Improved method and apparatus for positioning integrated circuits on die pads

Field of the invention

The present invention relates to methods of positioning integrated circuits (dies) on leadframes, as part of methods for producing integrated circuit packages. The invention further relates to apparatus for positioning integrated circuits on leadframes.

Background of Invention

One common method of forming an integrated circuit (die) package is to position an integrated circuit on a die pad portion of a lead frame, bond the integrated circuit to the die pad portion, form electrical connections (wire bonds) between electrical contacts on the integrated circuit and lead portions of the lead frame, encase the integrated circuit and bonds in a resin material, and then cut the lead frame to form singulated integrated circuit packages with the leads protruding out of them.

We now concentrate on the first of these steps, in which the integrated circuits are positioned on the die pads of the lead frame. The steps of a known method are shown in Fig. 1(a) to 1(e). Initially, the integrated circuits 1 are spaced apart on the surface of a wafer foil 3. The foil 3 is moved so that an integrated circuit 1 which is to be moved onto the die pad portion 9 of a lead frame is located over a "push needle" 5. The apparatus further comprises a bonding arm 7, which is movable up-and-down (as shown in Fig. 1(a)), and laterally between a position over the push needle 5 and a position over die pad 9 of the lead frame.

As shown in Fig. 1(b), the bonding arm 7 is moved towards the die 1, and the push needle 5 is raised, so that its tip meets the foil 3, and begins to penetrate

it. As shown in Fig. 1(c), the push needle 5 pushes the die 1 away from the foil 3, and the bonding arm 7 lifts it. As shown in Fig. 1(d), the bonding arm 7 then carries the die 1 to the die pad 9 of the lead frame. As shown in Fig 1(e), the bonding arm 7 deposits the die 1 on the die pad portion 9 of the lead frame.

Note that the process includes two stages which must be carried out with high precision: a first stage of pushing the die up by the push needle and picking it up by the bonding arm, and a second stage of placing the die onto the lead frame. In each cycle of two stages, only one die is attached to the lead frame.

Summary of the Invention

The present invention aims to provide new and useful methods and apparatus for positioning integrated circuits on lead frames, as part of an integrated circuit packaging process.

In general terms, the present invention proposes that the integrated circuit is brought into register with the die pad while on the foil, so that the integrated circuit can be transferred to the lead frame by a single movement. Since the number of precision processing steps is cut from two to one, the cycle time is much reduced.

The single movement can be produced by pushing the integrated circuit off the foil and onto the die pad using a push needle. Thus, no bonding arm is required.

Preferably, a plurality of integrated circuits are provided on the foil in a configuration corresponding to the configuration of respective die pads on the lead frame. Thus, the plurality of integrated circuits can be brought into register with the respective die pads by positioning the foil in relation to the lead frame. The plurality of dies can then be transferred to the die pads without moving the foil. Preferably, the integrated circuits are transferred

simultaneously, such as by a plurality of respective push needles. Thus, the present invention makes it possible to dramatically increase the rate at which integrated circuits are connected to lead frames.

The concept of transferring multiple integrated circuits simultaneously from a carrier to respective die pads is an alternative expression of the invention.

Preferably, the lead frame, or the body supporting it, is formed with means for holding an integrated circuit in position on the die pad until it is bonded there. These means may be a vacuum source and an aperture formed in the die pad, connected to the vacuum source, and arranged to be in register with an integrated circuit placed on the die pad.

Brief Description of The Figures

Preferred features of the invention will now be described, for the sake of illustration only, with reference to the following figures in which:

Fig. 1, which is composed of Figs. 1(a) to 1(e), shows the steps of a conventional method of placing an integrated circuit onto a die pad;

Fig. 2, which is composed of Figs. 2(a) to 2(f), shows the steps of a method which is an embodiment of the invention; and

Fig. 3, which is composed of Fig. 3(a) and Fig. 3(b), is views of the embodiment of Fig. 2 in operation.

Detailed Description of the embodiments

In Fig. 2, which is composed of Figs. 2(a) to 2(f), elements having the same significance as corresponding elements of Fig. 1 are given the same reference numerals. Referring firstly to Fig. 2(a), in a first step of the method which is an embodiment of the invention, a foil 3 carrying a plurality of integrated circuits 1 on its underside is located such that the integrated circuits 1 are in register with a plurality of die pad portions 9 of one or more

leadframes. Each of the die pad portions 9 includes at least one aperture 11. The integrated circuits are also in register with a plurality of push needles 5, which are movable in the vertical direction (i.e. the up-down direction in Fig. 2(a)). Each integrated circuit 1 is adhered to foil 3 by a layer of adhesive, sufficiently securely to avoid die from dropping during wafer handling. Although in Fig. 2 the dies are shown spaced quite a long way from the leadframes, in fact in reality the spacing be short, so that the dies cannot move much to the side as they fall onto the die pads.

As shown in Fig. 2(b), the push needles 5 are moved down so that their tips impact on the foil 3, and then push through the foil. At this point a vacuum source is connected to the apertures 11 of the die pads 9, so as to create suction through the apertures 11.

As shown in Fig. 2(c), the integrated circuits 1 are pushed off the foil 3, and pulled downwardly by the suction, so that, as shown in Fig. 2(d), the integrated circuits 1 are transferred to the die pads 9, where the suction force holds them in the correct positions on the die pads 9. Optionally, guide elements (not shown) may be provided to guide the integrated circuits 1 during the fall.

Then, as shown in Fig. 2(e), the push needles 5 are then retracted upwardly. When, as shown in Fig. 2(f), the push needles 5 no longer extend through the foil 3, the foil 3 can be moved, for example to bring a fresh row of integrated cicuits into register with a fresh set of die pads.

Fig. 3 shows a top view of the process. The die pads 9 are arranged in rows 11 (which are shown in the vertical direction in Fig. 3) of, for example, eight die pads 9. They are supported on a matrix (e.g. a lead frame) which carries them to the right as seen in Fig. 3 by increments equal to the spacing of the

die pads in the left-right direction. Thus, successive rows 11 of die pads 9 pass into the region 16, and remain in that position for a short time. While the die pads 9 of a given row 11 are in the region 16 they are in register with a row of eight push needles (not shown in Fig. 3, but extending in the direction into the page), which deposit eight respective integrated circuits 1 from a foil layer (not shown in Fig. 3) onto the die pads 9 of the row. Thus, the rows 11 of die pads leaving area 16 each carry an integrated circuit 1 on each die pad 9.

Since a number of integrated circuits are deposited simultaneously, and each integrated circuit is deposited by a single simple movement, the cycle time per integrated circuit is many times less than in the conventional integrated circuit deposit method described above. This means that the number of integrated circuits which can be deposited per second by a given depositing apparatus is many times higher than in the conventional method, which dramatically reduces the number of depositing apparatuses required to deposit integrated circuits on die pads at a given rate.

Although only a single embodiment of the present invention has been described, many variations are possible within the scope of the invention as will be clear to a skilled reader.

Claims

1. A method of positioning an integrated circuit on a die pad of a lead frame, the method including:

positioning a foil carrying the integrated circuit with the integrated circuit in register with the die pad; and

urging the pad from the foil to the die pad.

2. A method according to claim 1 in which the die is pushed to the die pad by a push needle projecting through the foil.

3. A method according to claim 1 or claim 2 in which the die pad includes fixing means for maintaining the integrated circuits on the die pad.

4. A method according to claim 3 in which the fixing means include apertures in the die pads in communication with a vacuum source.

5. A method of positioning an integrated circuit on the die pad of a lead frame, the method including positioning a carrier carrying a plurality of integrated circuits in a position in which the integrated circuits are in register with a respective plurality of die pads, and urging the integrated circuits simultaneously off the carrier and onto the respective die pads.

6. A method according to claim 5 in which the carrier is a foil.

7. A method according to claim 6 in which the integrated circuits are pushed from the foil onto the respective die pads by push needles projecting through the foil.

8. A method according to any of claims 5 to 7 in which the die pads include fixing means for maintaining the integrated circuits on the die pads.

9. A method according to claim 8 in which the fixing means include apertures in the die pads in communication with a vacuum source.

10. A method according to any of claims 5 to 9 in which the integrated circuits are arranged in rows, successive rows of integrated circuits being brought into register with successive sets of die pads and transferred to the die pads.

11. A method of packaging integrated circuits, the method including positioning a plurality of integrated circuits on respective die pads of at least one lead frame by a method according to any preceding claim, forming electrical bonds between electrical contacts of the integrated circuits and leads of the lead frame, encasing the integrated circuits and electrical bonding in resin to form resin bodies, and singulating the resin bodies.

12. An apparatus for positioning an integrated circuit on a die pad of a lead frame, the apparatus including:

means for positioning a foil carrying the integrated circuit with the integrated circuit in register with the die pad; and

urging means for urging the integrated circuit from the foil to the die pad.

13. An apparatus according to claim 12 in which the urging means is a push needle projecting through the foil.

14. An apparatus for positioning an integrated circuit on the die pad of a lead frame, the method including:

means for positioning a carrier with a plurality of integrated circuits in a position in which the integrated circuits are in register with a respective plurality of die pads,

urging means for simultaneously urging the integrated circuits off the carrier and onto the respective die pads.

15. An apparatus according to claim 14 in which the urging means comprises push needles for each respective integrated circuit.

16. An apparatus according to any of claims 12 to 15 comprising a vacuum source for generating a vacuum force for holding the integrated circuit on the die pad.

17. A system for packaging integrated circuits, including:

an apparatus according to any of claims 12 to 16 for positioning integrated circuits on respective die pads,

an apparatus for forming electrical bonds between electrical contacts of the integrated circuits and leads of the lead frame,

a moulding apparatus for encasing the integrated circuits and electrical bonding in resin to form resin bodies, and

a singulating apparatus for singulating the resin bodies.