DESCRIPTION

PLASTIC MOLDED TYPE SEMICONDUCTOR DEVICE AND FABRICATION PROCESS THEREOF

Technical Field

The present invention relates to a plastic molded type semiconductor device, in particular, to a plastic molded type semiconductor device fabricated by the transfer mold method and a technique effective when applied to a process for the fabrication of the device.

Background Art

A plastic molded type semiconductor device is fabricated by mounting a semiconductor chip on a chip mounting surface of a die pad (which is also called tab) supported on the frame body of a lead frame through a supporting lead, electrically connecting an external terminal, which is disposed on the principal surface of the semiconductor chip, with an inner portion of the lead supported onto the frame body of the lead frame through a bonding wire, sealing the semiconductor chip, die pad, supporting lead, inner portion of the lead, bonding wire and the like with a plastic mold, cutting the supporting lead and the outer portion of the lead from the frame body of the lead frame, and then forming the outer portion of

the lead into a predetermined shape.

The plastic mold for the above-described plastic molded type semiconductor device is fabricated in accordance with the transfer mold method suited for mass production. Described specifically, a lead frame subjected to the preceding steps (die bonding step and wire bonding step) is disposed between the top portion and the bottom portion of a mold and at the same time, within the cavity of the mold, a semiconductor chip, die pad, supporting leads and inner portions of the leads and bonding wires are arranged. Then a resin is poured under pressure into the cavity from a pot of the mold through its runner and gate, whereby a plastic mold can be prepared.

In the fabrication step of the above-described plastic mold, with a view to suppressing a failure to fill the resin into the cavity, in other words, suppressing the generation of a void, there has been an attempt to make the fluidity of the resin flowing into the filling region 11A on the principal surface side of the semiconductor chip 2 equal to the fluidity of the resin flowing into the filling region 11B on the reverse surface side of the semiconductor chip 2 by arranging the semiconductor chip 2 and the die pad 3A within the cavity 11 so as to, as illustrated in FIG. 16 (a schematic cross-sectional view), make a clearance L1 from the principal surface of the

semiconductor chip 2 to the inside wall surface of the cavity 11 opposite to the principal surface equal to a clearance L2 from the reverse surface of the die pad 3A to the inside wall surface of the cavity 11 opposite to the reverse surface. In addition, there has also been an attempt to fill the resin simultaneously into the filling region 11A on the principal surface side of the semiconductor chip 2 and the filling region 11B on the reverse surface side by adopting, as a gate for controlling the amount of the resin poured into the cavity 2, a center gate 12 (which will also be called "vertical gate") extending above and below the lead frame 3.

In the above-described plastic molded semiconductor device, the die pad, together with the semiconductor chip, is sealed with the plastic mold so that water contained in the plastic mold tends to be collected in the reverse surface of the die pad. Water content collected in the reverse surface of the die pad vaporizes and expands by the heat generated upon a temperature cycle test, which is an environmental test effected after the completion of the product, or the heat generated upon packaging and becomes a cause for cracks (package cracks) of the plastic mold.

With a view to overcoming such technical problems, disclosed in Japanese Patent Laid-Open No. SHO 63-204753 is a technique for making the area of a die pad smaller than

that of a semiconductor chip, by which technique, a phenomenon that water contained in the resin of a plastic mold is collected in the reverse surface of the die pad can be suppressed. Thus, cracks (package cracks) of the plastic mold caused by vaporization and expansion of the water content in the reverse surface of the die pad can be prevented.

As illustrated in FIG. 17 (a schematic cross-sectional view), when the area of a die pad 3A is made smaller than that of a semiconductor chip 2, a filling region 11B on the reverse surface side of the semiconductor chip 2 becomes wider in proportion, which makes the fluidity of a resin flowing in the filling region 11B on the reverse surface side of the semiconductor chip 2 higher than that flowing in the filling region 11A on the principal surface side of the semiconductor chip 2. In other words, the filling of the resin into the filling region 11B on the reverse surface side of the semiconductor chip 2 is completed earlier than that into the filling region 11A on the principal surface side of the semiconductor chip 2. As illustrated in FIG. 18 (a schematic cross-sectional view), a resin 1A filled in the filling region 11B on the reverse surface side of the semiconductor chip 2 lifts the semiconductor chip 2 upwardly and causes inconvenient appearance of the semiconductor chip 2, bonding wire and

the like from the plastic mold, leading to a marked reduction in the yield of the plastic molded type semiconductor device.

In the resin molded type semiconductor device adopting a QFP structure, on the other hand, supporting leads are arranged in the outside region of the corner of a semiconductor chip, while a plurality of leads and a plurality of bonding wires are arranged on the outside region of each side of the semiconductor chip. In other words, the outside region of the corner of the semiconductor chip is coarser than the outside region of each side of the semiconductor chip so that the fluidity of the resin is higher in the outside region of the corner of the semiconductor chip than the outside region of each side of the semiconductor chip. Accordingly, the bonding wire tends to flow owing to the resin flowing into the outside region of each side of the semiconductor chip from the outside region of the corner and a short circuit occurs between two adjacent bonding wires, which brings about a marked deterioration in a yield of the plastic molded type semiconductor device. The short circuit between these bonding wires is particularly marked between a bonding wire connected to a first-stage lead most adjacent to the outside region of the corner of the semiconductor chip and a bonding wire connected to a second-stage lead adjacent to

the first lead.

An object of the present invention is to provide a technique which can increase an yield of a plastic molded type semiconductor device.

Another object of the present invention is to provide a technique which can heighten an yield in the fabrication process of a plastic molded type semiconductor device.

The above-described and the other objects and novel features of the present invention will be apparent by the following description and accompanying drawings.

Disclosure of the Invention

Typical inventions disclosed in this application will next be summarized briefly.

(1) A process for the fabrication of a plastic mold semiconductor device in which a die pad is formed to have a smaller area than a semiconductor chip mounted on a principal surface of the die pad and the semiconductor chip and die pad are sealed with a plastic mold, which comprises a step of mounting the semiconductor chip on the principal surface of the die pad supported onto a frame body of a lead frame through supporting leads; a step of arranging said lead frame between the top portion and the bottom portion of a mold and arranging, in a cavity of the mold, the semiconductor chip and die pad so that a clearance from

the reverse surface side of the die pad to the inside wall surface of the cavity opposite to the reverse surface side of the die pad becomes narrower, by the thickness of the die pad, than a clearance from the principal surface of the semiconductor chip to the inside wall surface of the cavity opposite to the principal surface of the semiconductor chip; and a step of pouring a resin from a gate of said mold positioned on one side of said semiconductor chip. It further comprises using as the gate of the mold, a center gate extending above and below the lead frame and pouring the resin to the upper and lower portions of the cavity simultaneously, thereby forming a plastic mold.

(2) A plastic molded type semiconductor device in which a plurality of external terminals are arranged on and along at least one side of the principal surface of a semiconductor chip, a plurality of leads are arranged outside and along one side of said semiconductor chip, each of the plurality of external terminals is electrically connected with one end portion of each of said plurality of leads through a bonding wire, and the semiconductor chip, leads and bonding wires are sealed with a resin. In this plastic molded type semiconductor device, at least a distance between an end portion of a first-stage lead most adjacent to a corner of said semiconductor chip and a second-stage lead adjacent to the first-stage lead is

formed wider than a distance of the other two leads at one end portion.

According to the means (1), the filling region on the principal surface side of the semiconductor chip has substantially the same volume with that of the filling region on the reverse surface side, each region disposed within the cavity, whereby the fluidity of the resin flowing through the filling region on the principal surface side of the semiconductor chip can be made almost equal to that of the resin flowing through the filling region on the reverse surface side. Furthermore, the adoption of the center gate makes it possible to supply the resin to the filling region on the principal surface side of the semiconductor chip and the filling region on its reverse surface side simultaneously. Accordingly, the filling of the resin to the filling region on the principal surface side of the semiconductor chip and the filling to the filling region on the reverse surface side can be completed almost at the same time, which makes it possible to prevent the semiconductor chip from being lifted upwardly by the resin filled to the filling region on the reverse surface side of the semiconductor chip. As a result, inconvenient appearance of the semiconductor chip, bonding wires and the like from the plastic mold can be prevented and the yield of the plastic molded type semiconductor device can be

heightened.

According to the above-described means (2), since the clearance between a bonding wire connected to one end portion of the first-stage lead most adjacent to the outside region of the corner portion of the semiconductor chip and another bonding wire connected to one end portion of the second-stage lead adjacent to the first-stage lead can be formed wider, even if the boding wire moves owing to the resin flowing into the outside region of one side of the semiconductor chip from the outside region of the corner of the semiconductor chip, a short circuit between these bonding wires can be suppressed. As a result, an yield of the plastic molded type semiconductor device can be heightened.

Brief Description of the Drawings

FIG. 1 is a plan view a plastic molded type semiconductor device according to a first embodiment of the present invention from which the upper portion of a plastic mold has been removed.

FIG. 2 is a cross-sectional view taken along line A-A of FIG. 1.

FIG. 3 is a cross-sectional view taken along line B-B of FIG. 1.

FIG. 4 is a plan view of a lead frame used for the

fabrication of the above-described plastic molded type semiconductor device.

FIG. 5 is a fragmentary cross-sectional view for illustrating the process for the fabrication of the above-described plastic molded type semiconductor device.

FIG. 6 is another fragmentary cross-sectional view for illustrating the process for the fabrication of the above-described plastic molded type semiconductor device.

FIG. 7 is a schematic cross-sectional view for illustrating the flow of a resin.

FIG. 8 is another schematic cross-sectional view for illustrating the flow of a resin.

FIG. 9 is a plan view of another lead frame used for the fabrication of the above-described plastic molded type semiconductor device.

FIG. 10 is a plan view of a further lead frame used for the fabrication of the above-described plastic molded type semiconductor device.

FIG. 11 is a plan view of a plastic molded type semiconductor device according to a second embodiment of the present invention from which the upper portion of a plastic mold has been removed.

FIG. 12 is a fragmentary enlarged cross-sectional view of FIG. 11.

FIG. 13 is a plan view of a lead frame used for the

fabrication of the above-described plastic molded type semiconductor device.

FIG. 14 is a fragmentary plan view illustrating a modification of the above-described plastic molded type semiconductor device.

FIG. 15 is a plan view of a semiconductor chip illustrating a modification of the above-described plastic molded type semiconductor device.

FIG. 16 is a schematic cross-sectional view for illustrating the conventional problems.

FIG. 17 is another schematic cross-sectional view illustrating the conventional problems.

FIG. 18 is a further schematic cross-sectional view illustrating the conventional problems.

Best Modes for Carrying Out the Invention

The constitution of the present invention will hereinafter be described with reference to embodiments.

In any one of the drawings illustrating the embodiment, like elements of function will be identified by like reference numerals and overlapping descriptions will be omitted.

(First Embodiment)

In the plastic molded type semiconductor device according to this embodiment, a semiconductor chip 2 is

mounted on a chip mounting surface (principal surface) of a die pad 3A as illustrated in FIGS. 1 and 2.

The semiconductor chip 2 has a planar shape, for example, a square plane having an outside dimension of 9 [mm] x 9 [mm]. It is, for example, formed mainly of a semiconductor substrate made of single crystal silicon and an interconnection layer formed on the principal surface of the substrate.

On the semiconductor chip 2, mounted are, for example, a logic circuit system or a mixed circuit system having a logic circuit system and a memory circuit system in combination. Besides, on the principal surface of the semiconductor chip 2, a plurality of external terminals (bonding pads) 2A are arranged along each side of the principal surface. Each of these external terminals 2A is formed on the top interconnection layer among the interconnection layers of the semiconductor chip 2, and is formed of an aluminum (Al) film or aluminum alloy film.

Outside of each side of the semiconductor chip 2, a plurality of leads 3C are arranged along each side. Each of the respective inner portions 3C1 of these plurality of leads 3C is electrically connected, through a bonding wire 5, with each of the plurality of external terminals 2A arranged on the principal surface of the semiconductor chip 2.

As the bonding wire 5, a gold (Au) wire is used by way of example. Alternatively, a wire having a metal wire such as aluminum (Al) wire or copper (Cu) wire covered with an insulating resin may be used. The connection of the bonding wire 5 is effected by the bonding method using thermo-compression bonding and ultrasonic vibration in combination.

To the die pad 3A, four supporting leads 3B are coupled. Each of these four supporting leads 3B serves to support the die pad 3A onto a frame body of the lead frame under the condition of the lead frame. The four supporting leads 3B support the die pad 3A at four points thereof so as to form a character X with the die pad 3A as an intersection. The width of the supporting lead 3B is set, for example, to 0.4 [mm].

The semiconductor chip 2, die pad 3A, supporting leads 3B, inner portions 3C1 of leads 3C and bonding wires 5 and the like are sealed with a plastic mold 1 formed by the transfer mold method. The plastic mold 1 is formed, for example, of a biphenyl resin added with a phenol hardener, silicone rubber, filler and the like in order to lower stress. The transfer mold method is a method to form a plastic mold by using a mold equipped with a pot, a runner, a gate, a cavity and the like and pouring a resin into the cavity from the pot through the runner and gate

under pressure.

The planar shape of the plastic mold 1 is, for example, a square shape having an outside dimension of 14 [mm] x 14 [mm]. Outside of each side of the plastic mold 1, outer portions 3C2 of a plurality of leads 3C are arranged. The outer portions 3C2 of the plurality of leads 3C are arranged along each side of the plastic mold 1, for example, in the form of a gull-wing. In short, the plastic mold semiconductor device according to this embodiment is fabricated to have a QFP (Quad Flat Package) structure.

The planar shape of the die pad 3A is, for example, in the circular form having an outside dimension of 2 to 4 [mm]ϕ. In other words, the die pad 3A according to this embodiment is formed to have a smaller area than that of the semiconductor chip 2. By forming the die pad 3A to have a smaller area than that of the semiconductor chip 2, the phenomenon that the water content, which is contained in the resin of the plastic mold 1, is collected in the reverse surface side of the die pad 3A can be suppressed, leading to the prevention of cracks of the plastic mold 1 caused by vaporization and expansion of the water content.

In the fabrication step of the plastic mold 1, even if the middle portion of the bonding wire 5 hangs down, the contact of the die pad 3A with the bonding wire 5 can be prevented, because the die pad 3A does not exist outside of

the outer periphery of the semiconductor chip 2. The longer the bonding wire 5 is, the middle portion of the bonding wire 5 hangs down more markedly.

On the other hand, when the area of the semiconductor chip 2 is reduced to that of the die pad 3A, the die pad 3A does not exist outside of the outer periphery of the semiconductor chip 2. Accordingly, even if the middle portion of the bonding wire 5 hangs down, the die pad 3A is not brought into contact with the bonding wire 5 so that a semiconductor chip 2 having a different outside dimension can be mounted.

The central region of the reverse surface opposite to the principal surface of the semiconductor chip 2 is adhered and fixed to the chip mounting surface of the die pad 3A through an adhesive 4. The adhesive 4 is composed of, for example, an epoxy-based silver (Ag) paste material. The adhesive 4 is applied, in the bonding step of the semiconductor chip 2, to the chip mounting surface of the die pad 3A by the multi-point coating method.

The supporting lead 3B is, as illustrated in FIG. 3, formed of a lead portion 3B1 and a lead portion 3B2. The lead portion 3B1 is disposed at the same position, in the thickness direction (vertical direction) of the mold, as that of the inner portion 3C1 of the lead 3C illustrated in FIG. 2, while the lead portion 3B2 is disposed at the same

position, in the thickness direction (vertical direction) of the mold, as that of the die pad 3A. In the plastic molded type semiconductor device according to this embodiment, the chip mounting surface of the die pad 3A is lowered in the thickness direction of the mold from the upper surface (bonding surface) of the inner portion 3C1 of the lead 3C.

In the plastic mold 1, as illustrated in FIG. 2 and FIG. 3, the thickness L1 of the resin on the principal surface of the semiconductor chip 2 is thicker, by the thickness corresponding to the thickness of the die pad 3A, than the thickness L2 of the resin on the reverse surface of the die pad 3A. In other words, the semiconductor chip 2 is disposed nearly at the center of the plastic mold 1 in the thickness direction of the plastic mold 1.

The plastic molded type semiconductor device having the above-described constitution is fabricated by a process using a lead frame 3 as illustrated in FIG. 4.

The lead frame 3 has a die pad 3A, four supporting leads 3B, a plurality of leads 3C and the like, each arranged within a region defined by the frame body 3E. The die pad 3A is coupled to the frame body 3E through the four supporting leads 3B. The plurality of the leads 3C are connected with the frame body 3E and at the same time, are connected through a tie bar (dam bar) 3D each other.

The lead 3C is formed of an inner portion 3C1 to be sealed with the plastic mold 1 and an outer portion 3C2 formed into a predetermined shape. The supporting lead 3B is formed of the lead portion 3B1 and the lead portion 3B2. The lead portion 3B1 is disposed at the same position in the thickness direction (vertical direction) of the mold as that of the inner portion 3C1 of the lead 3C, while the lead portion 3B2 is disposed at the same position in the thickness direction (vertical direction) of the mold as that of the die pad 3A.

The lead frame 3 is composed of, for example, an iron (Fe)-nickel (Ni) based alloy, copper (Cu) or copper based alloy. This lead frame is formed by etching or pressing a plate material into a predetermined pattern, followed by pressing the supporting lead 3B.

In the vicinity of the region where the supporting leads 3B are connected to the frame body 3E of the lead frame 3, a penetration hole 3F is formed for the injection of the resin. This penetration hole 3F is to divide the flow of the resin, which has been supplied from the pot of the mold through the runner, into two streams, that is, streams above and below the lead frame 3 during the fabrication step of the plastic mold 1.

The smaller the outer dimension of the die pad 3A, the longer the supporting leads 3B become, which makes it easy

to move the die pad 3A in the vertical direction. Moreover, with an increase in the number of the pins, the supporting leads 3B becomes narrower and the die pad 3A can be moved more easily in the vertical direction. Further, the thinner the plastic mold 1, the thinner the supporting leads 3B, which makes it easy to move the die pad 3A in the vertical direction.

A description will next be made of the fabrication method of the above-described plastic molded type semiconductor device.

First, a lead frame 3 as illustrated in FIG. 4 is prepared.

Then, an adhesive 4 is applied by a multi-point coating method onto a chip mounting surface (principal surface) of a die pad 3A supported onto a frame body 3E of the lead frame 3 through supporting leads 3B.

On the chip mounting surface of the die pad 3A, a semiconductor chip 2 is mounted through the adhesive 4. The semiconductor chip 2 is adhered and thereby fixed onto the chip mounting surface of the die pad 3A through the adhesive 4.

External terminals 2A of the semiconductor chip 2 are electrically connected with inner portions 3C1 of the lead 3C supported to the frame body of the lead frame 3 through bonding wires 5.

As illustrated in FIGS. 5 and 6, the lead frame 3 is disposed between a top portion 10A and a bottom portion 10B of a mold 10 and at the same time, within a cavity 11 of the mold 10, the semiconductor chip 2 and the die pad 3A are disposed in such a way that a clearance L2 from the reverse surface side of the die pad 3A to the inside wall surface of the cavity 11 opposite to the reverse surface side becomes narrower, by a length corresponding to the thickness of the die pad 3A, than a clearance L1 from the principal surface of the semiconductor chip 2 to the inside wall surface of the cavity 11 opposite to the principal surface. By disposing the semiconductor chip 2 and the die pad 3A in such a way that the clearance L2 from the reverse surface of the die pad 3A to the inside wall surface of the cavity 11 opposite to the reverse surface becomes narrower, by a length corresponding to the thickness of the die pad 3A, than the clearance L1 from the principal surface of the semiconductor chip 2 to the inside wall surface of the cavity opposite to the principal surface, a filling region 11A on the principal surface side of the semiconductor chip 2 has almost the same volume as a filling region 11B on the reverse surface side, whereby the fluidity of the resin flowing in the filling region 11A on the principal surface side of the semiconductor chip 2 can be made almost equal to that of the resin flowing through the filling region 11B

on the reverse surface side.

Incidentally, in the cavity 11, supporting leads 3B, inner portions 3C1 of leads 3C, bonding wires 5 and the like are disposed as well as the semiconductor chip 2 and the die pad 3A. The mold 10 is equipped with, in addition to the cavity 11, a pot, a runner and a center gate 12. The center gate 12 exists above and below the lead frame 3 so that a resin can be supplied simultaneously to the filling region 11A on the principal surface side of the semiconductor chip 2 disposed within the cavity 11 and the filling region 11B on the reverse surface side of the semiconductor chip. The center gate 12 is disposed in the vicinity of the region where the supporting leads 3B are connected with the frame body 3E of the lead frame 3.

Then, a plastic mold 1 is formed by pouring a resin, under pressure, into the cavity 11 through the center gate 12 existing above and below the lead frame 3. The resin is supplied to the center gate 12 from the pot of the mold 10 through the runner. FIGS. 7 and 8 illustrate the flow of the resin in this step. The resin 1A injected from the center gate 12 is fed almost simultaneously to the filling region 11A on the principal surface side of the semiconductor chip 2 and the filling region 11B on its reverse surface side. The filling of the resin 1A to the filling region 11A and the filling to the filling region

11B are completed almost at the same time, as illustrated in FIG. 8. In other words, the semiconductor chip 2 is not lifted upwardly by the resin 1A filled in the filling region 11A on the reverse surface side of the semiconductor chip 2.

The plastic molded type semiconductor device as illustrated in FIGS. 1, 2 and 3 are substantially completed by cutting the supporting leads 3B and outer portions 3C2 of the leads 3C from the frame body 3E of the lead frame 3 and then forming the outer portions 3C2 of the leads 3C into a gull-wing shape.

Described above in this embodiment is a process for the fabrication of the plastic molded type semiconductor device in which the die pad 3A is formed smaller in area than the semiconductor chip 2 to be mounted on the principal surface thereof and the semiconductor chip 2 and die pad 3A are sealed with the plastic mold 1. It comprises a step of mounting the semiconductor chip 2 on the principal surface of the die pad 3A supported onto the frame body 3E of the lead frames 3 through the supporting leads 3B; a step of disposing the lead frame 3 between the top portion 10A and the bottom portion 10B of the mold 10; a step of disposing the semiconductor chip 2 and the die pad 3A so that the clearance L2 from the reverse surface of the die pad 3A to the inside wall surface of the cavity 11

opposite to the reverse surface becomes narrower, by a length corresponding to the thickness of the die pad 3A, than the clearance L1 from the principal surface of the semiconductor chip 2 to the inside wall surface of the cavity 11 opposite to its the principal surface; and a step of pouring a resin to the cavity 11 from one side of the semiconductor chip. Furthermore, the resin pouring step comprises a step of pouring the resin into the cavity 11 from the center gate 12 existing above and below the lead frame 3, thereby forming the plastic mold 1.

According to the above-described process, the filling region 11A on the principal surface side of the semiconductor chip 2 disposed in the cavity 11 is made substantially equal in volume to that of the filling region 11B on the reverse surface side, whereby the fluidity of the resin flowing through the filling region 11A on the principal surface side of the semiconductor chip 2 can be made almost equal to that of the resin flowing through the filling region 11B on its reverse surface side. The adoption of the center gate 12 makes it possible to supply the resin to the filling region 11A on the principal surface side and the filling region 11B on the reverse surface side simultaneously. Accordingly, the filling of the resin to the filling region 11A on the principal surface side of the semiconductor chip 2 and filling to the

filling region 11B on the reverse surface side 2 can be completed almost at the same time, which prevents the semiconductor chip 2 from being lifted upwardly by the resin filled to the filling region on the reverse surface side of the semiconductor chip 2. As a result, inconvenient appearance of the semiconductor chip 2, bonding wires 5 and the like from the plastic mold 1 can be prevented and a yield of the plastic molded type semiconductor device can be heightened.

By disposing the die pad 3A lower, in the thickness direction of the plastic mold, than the inner portions 3C1 of the leads 3C supported by the frame body 3E of the frame 3, the fluidity of the resin flowing in the filling region 11A on the principal surface side of the semiconductor chip 2 can be made substantially equal to that of the resin flowing in the filling region 11B on the reverse surface side.

Incidentally, the plastic molded type semiconductor device may be prepared, as illustrated in FIG. 9, by the fabrication process using a lead frame 3 having a die pad 3A formed to have a square plane. Similar advantages can be obtained by this process employing such a lead frame 3.

The plastic molded type semiconductor device may also be prepared, as illustrated in FIG. 10, by the fabrication process using a lead frame 3 having a die pad 3A formed to

have a X-shaped plane. Similar advantages can be obtained by this process employing such a lead frame 3.

(Second Embodiment)

A plastic molded type semiconductor device according to this embodiment has, as illustrated in FIGS. 11 and 12, a semiconductor chip 2 mounted on a chip mounting surface (principal surface) of a die pad 3A.

The semiconductor chip 2 has a planar shape, for example, a square shape having an outside dimension of 9 [mm] x 9 [mm]. On the principal surface of the semiconductor chip 2, a plurality of external terminals (bonding pads) 2A are arranged along each side of the principal surface.

In the outside region of each side of the semiconductor chip 2, a plurality of leads 3C arranged along each side are disposed. To the inner portions 3C1 of these plural leads 3C, a plurality of external terminals 2A disposed on the principal surface of the semiconductor chip 2 are electrically connected through bonding wires.

To the die pad 3A, four supporting leads 3B are coupled. These four supporting leads 3B serve to support the die pad 3A onto the frame body of the lead frame under the condition of the lead frame. These four supporting leads 3B are disposed on the outside regions of the four corners of the semiconductor chip 2, respectively.

The semiconductor chip 2, die pad 3A, supporting leads 3B, inner portions 3C1 of the leads 3C, bonding wires 5 and the like are sealed by a plastic mold 1 formed by the transfer mold method.

The planar shape of the plastic mold 1 is, for example, a square shape having an outside dimension of 14 [mm] x 14 [mm]. Outside of each side of the plastic mold 1, outer portions 3C2 of a plurality of leads 3C are arranged. The outer portions 3C2 of the plurality of leads 3C are arranged along each side of the plastic mold 1, for example, in the form of a gull-wing. The plastic mold semiconductor device according to this embodiment is thus fabricated to have a QFP (Quad Flat Package) structure.

The planar shape of the die pad 3A is, for example, in the circular form having an outside dimension of 2 to 4 [mm]ϕ. In other words, the die pad 3A is formed to have a smaller area than that of the semiconductor chip 2.

Each of the supporting leads 3B is, similar to the above first embodiment, formed of a lead portion (3B1) and another lead portion (3B2).

With regards to a plurality of leads 3C arranged in the outside region of each side of the semiconductor chip 2, a distance P from one end portion of a first-stage lead 3CA adjacent to the outside region of the corner of the semiconductor chip 2 to a second-stage lead 3CB adjacent to

the first-stage lead 3CA is formed wider than a distance between any other two leads 3C. By forming, as described above, a distance P from one end portion of the first-stage lead 3CA adjacent to the outside region of the corner of the semiconductor chip 2 to the second-stage lead 3CB adjacent to the first-stage lead 3CA wider than a distance between any other two leads 3C, it is possible to widen the clearance between a bonding wire 5 connected to one end portion of the first-stage lead 3CA most adjacent to the outside region of the corner of the semiconductor chip 2 and another bonding wire 5 connected to one end portion of the second-stage lead 3CB adjacent to the first-stage lead 3CA.

The plastic molded type semiconductor device as constructed above can be fabricated by a process using a lead frame 3 as illustrated in FIG. 13.

The lead frame 3 has a die pad 3A, four supporting leads 3B and a plurality of leads 3C arranged within a region defined by the frame body 3E. The die pad 3A is coupled to the frame body 3E through the four supporting leads 3B. The plurality of leads 3C are connected with the frame body 3E and at the same time, are connected through a tie bar (dam bar) 3D each other.

The frame body 3E has a square plane. Each of the plurality of leads 3C is arranged along each side of the

frame body 3E and these four supporting leads 3B are arranged along the diagonal lines of the frame body 3E.

With regards to the plurality of leads 3C arranged along each side of the frame body 3E, the distance between one end portion of the first-stage lead 3CA most adjacent to the supporting lead 3B and one end portion of the second-stage lead 3CB adjacent to the first-stage lead 3CA is formed wider than the distance between any other two leads 3C at one end portion.

A description will next be made of the fabrication process of the above-described plastic molded type semiconductor device.

First, a lead frame 3 as illustrated in FIG. 13 is prepared.

Then, a semiconductor chip 2 is mounted through an adhesive onto a chip mounting surface (principal surface) of a die pad 3A supported to a frame body 3E of the lead frame 3 through supporting leads 3B.

External terminals 2A of the semiconductor chip 2 are electrically connected with one end portions (one end portions of inner portions 3C1) of the leads 3C supported onto the frame body of the lead frame 3 through bonding wires 5.

As described in the first embodiment 1, the lead frame 3 is disposed between a top portion 10A and a bottom

portion 10B of a mold and at the same time, within a cavity of the mold, the semiconductor chip 2, the die pad 3A, supporting leads 3B, inner portions 3C1 of leads 3C, bonding wires and the like are disposed.

Then, a plastic mold 1 is formed by injecting a resin from a pot of the mold 1 through the runner and the gate. In this step, a supporting lead 3B is disposed on the outside region of a corner of the semiconductor chip 2 and a plurality of leads 3C and a plurality of bonding wires 5 are disposed on the outside region of each side of the semiconductor chip 2. In other words, the outside region of one corner of the semiconductor chip 2 is coarser than the outside region of one side of the semiconductor chip 2 so that the fluidity of the resin is higher in the outside region of one corner of the semiconductor chip 2 than the outside region of one side of the semiconductor chip 2. Accordingly, the bonding wire 5 tends to flow owing to the resin flowing into the outside region of one side of the semiconductor chip 2 from the outside region of one corner. Since the clearance between the bonding wire 5 connected to one end portion of the first-stage lead 3CA most adjacent to the outside region of the corner of the semiconductor chip 2 and another bonding wire 5 connected to one end portion of the second-stage lead 3CB adjacent to the first-stage lead 3CA is formed wide, even if the boding wire

flows owing to the resin flowing into the outside region of one side of the semiconductor chip 2 from the outside region of its corner, a short circuit between these bonding wires 5 can be suppressed.

The plastic molded type semiconductor device as illustrated in FIG. 11 is substantially completed by cutting the supporting leads 3B and outer portions 3C2 of the leads 3C from the frame body 3E of the lead frame 3 and then forming the outer portions 3C2 of the leads 3C into a gull-wing shape.

Described in this embodiment is a plastic molded type semiconductor device in which a plurality of external terminals 2A are arranged on and along at least one side of the principal surface of the semiconductor chip 2; a plurality of leads 3C are arranged outside of and along one side of the semiconductor chip 2; one end portion of each of the plurality of the leads 3C is electrically connected through a bonding wire 5 with each of the plurality of external terminals 2A; and the semiconductor chip, leads, bonding wires and the like are sealed by a plastic mold 1. In this plastic molded type semiconductor device, the distance P between one end portion of the first-stage lead 3CA most adjacent to the outside region of the corner of the semiconductor chip 2 and one end portion of the second-stage lead 3CB adjacent to the first-stage lead 3CA is

formed wider than the distance between any other two leads 3C at one end portion.

The above-described construction makes it possible to widen the distance between a bonding wire 5 connected to one end portion of the first-stage lead 3CA most adjacent to the outside region of the corner of the semiconductor chip 2 and another bonding wire 5 connected to one end portion of the second-stage lead 3CB adjacent to the first-stage lead 3CA. Therefore, in the fabrication step of the plastic mold, even if a flow of a bonding wire occurs owing to the resin flowing from the outside region of the corner of the semiconductor chip 2 to the outside region of one side, occurrence of a short circuit between bonding wires 5 can be prevented. As a result, a yield of the plastic molded type semiconductor device can be heightened.

When the outer dimension of the semiconductor chip 2 is reduced, this reduction is accompanied with an increase in the length of the bonding wire 5. Even if the distance P between one end portion of the first-stage lead 3CA and one end portion of the second stage lead 3CB is widened and the bonding wire 5 becomes longer with a decrease in the outer dimension of the semiconductor chip 2, a short circuit between a bonding wire 5 connected with the one end portion of the first-stage lead 3CA and another bonding wire 5 connected with the one end portion of the second-

stage lead 3CB can be prevented.

Incidentally, among a plurality of external terminals 2A arranged on and along one side of the principal surface of the semiconductor chip 2, as illustrated in FIG. 14, it is also possible to widen the distance P between the external terminal 2A1 most adjacent to the corner of the semiconductor chip 2 and the external terminal 2A2 adjacent to the external terminal 2A1 compared with the distance between any other two external terminals. Also in this case, the distance between the bonding wire 5 connected to one end portion of the first-stage lead 3CA and another bonding wire 5 connected to one end portion of the second-stage lead 3CB can be widened so that a short circuit between these bonding wires 5 can be suppressed.

Furthermore, the fluidity of the resin flowing from the outside region of the corner of the semiconductor chip 2 into the outside region of one side of the semiconductor chip gradually becomes lower toward the center of the outside region of one side of the semiconductor chip 2. As illustrated in FIG. 15, with regards to a plurality of external terminals 2A arranged on and along one side of the principal surface of the semiconductor chip 2, it is therefore possible to widen each of the distances between two adjacent external terminals 2A stepwise from the center of one side of the semiconductor chip 2 toward the corner

thereof. In this case, a short circuit between any two adjacent bonding wires 5 can be suppressed without a marked increase in the outer dimension of the semiconductor chip, because the distance between bonding wires 5 can be widened gradually, according to the fluidity of the resin, from the center of one side of the semiconductor chip 2 toward its corner.

The invention completed by the present inventors were described specifically with reference to the above embodiments. It should however be borne in mind that the present invention is not limited to or by those embodiments and can be modified within an extent not departing from the subject matter.

Capability of Exploitation in Industry

The present invention makes it possible to heighten the yield of the plastic molded type semiconductor device.



CLAIMS

1. A process for the fabrication of a plastic molded type semiconductor device in which a die pad is formed to have a smaller area than a semiconductor chip mounted on a principal surface of the die pad and said semiconductor chip and said die pad are sealed with a plastic mold, comprising:

(A) a step of mounting the semiconductor chip on the principal surface of the die pad supported onto a frame body of a lead frame through a supporting lead;

(B) a step of disposing said lead frame between a top portion and a bottom portion of a mold and arranging, in a cavity of said mold, said semiconductor chip and die pad so that a clearance from the reverse surface of the die pad to the inside wall surface of the cavity opposite to the reverse surface of the die pad becomes narrower than a clearance from the principal surface of the semiconductor chip to the inside wall surface of the cavity opposite to the principal surface of the semiconductor chip; and

(c) a step of pouring a resin from a gate of said mold positioned on one side of said semiconductor chip, thereby sealing said semiconductor chip and said die pad with the resin.

2. A process according to claim 1, wherein said gate is defined by the upper and lower portions of said lead

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frame.

3. A process according to claim 1, wherein said die pad is positioned lower, in the thickness direction of the plastic mold, than an inner portion of said lead supported onto the frame body of said lead frame.

4. A process according to claim 1, wherein said die pad is formed to have a circular plane, square plane or X-shaped plane.

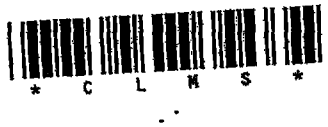
5. A process according to claim 1, wherein said gate is disposed in the vicinity of a region where a supporting lead is connected with said frame body.

6. A plastic molded type semiconductor device in which a plurality of external terminals are arranged on and along at least one side of a principal surface of a semiconductor chip, a plurality of leads are arranged outside and along one side of said semiconductor chip, each of said plurality of external terminals is electrically connected with one end portion of each of said plurality of leads through a bonding wire, and said semiconductor chip, leads and bonding wires are sealed with a resin, wherein at least a distance between one end portion of the lead most adjacent to a corner of said semiconductor chip and one end portion of a lead adjacent thereto is formed wider than a distance between any other two leads at one end portion.

7. A plastic molded type semiconductor device in

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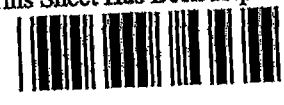
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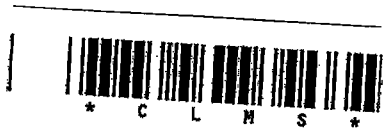
which a plurality of external terminals are arranged on and along at least one side of a principal surface of a semiconductor chip, a plurality of leads are arranged outside and along one side of said semiconductor chip, each of said plurality of external terminals is electrically connected with one end portion of each of said plurality of leads through a bonding wire, and said semiconductor chips, leads and bonding wires are sealed with a resin, wherein at least a distance between an external terminal most adjacent to a corner of said semiconductor chip and another external terminal adjacent thereto is formed wider than a distance between any other two external terminals.

8. A plastic molded type semiconductor device in which a plurality of external terminals are arranged on and along at least one side of a principal surface of a semiconductor chip, a plurality of leads are arranged outside and along one side of said semiconductor chip, each of said plurality of external terminals is electrically connected with one end portion of each of said plurality of leads through a bonding wire, and said external terminals, leads and bonding wires are sealed with a resin, wherein a distance between said plurality of external terminals gradually becomes wider toward the corner of said semiconductor chip from a center of one side of said semiconductor chip.

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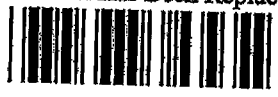
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9. A plastic molded type semiconductor device according to claim 6, wherein outside the corner of said semiconductor chip, the supporting leads which extend from said corner toward the outside thereof and are connected with the die pad on which said semiconductor chip is to be mounted are disposed.

10. A plastic molded type semiconductor device according to claim 6, wherein said die pad is formed to have a smaller area compared with said semiconductor chip.

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