Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).
Description

[0001] The present invention relates to a method of manufacturing semiconductor devices and a resin-molding machine for said method.

[0002] A conventional method of manufacturing semiconductor devices will be explained with reference to Fig. 9. A plurality of semiconductor chips 10 are matrically arranged on a substrate 12 at regular separations. The substrate 12 is molded with resin 14. After the resin 14 is solidified, the semiconductor chips 10 are respectively separated by cutting the resin 14 and the substrate 12 with a dicing cutter or a laser means, so that pieces of the semiconductor devices can be manufactured.

[0003] In the conventional method, a large number of semiconductor chips 10 can be arranged in the substrate 12 with high density, so that small semiconductor devices can be efficiently manufactured and manufacturing cost can be effectively reduced.

[0004] However, the conventional method, in which one side face of the substrate 12, on which the semiconductor devices 10 are arranged, is molded and the substrate 12 is cut to form the pieces of the semiconductor devices, has the following disadvantages. In the case of cutting the substrate 12 with a dicing cutter, a dicing blade of the dicing cutter is apt to be damaged because the dicing blade cuts different materials, i.e., the substrate 12 and the solidified resin 14. Further, edges of the pieces of the semiconductor devices are apt to be broken and cracked. On the other hand, in the case of cutting with the laser means, it takes a long time to cut the substrate 12.

[0005] If the semiconductor chips 10 are molded by potting resin 14, it takes a long time to solidify the resin 14, so manufacturing efficiency is quite low. In the case of molding a transfer molding machine, wires are apt to be deformed by resin flow, so that bad products will be produced. Further, the molded substrate will be deformed or curved because one side face of the substrate 12 is wholly molded.


[0007] JP 61 167515A discloses a molding assembly in which resin is injected into the cavity of a mold from a pot.

[0008] According to one aspect of the present invention there is provided a method of manufacturing molded semiconductor devices using a molding machine including an upper die and a lower die, comprising the steps of clamping a substrate carrying semiconductor devices to be molded between the dies, filling cavities in one of the dies with resin, and forming the molded semiconductor devices by cutting the molded substrate, wherein said cavities are formed in a molding face of one of said dies and are separated by parting plates, said cavities being positioned to receive therein at least one respective semiconductor device to be molded, the method comprising the step of covering inner faces of said cavities and a parting face of one of said dies which contacts the substrate carrying the semiconductor devices to be molded with release film which is easily peelable from said dies and from said resin; characterised in that said parting plates are movable in the open-close direction of the dies between (a) an opened configuration in which their upper end faces are spaced from the substrate to define resin paths communicating adjacent cavity spaces so that all cavity spaces can be filled with resin; and (b) a closed configuration in which their upper end faces contact the bottom face of the substrate and the cavity spaces are entirely separated from each other; wherein resin is passed in to fill the cavity spaces when the mold is closed, with the substrate and film clamped between the dies and with the parting plates in the opened configuration; whereafter the parting plates are moved to the closed configuration.

[0009] According to a further aspect of the present invention there is provided a resin molding machine for use in such a method comprising an upper die and a lower die for clamping therebetween a member to be molded, which member includes a substrate on which semiconductor chips and/or circuit elements are mounted, a plurality of cavities being formed in one of said dies, said cavities being separated by said movable parting plates and being capable of accommodating the semiconductor chips and/or the circuit elements; said machine including a release film feeding mechanism for feeding release film, which is easily peelable from said dies and from the resin, so as to cover inner faces of said cavities and a parting face of one of said dies which contacts the substrate, and a resin filling mechanism for feeding resin from a pot to said cavities while the member to be molded, together with said release film, is clamped between said dies, whereby the semiconductor chips and/or the circuit elements are respectively molded with resin.

[0010] The present invention will now be described by way of examples and with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view of a resin molding machine outside the scope of the present invention, wherein a member to be molded is set therein;

Fig. 2 is a sectional view of the resin molding machine of Fig. 1 wherein the member to be molded is clamped and molded with resin;

Fig. 3 is a perspective view of a lower die of the resin molding machine of Fig. 1;

Fig. 4 is a perspective view of a lower die of the resin molding machine of Fig. 1;

Figs. 5 and 6 are sectional views of further resin molding machines outside the scope of the present invention;

Fig. 7 is a sectional view of a resin molding machine which is an embodiment of the present invention;

Fig. 8 is a perspective view of a member molded with resin by the machine of Fig. 7; and
The release film 40 should have enough flexibility and extensibility so as to easily deform along inner faces of the molding sections, e.g., the cavities 26a. Further, the release film 40 should be easily peelable from solidified resin.

The release film 40 is fed to wholly cover the parting faces, and the feeding action is synchronized with the molding action. The release film 40 may be merely mounted on the parting faces of the dies, preferably the release film 40 is fixed on and along the inner faces of the cavities 26a by sucking air through inner bottom faces of the cavities 26a. Air is sucked through air sucking holes 32 to fix the release film 40. The air sucking holes 32 are formed like, for example, slits and opened in the inner bottom faces of the cavities 26a. The air sucking holes 32 are communicated to an air mechanism for sucking air.

Since the release film 40 has enough flexibility, the release film 40 can be easily deformed and fixed along the inner faces of the cavities 26a by sucking air through the air sucking holes 32. With this action, the cavity spaces 26 can form an inner circumferential face of the pot 24 and the whole parting faces of the lower dies 21.

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Since the release film 40 has enough flexibility, the release film 40 can be easily deformed and fixed along the inner faces of the cavities 26a by sucking air through the air sucking holes 32. With this action, the cavity spaces 26 can form an inner circumferential face of the pot 24 and the whole parting faces of the lower dies 21.
the cavity space 26 which is the nearest to the pot 24 is filled with the resin 34a, then further cavity spaces 26 are filled in order. Each runner path 30 mutually communicates the adjacent cavity spaces 26 and acts as a resin path to fill the cavity spaces 26 with the resin 34a. After the resin 34a is sent from the pot 24 to all the cavity spaces 26, resin pressure is kept to solidify the resin 34a. After the resin 34a is solidified, the dies are opened, and the molded products are taken from the lower dies 21. The molded products may be taken out by the steps of: taking out the molded products, together with the release film 40, from the dies; and removing the release film 40 from the molded products, or by the steps of: removing the release film from the molded products in the dies; and separately taking out the molded products and the release film 40 from the dies. The molded member (product) is shown in Fig. 4. A plurality of rectangular resin-molded sections 36 are matrically arranged on the substrate 12 with regular separations. No resin is stuck between the adjacent resin-molded sections 36, so that the surface of the substrate 12 is partially exposed therebetween. Resin pieces 30a were solidified in the runner path 30 and stuck to the substrate 12. The semiconductor devices are completed by dividing the substrate 12 along the resin-molded sections 36. In Fig. 4, lines A-A are dividing lines in the longitudinal direction of the substrate 12; lines B-B are dividing lines perpendicular to the dividing lines A-A. In the products molded by the resin molding machine of Fig. 1, the solidified resin pieces 30a are partially left in the runner paths 30, but the surface of the substrate is partially exposed between the adjacent resin-molded sections 36 so that pieces of the semiconductor devices can be easily gained by cutting the substrate 12 along the dividing lines. Since the semiconductor devices are separated by cutting the substrate 12 only, a blade of a dicing cutter is not damaged and the semiconductor devices can be separated. To easily separate the substrate 12 by the dicing cutter, slit holes may be formed along the dividing lines except the portions in which the runner paths 30 are formed. Further, notches, which corresponds to the dividing lines, may be formed in the substrate 12. In this case, the substrate 12 is broken along lines including the notches so as to separate the semiconductor devices. By employing the release film 40, the members 16 to be molded can be securely clamped and properly molded. If the substrate 12 is made of a plastic, thickness of the substrate 12 is partially different. But, the difference of the thickness can be absorbed by the release film 40, so that the substrate 12 can be securely molded without forming resin flash on the surface thereof. In the conventional resin molding machine, the molded products are ejected by ejector pins while the dies are opened. By employing the release film 40, the molded products can be ejected from the dies without ejector pins. Namely, no ejector pins are assembled in the dies, so that structures of the dies can be simpler. By covering the inner faces of the molding sections, e.g., the cavities, with the release film 40, the resin 34a can smoothly flow on inner faces of the cavities 26a, so that the cavity spaces 26 can be easily filled with the resin 34a and the substrates can be securely molded without forming voids in the resin-molded sections 36. Since the resin 34a can smoothly flow in the cavity spaces 26, the semiconductor devices having thin resin-molded sections 36, whose thickness is, for example, 0.1mm, can be manufactured easily. In the conventional resin molding machine, the resin, which is capable of smoothly flowing in the cavity spaces 26 and easily peelable from the dies, is selected. In the machine of Fig. 1, since the release film 40 is employed, the resin does not directly contact the dies, so that the resin may be selected on the basis of characteristics of filling the cavity spaces 26 and electric characteristics of the semiconductor devices only. The release film 40 may be used as shown in Fig. 5. Two sheets of the release film 40 respectively cover the parting faces of the upper die 20 and the lower die 21. And, the pot 24 may be faced to the substrate of the member 16. Further, as shown in Fig. 6, concave sections 20a, whose depth is equal to the thickness of the member 16 to be molded, may be formed in the upper die 20 so as to accommodate the members 16 respectively therein. The runner paths 30 are formed in the parting sections 28 of the lower die 21. To leave no solidified resin pieces, which have been solidified in the runner paths 30, on the substrate 12, the dies shown in Fig. 7 may be employed. Fig. 7 shows an embodiment of the invention. In the dies shown in Fig. 7, the parting sections 28a divide the rectangular cavities 26a as well as the parting sections 28 of the lower die 21 shown in Fig. 3. But, the parting sections 28a of Fig. 7 are parting plates, which can be moved in the vertical direction. The parting plates 28a are supported by a supporting plate 38, which is moved in the vertical direction. In Fig. 7, the members 16 are clamped by the upper die 20 and the lower die 21 together with the release film 40, and the resin 34a is sent from the pot 24 to the cavity spaces 26. Since upper end faces of the parting plates 28a are separated from the bottom face of the substrate 12 so as to form the resin paths 31, which mutually communicate the adjacent cavity spaces 26, when the cavity spaces 26 are filled with the resin 34a, all the cavity spaces 26 can be filled with the resin 34a. Upon filling all the cavity spaces 26 with the resin 34a, the supporting plate 38 is moved upward until the upper end faces of the parting plates 28a contact the bottom face of the substrate 12, so that each cavity space 26 can be perfectly divided. With this manner, no resin pieces are left in the resin paths 31, each of which is formed on the bottom face of the substrate 12 and communicates the adjacent
cavity spaces 26, after completing the molding actions, so that the molded product whose resin-molded sections 36 are perfectly separated on the substrate 12 can be produced as shown in Fig. 8. Since the resin-molded sections 36 are perfectly separated, the pieces of the semiconductor devices can be easily produced by cutting the substrate 12.

[0042] The parting plates 28a are moved in vertical holes bored in the lower dies 21, so the release film 40 can be fixed on and along the inner faces of the cavities 26a by sucking air through the vertical holes. Therefore, no air sucking holes are separately required.

[0043] In the above described machines, the cavities 26a are formed in the lower dies 21, but the methods can be applied to the resin molding machine in which the cavities 26a are formed in the upper die 20. In the case of forming the cavities 26a in the upper die 20, the resin paths for mutually communicating the cavity spaces 26 are formed in the upper die 20.

Claims

1. A method of manufacturing molded semiconductor devices using a molding machine including an upper die (20) and a lower die (21), comprising the steps of clamping a substrate (12) carrying semiconductor devices (10) to be molded between the dies, filling cavities (26) in one of the dies (20,21) with resin (14), and forming the molded semiconductor devices by cutting the molded substrate (12), wherein said cavities (26) are formed in a molding face of one of said dies (20,21) and are separated by parting plates (28a), said cavities being positioned to receive therein at least one respective semiconductor device (10) to be molded, the method comprising the step of covering inner faces of said cavities (26) and a parting face of one of said dies (20,21) which contacts the substrate (12) carrying the semiconductor devices (10) to be molded with release film (40) which is easily peelable from said dies (20,21) and from said resin (14); characterised in that said parting plates (28a) are movable in the open-close direction of the dies (20,21) between (a) an opened configuration in which their upper end faces are spaced from the substrate (12) to define resin paths (31) communicating adjacent cavity spaces (26) so that all cavity spaces can be filled with resin; and (b) a closed configuration in which their upper end faces contact the bottom face of the substrate and the cavity spaces (26) are entirely separated from each other; wherein resin (14) is passed in to fill the cavity spaces (26) when the mold is closed, with the substrate (12) and film (40) clamped between the dies and with the parting plates (28a) in the opened configuration; whereafter the parting plates (28a) are moved to the closed configuration.

2. The method according to claim 1 in which the resin (34a) is pressurised in a pot (24) and sent from the pot (24) to fill the cavities (26).

3. The method according to claim 1 or claim 2 wherein said release film (40) is fixed on the inner faces of said cavities (26) by sucking air through air sucking holes (32), which respectively open into the inner faces of said cavities, when the inner faces of said cavities (26) and the parting face of said die (21) are covered with said release film (40).

4. The method according to claim 3 wherein the parting plates (28a) move in vertical holes bored in the lower die (21), which holes also serve as said air sucking holes (32).

5. A resin molding machine for use in a method according to any preceding claim comprising an upper die (20) and a lower die (21) for clamping therebetween a member (16) to be molded, which member (16) includes a substrate (12) on which semiconductor chips (10) and/or circuit elements are mounted, a plurality of cavities (26) being formed in one of said dies (20,21), said cavities (26) being separated by said movable parting plates (28a) and being capable of accommodating the semiconductor chips (10) and/or the circuit elements; said machine including a release film feeding mechanism for feeding release film (40), which is easily peelable from said dies (20,21) and from the resin (34a), so as to cover inner faces of said cavities (26) and a parting face of one of said dies (20,21) which contacts the substrate (12), and a resin filling mechanism for feeding resin (34a) from a pot (24) to said cavities (26) while the member (16) to be molded, together with said release film (40), is clamped between said dies, whereby the semiconductor chips (10) and/or the circuit elements are respectively molded with resin (34a).

Patentansprüche

1. Verfahren zur Herstellung von geformten Halbleitervorrichtungen unter Verwendung einer Formmaschine, einschließlich eines oberen Pressstempels (20) und eines unteren Pressstempels (21), wobei das Verfahren folgende Schritte umfasst: das Einspannen eines Substrats (12), das die Halbleitervorrichtungen (10) trägt, die geformt werden sollen, zwischen den Pressstempeln, das Füllen von Vertiefungen (26) in einem der Pressstempel (20, 21) mit Harz (14) und das Formen der geformten Halbleitervorrichtungen durch das Trennen des geformten Substrats (12), wobei die Vertiefungen (26) in einer Formfläche eines der Pressstempel (20, 21) ausgebildet sind und durch Trennplatten (28a) voneinander getrennt sind, wobei die Vertiefungen angeord-
5. Harzformmaschine zur Verwendung in einem Verfahren nach Anspruch 3, worin sich die Trennungsräume (26) und eine Trennfläche eines der Pressstempel (20, 21, 20, 21) berührt, das die Halbleitervorrichtungen (10) trägt, die geformt werden sollen, mit Trennmittel, der einfach von den Pressstempeln (20, 21) und dem Harz (14) abziehbar ist; dadurch gekennzeichnet, dass die Trennplatten (28a) in der Offen-Geschlossen-Richtung der Pressstempel (20, 21) zwischen (a) einer geöffneten Anordnung, in der ihre oberen Endflächen von dem Substrat (12) beabsichtigt sind, um Harzpfade (31) zu definieren, die benachbarte Vertiefungsräume (26) verbinden, damit alle Vertiefungsräume mit Harz gefüllt werden können, und (b) einer geschlossenen Anordnung, in der ihre oberen Endflächen die untere Fläche des Substrats berühren und die Vertiefungsräume (26) vollständig von einander getrennt sind, bewegbar sind; wobei Harz (14) eingeleitet wird, um die Vertiefungsräume (26) zu benetzen, wenn die Form geschlossen ist, wobei das Substrat (12) und der Film (40) zwischen den Pressstempeln eingeklemmt sind und die Trennplatten (28a) sich in ihrer offenen Anordnung befinden; wonach die Trennplatten (28a) in ihre geschlossene Anordnung bewegt werden.

2. Verfahren nach Anspruch 1, worin das Harz (34a) in einem Tiegel (24) unter Druck gesetzt wird und zur Befüllung der Vertiefungen (26) aus dem Tiegel (24) geleitet wird.

3. Verfahren nach Anspruch 1 oder 2, worin, wenn die Innenflächen der Vertiefungen (26) und die Trennfläche des Pressstempels (21) mit dem Trennfilm (40) bedeckt sind, der Trennfilm (40) an den Innenflächen der Vertiefungen (26) fixiert wird, indem Luft durch Luftabsauglöcher (32) gesaugt wird, die jeweils in die Innenflächen der Vertiefungen einmünden.

4. Verfahren nach Anspruch 3, worin sich die Trennplatten (28a) in vertikalen Löchern bewegen, die in den unteren Pressstempel (21) gebohrt sind, wobei die Löcher auch als die Luftabsauglöcher (32) dienen.

5. Harzformmaschine zur Verwendung in einem Verfahren nach einem der vorangegangenen Ansprüche, umfassend einen oberen Pressstempel (20) und einen unteren Pressstempel (21), um dazwischen ein Element (16) einzuklammern, das geformt werden soll, wobei das Element (16) ein Substrat (12) umfasst, auf dem Halbleiterchips (10) und/oder Schaltungselemente befestigt sind, wobei eine Vielzahl an Vertiefungen (26) in einem der Pressstempel (20, 21) ausgebildet ist, wobei die Vertiefungen (26) durch die bewegbaren Trennplatten (28a) getrennt sind und in der Lage sind, die Halbleiterchips (10) und/oder Schaltungselemente aufzunehmen; wobei die Maschine einen Trennfilmzufuhrmechanismus, um den Trennfilm (40) zuzu führen, der einfach von den Pressstempeln (20, 21) und von dem Harz (34a) abziehbar ist, um die Innenflächen der Vertiefungen (26) und eine Trennfläche eines der Pressstempel (20, 21), die das Substrat (12) berührt zu bedecken, und einen Harzbefüllungsmechanismus umfasst, um Harz (34a) aus einem Tiegel (24) in die Vertiefungen zuzuführen, während das Element (16), das geformt werden soll, gemeinsam mit dem Trennfilm (40) zwischen den Pressstempeln eingeklemmt ist, wobei die Halbleiterchips (10) und/oder die Schaltungselemente jeweils aus Harz (34a) geformt sind.

Revidications

1. Procédé de fabrication de dispositifs semiconducteurs moulés en utilisant une machine de moulage comportant une matrice supérieure (20) et une matrice inférieure (21), comprenant les étapes consistent à serrer un substrat (12) supportant les dispositifs semiconducteurs (10) à mouler entre les matrices, remplir les cavités (26) dans une des matrices (20, 21) avec la résine (14) et former les dispositifs semiconducteurs (10) moulés en coupant le substrat moulé (12), où lesdites cavités (26) sont formées dans une face de moulage d’une desdites matrices (20, 21) et sont séparées par des plaques de séparation (28a), lesdites cavités étant positionnées pour recevoir à l’intérieur au moins un dispositif semiconducteur respectif (10) à mouler, le procédé comprenant l’étape consistant à couvrir les faces intérieures desdites cavités (26) et une face de séparation d’une desdites matrices (20, 21) et de ladite résine (14), caractérisé en ce que lesdites plaques de séparation (28a) sont déplacables, dans la direction d’ouverture-fermeture des matrices (20, 21) entre (a) une configuration ouverte dans laquelle leurs faces d’extrémité supérieures sont espacées du substrat (12) pour définir des chemins de résine (31) communiquant avec des espaces de cavité adjacents (26) de sorte que tous les espaces de cavité peuvent être remplis de résine; et (b) une configuration fermée dans laquelle leurs faces d’extrémité supérieures viennent en contact avec la face inférieure du substrat, et les espaces de cavité (26) sont entièrement séparés les uns des autres; où la résine (14) est amenée à remplir les espaces de cavité (26) lorsque le moule est fermé, le substrat (12) et le film (40) étant serrés entre les
matrices, et les plaques de séparation (28a) se trouvant dans la configuration ouverte; à la suite de quoi les plaques de séparation (28a) sont amenées à la configuration fermée.

2. Procédé selon la revendication 1, dans lequel la résine (34a) est mise en pression dans un pot (24) et est évacuée du pot (24) pour remplir la cavité (26).

3. Procédé selon la revendication 1 ou la revendication 2, dans lequel le film de libération (40) est fixé sur les faces intérieures desdites cavités (26) en aspirant l’air à travers des trous d’aspiration d’air (32) qui s’ouvrent respectivement dans les faces intérieures desdites cavités, lorsque les faces intérieures desdites cavités (26) et la face de séparation de ladite matrice (21) sont couvertes par le film de libération (40).

4. Procédé selon la revendication 3, dans lequel les plaques de séparation (28a) se déplacent dans des trous verticaux percés dans la matrice inférieure (21), lesdits trous servent également de trous d’aspiration d’air précités (32).

5. Machine de moulage de résine pour utilisation dans un procédé selon l’une quelconque des revendications précédentes, comprenant une matrice supérieure (20) et une matrice inférieure (21) pour le serrage entre celles-ci d’un membre (16) à mouler, ledit membre (16) comporte un substrat (12) sur lequel des plaquettes de semiconducteur (10) et/ou des éléments de circuit sont montés, une pluralité de cavités (26) étant formées dans une desdites matrices (20, 21), lesdites cavités (26) étant séparées par lesdites plaques de séparation mobile (28a) et étant aptes à recevoir les pastilles de semiconducteur (10) et/ou des éléments de circuit; ladite machine comportant un mécanisme d’aménée de film de libération pour l’aménée du film de libération (40), qui peut être facilement décollé desdites matrices (20, 21) et de la résine (34a) de manière à couvrir les faces intérieures desdites cavités (26) et une face de séparation d’une desdites matrices (20, 21) qui vient en contact avec le substrat (12), et un mécanisme de remplissage de résine pour amener la résine (34a) d’un pot (24) auxdites cavités (26) pendant que l’élément (16) à mouler, ensemble avec ledit film de libération (40), est serré entre lesdites matrices, par quoi les pastilles de semiconducteur (10) et/ou les éléments de circuit sont respectivement moulés avec la résine (34a).
REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description