

ELECTRONIC COMPONENT, METHOD FOR PRODUCING ELECTRONIC
COMPONENT, AND APPARATUS FOR PRODUCING ELECTRONIC
COMPONENT

5 CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from Japanese Patent Application No. 2014-242572 filed on November 28, 2014. The entire subject matter of the Japanese Patent Application is incorporated herein by reference.

10 BACKGROUND OF THE INVENTION

[0001] The present invention relates to an electronic component, a method for producing the electronic component, and an apparatus for producing the electronic component.

[0002] Electronic components have been used for high-frequency circuits in
15 communication equipment such as cellular phones. The method for producing such an electronic component includes, for example, the following three steps. The first step is a step of placing an electronic device such as a semiconductor device such as integrated circuit (IC) on the upper surface of a wiring substrate having surface wiring patterns such as a signal wiring pattern and a ground wiring pattern. The
20 second step is a step of electrically connecting a connection electrode provided on the upper surface of the electronic device with the surface wiring pattern via a metal thin wire. The third step is a step of covering the electronic device with an insulative encapsulation resin.

[0003] A conventional electronic component has a risk of causing a malfunction by
25 the electromagnetic influence from other electronic components disposed around the electronic component or heat around the electronic component after being integrated in communication equipment such as a cellular phone. In particular, the risk of causing a malfunction is high when an electronic component is used for a high-frequency circuit. Hence there is an electronic component having a shield
30 member for protecting the electronic component from a surrounding electromagnetic field, heat, and the like to avoid the risk of causing a malfunction (JP 2009-289926 A (see paragraphs [0005], [0006], and [0007]), etc.). As the method for producing such an electronic component, for example, a production method having the following

steps has been proposed. First, a metal post is formed on a wiring substrate. Next, an electrode terminal (connection electrode) provided on the upper surface of a chip (electronic device) is electrically connected with a pad part (surface wiring pattern) on the substrate via a metal wire (metal thin wire). Then, on the upper surface of the metal post, a metal wire made of a material softer than that of a molding die to be used for resin-encapsulation is formed. Subsequently, in the state where the molding die being in contact with a metal wire is clamped, the chip and the metal post are encapsulated in an encapsulation resin. Then, a structure after resin-encapsulation obtained in the previous step is cut into individual pieces of device units with a dicer or the like. Thereafter, each individual piece of structure is equipped with a metal shield case. In this step, the metal wire exposed from the encapsulation resin and the metal shield case are electrically connected.

BRIEF SUMMARY OF THE INVENTION

[0004] The method for producing an electronic component using a shield member described in JP 2009-289926 A requires the step of resin-encapsulation and the step of attachment of a shield member separately, which makes the assembly operation of an electronic component complicated. The method also requires providing at least two metal wires having different wiring heights for a signal wiring pattern and a ground wiring pattern, which also makes the assembly operation complicated.

[0005] The present invention is made in consideration of the above-mentioned problem. The present invention is intended to provide an electronic component having a plate-like member that favorably shields an electromagnetic wave and has favorable heat radiation by the plate-like member, an apparatus for producing such an electronic component, and a method for producing such an electronic component with high productivity.

[0006] The present invention provides an electronic component including: a packaging substrate; an encapsulation resin; and a conductor-formed plate-like member, wherein the packaging substrate includes: an electronic device; a bonding pad electrically connected to a connection electrode of the electronic device; and a ground wiring pattern, the electronic device, the bonding pad, and the ground wiring pattern being covered with and encapsulated in the encapsulation resin, and the

conductor-formed plate-like member includes: a conductive plate-like member; and a conductive member attached to the plate-like member, the plate-like member being fixed on a surface of the encapsulation resin remote from the packaging substrate, and the conductive member being electrically connected to the ground wiring pattern and being covered with and encapsulated in the encapsulation resin.

[0007] The present invention also provides a first method for producing an electronic component using compression molding, including: providing a packaging substrate including an electronic device, a bonding pad electrically connected to a connection electrode of the electronic device; and a ground wiring pattern; providing a conductor-formed plate-like member including a conductive plate-like member and a conductive member attached to the plate-like member and projected from a principal surface of the plate-like member; temporarily fixing the packaging substrate at a predetermined position of a first die; disposing the conductor-formed plate-like member on an inner bottom surface of a cavity provided in a second die; filling the cavity with a flowable resin; immersing at least a part of the conductive member in the flowable resin; bringing the ground wiring pattern into contact with the conductive member by clamping the first die and the second die in a state where the cavity is filled with the flowable resin; immersing the electronic device, the bonding pad, and the ground wiring pattern in the flowable resin by clamping the first die and the second die; forming an encapsulation resin by curing or solidifying the flowable resin; and separating an electronic component including the packaging substrate, the conductor-formed plate-like member, and the encapsulation resin from the second die by unclamping the first die and the second die.

[0008] The present invention also provides a second method for producing an electronic component using transfer molding or injection molding, including: providing a packaging substrate including an electronic device, a bonding pad electrically connected to a connection electrode of the electronic device, and a ground wiring pattern; providing a conductor-formed plate-like member including a conductive plate-like member and a conductive member attached to the plate-like member and projected from a principal surface of the plate-like member; temporarily fixing the packaging substrate at a predetermined position of a first die; disposing the conductor-formed plate-like member on an inner bottom surface of a cavity provided in a second die; bringing the ground wiring pattern into contact with the

conductive member by clamping the first die and the second die; immersing at least a part of the conductive member, the electronic device, the bonding pad, and the ground wiring pattern in the flowable resin by injecting a flowable resin into the cavity in a state where the first die and the second die are clamped; forming an encapsulation resin by curing or solidifying the flowable resin; and separating an electronic component including the packaging substrate, the conductor-formed plate-like member, and the encapsulation resin from the second die by unclamping the first die and the second die.

[0009] Hereinafter, the first method for producing an electronic component according to the present invention and the second method for producing an electronic component according to the present invention are together referred to as a “method for producing an electronic component according to the present invention” or a “method for producing an electronic component of the present invention”.

Furthermore, in the method for producing an electronic component according to the present invention, the order of the steps is not particularly limited. That is, any of the steps can be performed prior to or subsequent to others or performed at the same time as long as the steps can be performed.

[0010] The present invention provides an apparatus for producing an electronic component by the method for producing an electronic component according to the present invention, including a first die to which a packaging substrate is temporarily fixed; and a second die having a cavity, wherein the cavity has an inner bottom surface on which a conductor-formed plate-like member can be disposed and, by disposing the conductor-formed plate-like member on the inner bottom surface of the cavity and filling the cavity with a flowable resin, at least a part of the conductive member can be immersed in the flowable resin, in a state where the first die and the second die are clamped, a ground wiring pattern can be brought into contact with the conductive member, and an electronic device, a bonding pad, and a ground wiring pattern can be immersed in the flowable resin, in the state where the first die and the second die are clamped, an encapsulation resin can be formed by curing or solidifying the flowable resin filled in the cavity, by unclamping the first die and the second die, an electronic component including the packaging substrate, the conductor-formed plate-like member, and the encapsulation resin can be separated from the second die, the cavity is provided with an alignment portion, and the cavity

and the conductor-formed plate-like member can be aligned by the alignment portion of the cavity and an alignment portion provided on the conductor-formed plate-like member.

[0011] According to the present invention, it is possible to provide an electronic component having a plate-like member that favorably shields an electromagnetic wave and has favorable heat radiation by the plate-like member, an apparatus for producing such an electronic component, and a method for producing such an electronic component with high productivity.

BRIEF DESCRIPTION OF THE DRAWINGS

[FIG. 1] FIG. 1 is a schematic cross sectional view showing the configuration of an electronic component according to the present invention.

[FIG. 2] FIGs. 2A to 2C are schematic cross sectional views showing a part of the steps of producing an electronic component according to the present invention;

FIG. 2A shows a step of providing a packaging substrate and a conductor-formed plate-like member; FIG. 2B shows a step of temporarily fixing the packaging substrate to an upper die; and FIG. 2C shows a step of disposing the conductor-formed plate-like member on a lower die.

[FIG. 3] FIGs. 3A to 3C are schematic cross sectional views showing a part of the steps of producing an electronic component according to the present invention; FIG. 3A shows a step of injecting a liquid resin into a cavity of a lower die; FIG. 3B shows a step of forming an encapsulation resin by curing in the state where an upper die and the lower die are clamped; and FIG. 3C shows a step of separating a molded article (electronic component) from the lower die by unclamping the upper die and the lower die.

[FIG. 4] FIGs. 4A to 4C are schematic cross sectional views showing a part of the steps of the method of producing an electronic component according to the present invention in Example 2; FIG. 4A shows a step of temporarily fixing a packaging substrate to an upper die and injecting a liquid resin into the cavity of the lower die after disposing a conductor-formed plate-like member on a cavity of a lower die; FIG. 4B shows a step of forming an encapsulation resin by curing in the state where the upper die and the lower die are clamped; and FIG. 4C shows a step of separating a molded article (electronic component) from the lower die by unclamping

the upper die and the lower die.

[FIG. 5] FIGs. 5A and 5B are schematic cross sectional views showing division of a molded article into individual pieces according to the present invention; FIG. 5A shows a step of dividing a molded article (encapsulated substrate) into individual pieces; and FIG. 5B shows an electronic component produced by the steps of Example 2.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Hereinafter, the present invention will be described in more detail with reference to illustrative examples. The present invention, however, is not limited by the following description.

[0014] In the electronic component according to the present invention, for example, the encapsulation resin may be a resin that is formed by curing or solidifying a flowable resin. Furthermore, in the electronic component according to the present invention of this case, for example, the conductive member may be electrically connected to the ground wiring pattern by curing or solidifying the flowable resin in a state where the conductive member is pressed toward the conductor-formed plate-like member by the packaging substrate. Also, in the electronic component according to the present invention of this case, for example, the conductive member may be electrically connected to the ground wiring pattern by curing or solidifying the flowable resin in the state where the conductive member is pressed toward the ground wiring pattern by a compressive stress at the time of curing or solidifying the flowable resin.

[0015] In the method for producing an electronic component according to the present invention, for example, in the forming the encapsulation resin, the flowable resin may be cured or solidified in a state where the conductive member is pressed toward the conductor-formed plate-like member by the packaging substrate.

[0016] In the method for producing an electronic component according to the present invention, for example, in the forming the encapsulation resin, the flowable resin may be cured or solidified in the state where the conductive member is pressed toward the ground wiring pattern by a compressive stress at the time of curing the flowable resin.

[0017] In the apparatus for producing an electronic component according to the

present invention, as described above, the cavity is provided with an alignment portion, and the cavity and the conductor-formed plate-like member can be aligned by the alignment portion of the cavity and an alignment portion provided on the conductor-formed plate-like member. For example, the alignment portion of the conductor-formed plate-like member may be a concave portion or a hole formed on the plate-like member, and the alignment portion of the cavity may have a shape corresponding to the shape of the concave portion or the hole of the plate-like member and may be a convex portion that can be fitted in the concave portion or the hole. Also, for example, the alignment portion of the conductor-formed plate-like member may be a convex portion formed on the plate-like member, and the alignment portion of the cavity may have a shape corresponding to the shape of the convex portion of the plate-like member and may be a concave portion that can be fitted with the convex portion.

[0018] Specific examples of the present invention will be described below. The present invention, however, is not limited by the following examples.

[0019] [Example 1]

Example 1 of the present invention will be described in detail with reference to drawings. In order to make it clearly understandable, the drawings of the present application are schematically illustrated by appropriately omitting or exaggerating.

[0020] FIG. 1 shows the structure of an electronic component according to the present example. An electronic component 1 shown in FIG. 1 includes a wiring substrate 2, an electronic device 3, an encapsulation resin 4, a plate-like member 5 serving as an electromagnetic shield plate or a heat radiation plate, and a conductive member 6 that electrically connects the wiring substrate 2 and the plate-like member 5.

[0021] The wiring substrate 2 is a rectangular flat laminate in which plural insulating layers and wiring layers are stacked. On each surface of the wiring substrate 2 and between the insulating layers, circuit wiring is formed. The circuit wiring is electrically interconnected to another circuit wiring via a via-hole conductor or the like. The wiring substrate 2 can be, for example, a printed board including a glass epoxy substrate as a base substrate, wiring, interlayer wiring, and a via-hole conductor, each of which is made of copper. The wiring substrate 2 has a principal

surface 7 on which power supply system patterns and a bonding pad 8 for signal system and power supply system are formed. The power supply system patterns include a + power supply pattern (not shown) and a ground wiring pattern 9. The + power supply pattern, the ground wiring pattern 9, and the bonding pad 8 are electrically connected to an external connection conductor (not shown) formed on the undersurface or the side surface of the wiring substrate 2 via a via-hole conductor or the like provided in the wiring substrate 2.

[0022] The principal surface 7 of the wiring substrate 2 is equipped with an electronic device 3 composed of a semiconductor device such as an integrated circuit (IC) or the like by using, for example, a die bonding material or a conductive resin. On the upper surface of the electronic device 3, plural connection electrodes 10 are formed. Each connection electrode 10 is electrically connected to the bonding pad 8 by a loop metal thin wire 11. The metal thin wire 11 is made of Au, Al, Cu, or the like, for example. The diameter of the metal thin wire 11 is not particularly limited and is, normally, in the range from 18 μm to 35 μm .

[0023] The plate-like member 5 serving as an electromagnetic shield plate or a heat radiation plate is made of a conductive member such as brass, copper, aluminum, solder, a conductive resin, or the like and has a rectangular or square shape. The plate-like member 5 is disposed so as to face the principal surface 7 of the wiring substrate 2. The plate-like member 5 may be a member obtained by forming a film of brass, copper, aluminum, solder, a conductive resin, or the like on at least one surface of an insulative plate-like member by electroless plating, vapor deposition, screen printing, or the like. The plate-like member 5 may have a box-shape in which a plate is provided with walls. In this case, in FIG. 1, it is preferred that the walls are extended downward from both ends or the middle part of the plate-like member 5 and that the lower ends of the walls and the ground wiring pattern 9 are electrically connected.

[0024] On one surface (the surface facing the principal surface 7 of the wiring substrate 2) of the plate-like member 5, a conductive member 6 is formed.

The conductive member 6 is used for electrically connecting the ground wiring pattern 9 of the wiring substrate 2 with the plate-like member 5. Examples of the material for the conductive member 6 include gold, brass, copper, aluminum, solder, and a conductive resin. FIG. 1 shows an example in which a loop metal thin wire

formed by wire bonding is used as the conductive member 6. It is preferred that the conductive member 6 has a diameter larger than that of the metal thin wire 11.

The conductive member 6 may be in a form of loop, arch, column, spiral, sphere, band, foil, ribbon, or wall projected from the one surface of the plate-like member 5.

5 [0025] The encapsulation resin 4 serves as an encapsulation resin for encapsulating the electronic device 3, the connection electrode 10, the metal thin wire 11, the + power supply pattern (not shown), the ground wiring pattern 9, the bonding pad 8, the principal surface 7 of the wiring substrate 2, and the conductive member 6. The encapsulation resin 4 can be, for example, a thermosetting resin
10 such as an epoxy resin and a silicone resin or a thermoplastic resin.

[0026] The method for producing an electronic component according to the present example will be described. FIG. 2A to 2C and FIG. 3A to 3C are schematic views showing the process order of the production method.

[0027] An electronic component is produced by encapsulating a packaging
15 substrate 12 shown in FIG. 2A in a resin. A molding die 13 for resin-encapsulation shown in FIG. 2B includes an upper die 14 and a lower die 15. The upper die 14 includes at least one of a fixing tool (not shown) and a vacuum suction mechanism (not shown) for fixing the packaging substrate 12. The lower die 15 includes a cavity 16. The cavity 16 is provided with a projection 17 at the inner bottom corner
20 for aligning the cavity 16 and a conductor-formed plate-like member (that will be described below).

[0028] First, as shown in FIG. 2A, the following two members (intermediates) are provided. The first member is a packaging substrate 12. The packaging substrate 12 is equipped with an electronic device 3. A connection electrode 10 of the
25 electronic device 3 is electrically connected with a power supply system patterns and a bonding pad 8 of the wiring substrate 2 by a metal thin wire 11.

[0029] The second member is a conductor-formed plate-like member 18 in which a conductive member 6 is formed on a plate-like member 5. The conductor-formed plate-like member 18 has a flat surface on which a conductive member 6 made of a
30 loop metal thin wire is formed (attached) by wire bonding. The conductive member 6 may be directly in contact with the plate-like member 5, for example. Also the conductive member 6 may not be directly in contact with the plate-like member 5 but may be electrically connected to the plate-like member 5 through any conductor,

for example. On the corner of the conductor-formed plate-like member 18, a notch 19 for alignment is preliminarily formed.

[0030] Subsequently, as shown in FIG. 2B, the packaging substrate 12 is temporally fixed to a predetermined position of the upper die 14 by a fixing tool or a vacuum suction mechanism. The predetermined position is a position where the cavity 16 places below the packaging substrate 12 within a principal surface 7 in the plan view.

[0031] Subsequently, as shown in FIG. 2C, on the inner bottom surface of the lower die 15 configured to have the cavity 16 (hereinafter referred to as “the inner bottom surface of the cavity 16”), the cavity 16 and the conductor-formed plate-like member 18 are aligned by a projection 17 of the cavity 16 and a notch 19 (see FIG. 2A) of the conductor-formed plate-like member 18.

[0032] Subsequently, as shown in FIG. 3A, an insulative liquid resin (flowable resin) 20 that is in a liquid form at room temperature is injected so that the conductor-formed plate-like member 18 disposed on the inner bottom surface of the cavity 16 (see FIG. 3C) is covered with the resin. As the liquid resin 20, for example, a thermosetting resin is used. In this process, the upper part of the conductive member 6 is avoided from being covered with the liquid resin 20. The upper part of the conductive member 6 is caused to be exposed from the upper surface of the liquid resin 20 filled in the cavity 16. In other words, before performing the wire bonding of the conductive member 6, the conductive member 6 is designed such that its upper part would be exposed from the upper surface of the liquid resin 20 filled in the cavity 16 (see FIG. 3C).

[0033] Subsequently, the upper die 14 and the lower die 15 are clamped from the state shown in FIG. 3A to the state shown in FIG. 3B. Thereby, first, the conductive member 6 formed on the principal surface (upper surface in FIG. 3B) of the plate-like member 5 is bent and brought into contact with the ground wiring pattern 9. Then, the electronic device 3, the bonding pad 8, the + power supply pattern (not shown), the ground wiring pattern 9, and the metal thin wire 11 provided on the principal surface 7 of the packaging substrate 12 are immersed in the liquid resin 20. Finally, the liquid resin 20 filled in the cavity 16 is brought into contact with the principal surface 7 of the packaging substrate 12. The state of being clamped is kept for a fixed period of time (at least 20 seconds). During this period, the liquid resin 20 is

heated at a predetermined curing temperature with a heater (not shown) provided in the lower die 15 while pressurizing the liquid resin 20. Thereby, as shown in FIGs. 3A and 3B, the liquid resin 20 is cured to form an encapsulation resin 4 formed of a curable resin.

5 [0034] Subsequently, as shown in FIG. 3C, the upper die 14 and the lower die 15 are unclamped. Thereby a molded electronic component 1 is separated from the lower die 15. By these processes, an electronic component 1 composed of a molded article is completed.

10 [0035] According to the present example, the upper part of the conductive member 6 formed on the conductor-formed plate-like member 18 is caused to be exposed from the upper surface of the liquid resin 4 filled in the cavity 16. This allows the conductive member 6 to be brought into contact with the ground wiring pattern 9 securely and allows the liquid resin 20 to be cured in the state where the conductive member 6 is pressed by the principal surface 7 of the packaging substrate 12
15 (specifically, ground wiring pattern 9). Therefore, the plate-like member 5 and the ground wiring pattern 9 can be electrically connected by the conductive member 6 securely. In other words, the conductive member 6 pressed by the compressive stress at the time of curing the liquid resin 20 is brought into contact with the ground wiring pattern 9. Accordingly, the conductive member 6 can be pressed
20 toward the ground wiring pattern 9 more securely with a greater force.

[0036] According to the present example, in the resin-encapsulation, the electrical connection between the plate-like member 5 and the ground wiring pattern 9 and the fixation of the plate-like member 5 are performed at the same time. This improves the productivity in producing an electronic component. In particular, in
25 the case where the plate-like member 5 has a box-shape, it is possible to obtain an electronic component that favorably shields an electromagnetic wave and has favorable heat radiation.

[0037] [Example 2]

30 Example 2 of the present invention will be described in detail with reference to FIGs. 4A to 4C and FIGs. 5A and 5B. The method for producing an electronic component according to the present example uses a different conductive member from Example 1. In addition, according to the present example, plural electronic components can be produced by equipping the wiring substrate with at least two

electronic devices 2 and dividing the molded article after resin-encapsulation into individual pieces.

[0038] As shown in FIG. 4A, the present example will be described with reference to a copper plate fixed by solder in the direction perpendicular to the flat surface of a plate-like member 5 as a conductive member 21. FIGs. 4A to 4C and FIGs. 5A and 5B show the production method according to the present example.

[0039] First, as shown in FIG. 4A, the following two members (intermediates) are provided. The first member is a packaging substrate 22. The packaging substrate 22 is equipped with plural electronic devices 3. The packaging substrate 22 is disposed at a predetermined position of an upper die 14. The predetermined position is a position where a cavity 16 places below the packaging substrate 22 within a principal surface 23 in the plan view (see FIG. 4C). The second member is a conductor-formed plate-like member 24 in which a conductive member 21 is formed on the plate-like member 5. The conductor-formed plate-like member 24 is disposed on the inner bottom surface of the cavity 16 of a lower die 15. Then, a liquid resin 20 is injected into the cavity 16 of the lower die 15 so as to cover the plate-like member 5. The upper part of the conductive member 21 is caused to be exposed from the upper surface of the liquid resin 20 filled in the cavity 16. In other words, before performing the fixation of the conductive member 21 to the plate-like member 5 by solder, the conductive member 21 is designed such that its upper part would be exposed from the upper surface of the liquid resin 20 filled in the cavity 16.

[0040] Subsequently, the upper die 14 and the lower die 15 are clamped from the state shown in FIG. 4A to the state shown in FIG. 4B. Thereby, first, the conductive member 21 formed on a principal surface 25 of the conductor-formed plate-like member 24 is bent and brought into contact with the ground wiring pattern 9. Then, an electronic device 3, a bonding pad 8, the ground wiring pattern 9, a + power supply pattern (not shown), and a metal thin wire 11 provided on the principal surface 23 of the packaging substrate 22 are immersed in the liquid resin 20.

Finally, the liquid resin 20 filled in the cavity 16 is brought into contact with the principal surface 23 of the packaging substrate 22. The state of being clamped is kept for a fixed period of time (at least 20 seconds). During this period, the liquid resin 20 is heated with a heater (not shown) provided in the lower die 15 while pressurizing the liquid resin 20. Thereby, as shown in FIGs. 4A and 4B, the liquid

resin 20 is cured to form an encapsulation resin 4 formed of a curable resin.

[0041] Subsequently, as shown in FIG. 4C, the upper die 14 and the lower die 15 are unclamped. Thereby a molded encapsulated substrate 26 is separated from the lower die 15.

5 [0042] Subsequently, as shown in FIG. 5A, the encapsulated substrate 26 is temporarily fixed to a stage (not shown). The encapsulated substrate 26 is cut with a rotary blade 27 along a dicing line 28 virtually provided in the encapsulated substrate 26 in the Y direction (front-back direction in FIG. 5A) and X direction (horizontal direction in FIG. 5A). In this manner, the encapsulated substrate 26 is
10 divided into individual pieces of divided regions 29. As shown in FIG. 5B, an electronic component 1 is completed by dividing the encapsulated substrate 26 into individual pieces.

[0043] According to the present example, the same effect as Example 1 can be obtained. In addition, the present example further improves the productivity in
15 producing an electronic component.

[0044] In each example, compression molding is employed for resin-encapsulation, as an example. As the molding method, transfer molding or injection molding may be employed. Either of an upper die or a lower die of a molding die may be provided with a cavity or both of the upper die and the lower die may respectively be provided
20 with cavities.

[0045] In each example, the upper part of the conductive member 6, 21 is caused to be exposed from the liquid resin 20. The present invention is not limited thereto and the upper die 14 and the lower die 15 may be clamped in the state where the conductive member 6, 21 is completely immersed in the liquid resin 20. In this case,
25 the height of the conductive member 6, 21 is preliminarily defined so that the conductive member 6, 21 is pressed by the principal surface 7 of the packaging substrate 12 (specifically, ground wiring pattern 9) in the state where the clamping is completed. As the conductive member 6, 21, a solder-plated lead, a solder paste, and the like may be used. In this manner, the plate-like member 5 and the ground
30 wiring pattern 9 can be electrically connected securely by the conductive member.

[0046] In the case where solder (including a solder paste and a solder-plated metal) is used as the conductive member 6, it is preferred to use solder which melts at a predetermined curing temperature for curing the liquid resin 20. Thereby, the

solder is melted in the state where the conductive member 6 pressed by the compressive stress at the time of curing the liquid resin 20 is in contact with the ground wiring pattern 9, and the solder is cured when the electronic component 1 is cooled after resin-encapsulation. This makes it possible to electrically connect the plate-like member 5 and the ground wiring pattern 9 securely by the cured solder.

[0047] For aligning the conductor-formed plate-like member 18, 24 and the cavity 16, for example, the following three means can be employed. The first means is to design the inner bottom surface of the cavity 16 so as to have the same shape as and be slightly larger than the flat surface of the conductor-formed plate-like member 18.

The second means is to preliminarily form a concave portion or a hole on the plate-like member by pressing and to preliminarily provide a pin or a projection having a shape corresponding to the shape of the concave portion or the hole on the inner bottom surface of the cavity 16. The third means is to preliminarily form a convex portion on the plate-like member by pressing and to preliminarily provide the concave portion having a shape corresponding to the shape of the convex portion on the inner bottom surface of the cavity 16.

[0048] In each example, a liquid resin is employed as an example of the resin material. The resin material to be used in the present invention may be a solid resin such as a granular resin, a powdery resin, or a resin tablet, and a flowable resin may be obtained by heating and melting the solid resin. Also, although a thermosetting resin is employed as an example of the resin material, a thermoplastic resin may be used instead of a thermosetting resin. In the case where the thermoplastic resin is used instead of the thermosetting resin, a molten resin (flowable resin) may be solidified by cooling instead of curing a liquid resin by heating.

[0049] The shape of the flat surface of the encapsulation resin 4 may be other than a rectangular shape. The shapes of the plate-like member 5 and the conductor-formed plate-like member 19 may be other than a rectangular shape according to the shape of the flat surface of the encapsulation resin 4. The shape can be, for example, a shape in which a projection is provided in the parallel direction of a sphere or a circular surface or a shape in which a notch is provided in the parallel direction of a circular surface.

[0050] As the electronic device 3, a power transistor, a power diode, a CMOS sensor,

or the like may be employed.

[0051] In each example, the wire bonding is employed, as an example of an electrical connection method of the electronic device 3. As the connection method, flip chip bonding or the like may be employed.

5 [0052] In each example, the electronic device 3 composed of a semiconductor device is employed as an example. The electronic device 3 may be a passive device such as a resistor, a capacitor, or an inductor. In addition, a combination of the electronic device 3 and a passive device may be employed.

10 [0053] A foil or a thin plate made of Cu, Al, or the like having an appropriate base and a rising part may be applied to the ground wiring pattern 9 with a conductive adhesive agent. A lead made of Cu, Al, or the like may be applied to the ground wiring pattern 9 with a conductive adhesive agent. A conductive flowable member such as a solder paste may be ejected onto the ground wiring pattern 9 with a nozzle.

15 [0054] In each example, a printed board is employed as an example of the wiring substrate 2. The wiring substrate 2 may be a ceramic substrate, a metal base substrate, a lead frame, or the like.

[0055] Example 2 was described with reference to a copper plate fixed by a solder paste in the direction perpendicular to the flat surface of the plate-like member as a conductive member 21. As the conductive member 21, a frame-shaped member
20 surrounding a product area of the electronic component may be used. Also, as the conductive member 21, a plate-like (wall-like) metal plate partially surrounding the electronic device 3 in the product area of the electronic component or the like may be used.

[0056] All aspects of the embodiments are illustrative and not restrictive. The
25 scope of the present invention is defined not by the above-described description but by the scope of claims. The present invention includes any changes equivalent to and within the scope of claims. For example, as shown in FIGs. 2B and 2C, the same electronic component can be produced even when the order of the step of temporarily attaching a wiring substrate at a predetermined position of the upper
30 die 14 with a fixing tool or a vacuum suction mechanism and the step of attaching the preliminarily formed conductive member 6-formed plate-like member 5 within an encapsulation area in the lower die 15 are switched.

Explanation of reference numerals

[0057]

	1	electronic component
	2	wiring substrate
5	3	electronic device
	4	encapsulation resin
	5	plate-like member
	6	conductive member
	7	principal surface of wiring substrate
10	8	bonding pad
	9	ground wiring pattern
	10	connection electrode
	11	metal thin wire
	12	packaging substrate
15	13	molding die
	14	upper die (first die)
	15	lower die (second die)
	16	cavity
	17	projection (second alignment portion)
20	18	conductor-formed plate-like member
	19	notch (first alignment portion)
	20	liquid resin
	21	conductive member
	22	packaging substrate
25	23	principal surface of packaging substrate
	24	conductor-formed plate-like member
	25	principal surface of conductor-formed plate-like member
	26	encapsulated substrate
	27	rotary blade
30	28	dicing line
	29	divided region

WHAT IS CLAIMED IS:

1. An electronic component comprising:
a packaging substrate;
5 an encapsulation resin; and
a conductor-formed plate-like member, wherein
the packaging substrate comprises:
an electronic device;
a bonding pad electrically connected to a connection electrode of the
10 electronic device; and
a ground wiring pattern, the electronic device, the bonding pad, and
the ground wiring pattern being covered with and encapsulated in the
encapsulation resin, and
the conductor-formed plate-like member comprises:
15 a conductive plate-like member; and
a conductive member attached to the plate-like member, the
plate-like member being fixed on a surface of the encapsulation resin remote
from the packaging substrate, and the conductive member being electrically
connected to the ground wiring pattern and being covered with and
20 encapsulated in the encapsulation resin.
2. The electronic component according to claim 1, wherein
the encapsulation resin is a resin that is formed by curing or solidifying a
flowable resin.
25
3. The electronic component according to claim 2, wherein
the conductive member is electrically connected to the ground wiring
pattern by curing or solidifying the flowable resin in a state where the conductive
member is pressed toward the conductor-formed plate-like member by the
30 packaging substrate.
4. The electronic component according to claim 2, wherein
the conductive member is electrically connected to the ground wiring

pattern by curing or solidifying the flowable resin in a state where the conductive member is pressed toward the ground wiring pattern by a compressive stress at the time of curing or solidifying the flowable resin.

5 5. A method for producing an electronic component using compression molding, comprising:

 providing a packaging substrate comprising an electronic device, a bonding pad electrically connected to a connection electrode of the electronic device; and a ground wiring pattern;

10 providing a conductor-formed plate-like member comprising a conductive plate-like member and a conductive member attached to the plate-like member and projected from a principal surface of the plate-like member;

 temporarily fixing the packaging substrate at a predetermined position of a first die;

15 disposing the conductor-formed plate-like member on an inner bottom surface of a cavity provided in a second die;

 filling the cavity with a flowable resin;

 immersing at least a part of the conductive member in the flowable resin;

20 bringing the ground wiring pattern into contact with the conductive member by clamping the first die and the second die in a state where the cavity is filled with the flowable resin;

 immersing the electronic device, the bonding pad, and the ground wiring pattern in the flowable resin by clamping the first die and the second die;

 forming an encapsulation resin by curing or solidifying the flowable resin;

25 and

 separating an electronic component comprising the packaging substrate, the conductor-formed plate-like member, and the encapsulation resin from the second die by unclamping the first die and the second die.

30 6. A method for producing an electronic component using transfer molding or injection molding, comprising:

 providing a packaging substrate comprising an electronic device, a bonding pad electrically connected to a connection electrode of the electronic device, and a

ground wiring pattern;

providing a conductor-formed plate-like member comprising a conductive plate-like member and a conductive member attached to the plate-like member and projected from a principal surface of the plate-like member;

5 temporarily fixing the packaging substrate at a predetermined position of a first die;

disposing the conductor-formed plate-like member on an inner bottom surface of a cavity provided in a second die;

10 bringing the ground wiring pattern into contact with the conductive member by clamping the first die and the second die;

immersing at least a part of the conductive member, the electronic device, the bonding pad, and the ground wiring pattern in the flowable resin by injecting a flowable resin into the cavity in a state where the first die and the second die are clamped;

15 forming an encapsulation resin by curing or solidifying the flowable resin; and

separating an electronic component comprising the packaging substrate, the conductor-formed plate-like member, and the encapsulation resin from the second die by unclamping the first die and the second die.

20

7. The method according to claim 5 or 6, wherein the forming the encapsulation resin comprising:

curing or solidifying the flowable resin in a state where the conductive member is pressed toward the conductor-formed plate-like member by the packaging substrate .

25

8. The method according to claim 5 or 6, wherein the forming the encapsulation resin comprising:

curing or solidifying the flowable resin in a state where the conductive member is pressed toward the ground wiring pattern by a compressive stress at the time of curing the flowable resin.

30

9. An apparatus for producing an electronic component by the method

according to any one of claims 5 to 8, comprising

the first die to which the packaging substrate is temporarily fixed; and

the second die having a cavity, wherein

the cavity has an inner bottom surface on which the conductor-formed

5 plate-like member can be disposed and, by disposing the conductor-formed plate-like member on the inner bottom surface of the cavity and filling the cavity with the flowable resin, at least a part of the conductive member can be immersed in the flowable resin,

10 in the state where the first die and the second die are clamped, the ground wiring pattern can be brought into contact with the conductive member, and the electronic device, the bonding pad, and the ground wiring pattern can be immersed in the flowable resin,

15 in the state where the first die and the second die are clamped, the encapsulation resin can be formed by curing or solidifying the flowable resin filled in the cavity,

by unclamping the first die and the second die, an electronic component comprising the packaging substrate, the conductor-formed plate-like member, and the encapsulation resin can be separated from the second die,

the cavity is provided with an alignment portion, and

20 the cavity and the conductor-formed plate-like member can be aligned by the alignment portion of the cavity and an alignment portion provided on the conductor-formed plate-like member.

10. The apparatus according to claim 9, wherein

25 the alignment portion of the conductor-formed plate-like member is a concave portion or a hole formed on the plate-like member, and

the alignment portion of the cavity has a shape corresponding to a shape of the concave portion or the hole of the plate-like member and is a convex portion that can be fitted in the concave portion or the hole.

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11. The apparatus according to claim 9, wherein

the alignment portion of the conductor-formed plate-like member is a convex portion formed on the plate-like member, and

the alignment portion of the cavity has a shape corresponding to a shape of the convex portion of the plate-like member and is a concave portion that can be fitted with the convex portion.