delivery to the next stage of the process.

Claims

1. A substrate delivery and chuck system for co-operation with a dicing machine, the system including:

a chuck table having two chuck sections;

a drive mechanism for moving the chuck sections between a first location and a second location; and

a lifting assembly for substantially simultaneously (i) depositing a first substrate onto a first of said chuck sections when the first chuck section is in the first location, and (ii) picking up singulated units of a previously diced substrate from a second of the chuck sections when the second chuck section is in the second location;

the chuck table and drive mechanism being operable (i) to co-operate with the dicing machine to dice the first substrate placed on the first chuck section at the first location, and (ii) to move the first chuck section to the second location.

2. The system according to claim 1 wherein the substrate comprises one or more discrete panels, each panel comprising a plurality of units to be singulated by the system.

3. The system according to claim 1 wherein the units are designed for 2x2 (1x1) packages.

4. The system according to claim 1 further including a panel separating device for separating a pre-determined number of panels in a single substrate from a larger substrate ready for placement on the first chuck section.

5. The system according to claim 4 wherein the separating device separates a single panel for placement on the first chuck table.

6. The system according to claim 4 wherein the separating device separates two or more panels for placement on the first chuck table as a single substrate.

7. The system according to claim 4 wherein the separating device comprises a feeding portion for feeding an original substrate into the device, an identification system to locate a point of separation of the original substrate to create the dicing substrate consisting of the pre-determined number of panels.

8. The system according to claim 7 wherein the identification system comprises an optical detection device in communication with a control system, said control system receiving instructions as to the pre-determined number of panels required and instructing the optical detection device to identify when the original substrate is suitably positioned in order to separate the pre-determined number of panels from the original substrate.

9. A support device for supporting a set of integrated circuit units, the device comprising :

a support frame, said frame having an array of recesses;

a soft material insert, adapted to fit within the support frame, said insert having an array of apertures placed so as to correspond with the recesses of the frame when said insert is fit within said frame;

a vacuum means in communication with each of said recesses and apertures;

wherein each unit of the set corresponds to an aperture of the insert and is held in place by the vacuum.