

METHOD FOR PRODUCING BUMP-FORMED PLATE-LIKE MEMBER,
BUMP-FORMED PLATE-LIKE MEMBER, METHOD FOR PRODUCING
ELECTRONIC COMPONENT, AND ELECTRONIC COMPONENT

5 CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from Japanese Patent Application No. 2014 -240752 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 a method for producing a bump-formed plate-like member, a bump-formed plate-like member, a method for producing an electronic component, and an electronic component.

15 [0002] An electronic component (hereinafter, may simply be referred to as a “chip”) such as an IC or a semiconductor chip is used after subjecting to resin-encapsulation molding in many cases.

[0003] The electronic component obtained by encapsulating a chip in a resin (hereinafter also referred to as a completed electronic component, a package, or the like; hereinafter also simply referred to as an “electronic component”) is formed by
20 embedding a via electrode in a resin in some cases. This via electrode can be formed by, for example, forming a hole or a groove for via formation (hereinafter referred to as a “hole for via formation”) in the resin of the electronic component from the upper surface of the package and embedding a material for forming a via electrode (e.g., plating, a shielding material, a solder ball, or the like) in the hole for
25 via formation. The hole for via formation can be formed by irradiating the resin with a laser beam from the upper surface of the electronic component (package), for example. Moreover, as another method for forming a via electrode, a method in which a metal structure having a projection is used and the projection is subjected to resin-encapsulation together with a semiconductor chip, and thereafter, the metal
30 structure except for the projection is removed has been proposed (JP 2012-015216 A). In this case, only the projection of the metal structure remains in the electronic component in the state where it is encapsulated in a resin, and this projection serves as a via electrode.

[0004] On the other hand, the electronic component is molded together with a plate-like member such as a heat radiation plate (heat sink) for cooling by releasing the heat generated from the chip or a shield plate (shield) for shielding an electromagnetic wave generated from the chip in some cases (e.g., JP 2013-187340 A and JP 2007-287937 A).

BRIEF SUMMARY OF THE INVENTION

[0005] For example, the method in which a hole for via formation is formed in a resin involves the following problems (1) to (5).

(1) There is a possibility that the depth and the like of a hole for via formation are not correctly formed in an appropriate manner on a wiring pattern of a substrate due to variations in thickness of the electronic component (package) and the like.

(2) Fillers contained in a resin material are prone to remain on a wiring pattern of a substrate.

(3) Depending on the conditions under which a hole for via formation is bored in the resin, there is a possibility that damage is caused to a wiring pattern on a chip-mounted substrate.

(4) In association with the problem (3), when the density of the filler in the resin material differs, it is required to change the conditions under which a laser

processing of boring a hole for via formation in the resin is performed, i.e., it is complicated to control the conditions under which a hole for via formation is formed.

(5) By the influences of the problems (1) to (4), it is difficult to improve the yield in production of a package.

[0006] On the other hand, in the method disclosed in JP 2012-015216 A, it is

required to remove the metal structure except for the projection after resin-encapsulation of the projection of the metal structure. Therefore, producing an electronic component (package) is complicated, and the material is wasted.

[0007] Moreover, in any of the above-described methods, in order to form a plate-like member, plating or the like is required to be performed after formation of a via electrode. Thus, the steps are complicated.

[0008] Although JP 2013-187340 A and JP 2007-287937 A disclose an electronic component having a plate-like member and a method for producing the same, neither of them discloses a method by which the problems of the above-described

methods are solved in formation of a via electrode.

[0009] As described above, there has been no technology that allows simple and efficient production of an electronic component having both of a via electrode(s) and a plate-like member.

5 [0010] Hence the present invention is intended to provide a method for producing a bump-formed plate-like member, a bump-formed plate-like member, a method for producing an electronic component, and an electronic component, that allow simple and efficient production of an electronic component having both of a via electrode(s) and a plate-like member.

10 [0011] In order to achieve the aforementioned object, the present invention provides a method for producing a bump-formed plate-like member used for producing an electronic component obtained by encapsulating at least one chip in a resin, the bump-formed plate-like member being provided with at least one bump on one side, the method including: molding the plate-like member and the at least one
15 bump at a same time by molding using a molding die.

[0012] The present invention also provides a bump-formed plate-like member produced by the method for producing a bump-formed plate-like member according to the present invention.

[0013] The present invention also provides a method for producing an electronic
20 component including: a substrate, at least one chip, a resin, a plate-like member having at least one surface, at least one bump, and a wiring pattern, the method including: disposing the at least one chip on the surface; and encapsulating the at least one chip in the resin, wherein the encapsulating includes: encapsulating the at least one chip in the resin between a bump-formed surface of the bump-formed
25 plate-like member according to the present invention and a wiring pattern-formed surface of the substrate on which the wiring pattern is formed; and bringing the at least one bump into in contact with the wiring pattern.

[0014] The present invention also provides an electronic component, including: a substrate; at least one chip; a resin; and the bump-formed plate-like member
30 according to the present invention, wherein the at least one chip is disposed on the substrate and encapsulated in the resin, a wiring pattern is formed on the substrate on a side on which the at least one chip is disposed, and the at least one bump penetrates the resin and is in contact with the wiring pattern.

[0015] According to the present invention, it is possible to provide a method for producing a bump-formed plate-like member, a bump-formed plate-like member, a method for producing an electronic component, and an electronic component, that allow simple and efficient production of an electronic component having both of a via electrode(s) (bump(s)) and a plate-like member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] [FIG. 1] FIG. 1 is a perspective view showing an example of the structure of the bump-formed plate-like member according to the present invention.

[FIG. 2] FIGs. 2A and 2B are perspective views showing examples of the structure of a bump in the bump-formed plate-like member according to the present invention.

[FIG. 3] FIG. 3 shows perspective views showing other examples of the structure of a bump in the bump-formed plate-like member according to the present invention.

[FIG. 4] FIG. 4 shows perspective views showing still other examples of the structure of a bump in the bump-formed plate-like member according to the present invention.

[FIG. 5] FIG. 5 shows step cross-sectional views showing an example of the production method of a bump-formed plate-like member by electroforming.

[FIG. 6] FIG. 6 is a cross-sectional view showing another example of the production method of a bump-formed plate-like member by electroforming.

[FIG. 7] FIG. 7 is a cross-sectional view showing still another example of the production method of a bump-formed plate-like member by electroforming.

[FIG. 8] FIG. 8 is a cross-sectional view showing yet another example of the production method of a bump-formed plate-like member by electroforming.

[FIG. 9] FIG. 9 shows step cross-sectional views showing further example of the production method of a bump-formed plate-like member by electroforming.

[FIG. 10A] FIG. 10A shows step cross-sectional views showing an example of the production method of a bump-formed plate-like member by compression molding.

[FIG. 10B] FIG. 10B shows step cross-sectional views showing the steps following the steps shown in FIG. 10A.

[FIG. 11] FIG. 11 is a step cross-sectional view showing an example of the production method of a bump-formed plate-like member by transfer molding.

[FIG. 12] FIG. 12 shows step cross-sectional views schematically showing the structure of the electronic component according to the present invention and an example of a production step thereof.

[FIG. 13] FIG. 13 is a cross-sectional view showing, as an example, the production method of an electronic component according to the present invention using transfer molding.

[FIG. 14] FIG. 14 is a cross-sectional view showing, as an example, a step in an example of the production method of an electronic component according to the present invention using compression molding.

[FIG. 15] FIG. 15 is a cross-sectional view showing, as an example, another step in the same production method as in FIG. 14.

[FIG. 16] FIG. 16 is a cross-sectional view showing, as an example, still another step in the same production method as in FIG. 14.

[FIG. 17] FIG. 17 is a cross-sectional view showing, as an example, yet another step in the same production method as in FIG. 14.

[FIG. 18] FIG. 18 is a cross-sectional view showing, as an example, a step in another example of the production method of an electronic component according to the present invention using compression molding.

[FIG. 19] FIG. 19 is a cross-sectional view showing, as an example, another step in the same production method as in FIG. 18.

[FIG. 20] FIG. 20 is a cross-sectional view showing, as an example, a step in still another example of the production method of an electronic component according to the present invention using compression molding.

[FIG. 21] FIG. 21 is a cross-sectional view showing, as an example, another step in the same production method as in FIG. 20.

[FIG. 22] FIG. 22 is a cross-sectional view showing, as an example, still another step in the same production method as in FIG. 20.

[FIG. 23] FIG. 23 is a cross-sectional view showing, as an example, yet another step in the same production method as in FIG. 20.

[FIG. 24] FIG. 24 is a cross-sectional view showing, as an example, a step in yet another example of the production method of an electronic component according

to the present invention using compression molding.

[FIG. 25] FIG. 25 is a cross-sectional view showing, as an example, a step in further example of the production method of an electronic component according to the present invention using compression molding.

5 [FIG. 26] FIG. 26 is a cross sectional view showing, as an example, another example of the production method of an electronic component according to the present invention.

[FIG. 27] FIG. 27 is a cross sectional view showing, as an example, still another example of the production method of an electronic component according to
10 the present invention.

[FIG. 28] FIG. 28 is a cross-sectional view showing, as an example, a step in still further example of the production method of an electronic component according to the present invention using compression molding.

[FIG. 29] FIG. 29 is a cross-sectional view showing, as an example, another
15 step in the same production method as in FIG. 28.

[FIG. 30] FIG. 30 is a cross-sectional view showing, as an example, still another step in the same production method as in FIG. 28.

[FIG. 31] FIG. 31 is a cross-sectional view showing, as an example, yet another step in the same production method as in FIG. 28.

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DETAILED DESCRIPTION OF THE INVENTION

[0017] The present invention is described in more detail below with reference to examples. The present invention, however, is not limited by the following description.

25 [0018] The method for producing a bump-formed plate-like member according to the present invention is, as mentioned above, a method for producing a member for an electronic component obtained by encapsulating at least one chip in a resin. The member is a bump-formed plate-like member having a surface on which at least one bump is formed. The method includes molding the plate-like member and the at
30 least one bump at the same time by molding using a molding die.

[0019] In the present invention, a “chip” refers to an electronic component before resin-encapsulation and can be, for example, specifically a chip-like electronic component such as an IC or a semiconductor chip. In the present invention, an

electronic component before resin-encapsulation is referred to as a “chip” as a matter of convenience in order to differentiate from an electronic component after resin-encapsulation. However, the “chip” in the present invention is not particularly limited as long as it is an electronic component before
5 resin-encapsulation, and may not be a chip-like electronic component. An “electronic component” in the present invention refers to an electronic component obtained by encapsulating a chip in a resin (a completed electronic component), unless otherwise mentioned.

[0020] First, the bump-formed plate-like member according to the present
10 invention that can be produced by the method for producing a bump-formed plate-like member according to the present invention will be described with reference to examples.

[0021] In the bump-formed plate-like member of the present invention, the number of the bumps is not particularly limited and may be any number of one or more.

15 The shape of the bump is not limited to particular shapes. When there are plural bumps, the shapes of the bumps may be identical to or different from each other.

The bump may have or may not have a deformable portion. It is preferred that the deformable portion is deformable by shrinking in the direction perpendicular to the plane direction of the plate-like member. As will be described below, it is preferred

20 that the bump has a deformable portion because there is no need to design the height of the bump having a deformable portion strictly according to the thickness of a completed electronic component, for example. For example, at least one bump may be a zigzag bump. In the zigzag bump, the deformable portion may be

25 deformable by shrinking in the direction perpendicular to the plane direction of the plate-like member by the zigzag bending of at least the deformable portion as viewed in the direction parallel with the plane direction of the plate-like member. The

zigzag bump is acceptable as long as at least the deformable portion is zigzagged, and the part other than the deformable portion may be zigzagged or may not be zigzagged. More specifically, the shape of the zigzag bump may be, for example, any

30 of the shapes shown in FIGs. 2A and 2B and (A) to (C) in FIG. 4 that will be described below.

[0022] For example, at least one bump may have a through hole. More specifically, for example, as shown in (A) to (C) in FIG. 3 and (A) to (C) in FIG. 4 that will be

described below, the through hole of a bump (12) having a through hole may be a through hole (12b) penetrating in the direction parallel with the plane direction (plate surface) of the plate-like member. Also the bump having a through hole may have a projection (12c) projecting at the end opposite to an end (12a side) formed in the plate-like member in the direction perpendicular to the plate surface of the plate-like member. The deformable portion may surround the through hole. It is preferred that the deformable portion which is deformable by shrinking in the direction perpendicular to the plane direction of the plate-like member surrounds the through hole. More specifically, the shape of such a bump having a through hole may be, for example, any of the shapes shown in (A) to (C) in FIG. 3 and (A) to (C) in FIG. 4 that will be described below. In the bump-formed plate-like member according to the present invention, the deformation of the deformable portion of the bump may be an elastic deformation or a plastic deformation. That is, the deformable portion may be a portion (elastic portion) which is elastically deformable or a portion (plastic portion) which is plastically deformable. Whether the deformation is an elastic deformation or a plastic deformation depends on the material of the bump and the like, for example.

[0023] In the production method according to the present invention, at least one bump may be a columnar bump. Examples of the shape of the columnar bump include a cylindrical shape, a prismatic shape, a cone shape, a pyramid shape, a truncated cone shape, and a truncated pyramid shape. For example, in the case of using a bump having a cylindrical shape, the entire bump may be a deformable portion which is deformable by shrinking in the direction perpendicular to the plane direction of the plate-like member. In this case, for example, the bump may have a bent barrel shape by entirely swelling the side surface of the cylindrical shape.

[0024] In the production method according to the present invention, at least one bump may be a plate-like bump. In this case, in the production method of an electronic component according to the present invention, there are plural chips, and in the encapsulating, the substrate may be partitioned into plural regions with the plate-like bump(s), and the chip(s) may be encapsulated in the resin in the plural regions. Moreover, it is preferred that the plate-like bump has a through hole and a projection, the through hole penetrates the plate-like bump in the direction parallel with the plate surface of the plate-like member, and the projection projects at the end

opposite to the end formed in the plate-like member in the direction perpendicular to the plate surface of the plate-like member. The deformable portion may surround the through hole. It is preferred that the deformable portion which is deformable by shrinking in the direction perpendicular to the plane direction of the plate-like member surrounds the through hole.

[0025] In the production method according to the present invention, although the plate-like member is not particularly limited, the plate-like member is preferably a heat radiation plate (heat sink) or a shield plate (shield). The shield plate may shield an electromagnetic wave emitted from the chip(s), for example. It is preferred that the heat radiation plate has a heat radiation fin on the surface opposite to the bump-formed surface. The shape of the plate-like member is not particularly limited except that the bump(s) is formed therein. For example, when the plate-like member is a heat radiation plate, the heat radiation plate may have a shape (e.g., fin shape) in which, in addition to the bump(s), one or more projections for improving heat radiation efficiency are bound thereto or the like. The material of the plate-like member also is not limited to particular materials, and when the plate-like member is a heat radiation plate or a shield plate, a metal material, a ceramic material, a resin, or a metal vapor deposition film can be used, for example. The metal vapor deposition film is not limited to particular films and may be, for example, a metal vapor deposition film obtained by vapor deposition of aluminium, silver, or the like on a film. Moreover, although the material of the bump(s) is not limited to particular materials, a metal material, a ceramic material, a resin, or the like can be used, for example. The metal material is not limited to particular materials, and examples thereof include: an iron-based material such as stainless or Permalloy (alloy of iron and nickel); a copper-based material such as brass, a copper-molybdenum alloy, or beryllium copper; and an aluminium-based material such as duralumin. The ceramic material is not limited to particular materials, and examples thereof include: an alumina-based material such as aluminum nitride; a silicon-based material such as silicon nitride; and zirconia-based material. The resin is not limited to particular resins, and examples thereof include: a rubber-based material such as an elastomer resin; a material obtained by mixing a conductive material in a silicon-based base material; and a resin material obtained by extrusion molding or injection molding of any of these materials. A conductive

layer may be formed on the surface of the plate-like member or the like in the bump-formed plate-like member by a surface treatment such as plating or coating. The plate-like member is also a functional member (working member) that has some functions. For example, in the case where the plate-like member is a heat radiation plate (heat sink), the plate-like member is a functional member (working member) having a heat radiation function (heat radiation action), and in the case where the plate-like member is a shield plate (shield), the plate-like member is a functional member (working member) having a shielding function (shielding action).

[0026] The shape of the plate-like member is not particularly limited as mentioned above, and the plate-like member may have a resin containing portion, for example. More specifically, for example, the plate-like member may have a protuberance at the peripheral edge toward the bump-formed surface of the plate-like member to form the resin containing portion in the central portion of the plate-like member.

[0027] The method for producing a bump-formed plate-like member according to the present invention will be described below with reference to examples.

[0028] As described above, the production method of a bump-formed plate-like member according to the present invention includes molding the plate-like member and the bump(s) at the same time by molding using a molding die. The molding die is not limited to particular dies, and examples thereof include a metal die, a ceramic die, and a resin die. The molding may be performed, for example, by electroforming, compression molding, or transfer molding. The molding method using a molding die is not limited to particular methods, and the method can be, for example, injection molding besides electroforming, compression molding, or transfer molding.

[0029] In the case where the molding is performed by electroforming, the bump(s) may have a deformable portion. Also in the case where the molding is performed by electroforming, the molding die may be a molding die produced by molding using a master die. In the case where the molding die is a molding die produced by molding using a master die, the molding die may be divided into plural pieces and the molding may be performed in the state where the divided pieces are assembled as a molding die. Also in this case, the molding die may be divided into plural pieces substantially in parallel with the plane direction of the plate-like member.

[0030] For example, the molding may be performed using a metal. Also, for example, the molding may be performed using a conductive resin. The conductive

resin may be, for example, a mixture of a resin and a conductive particle. The conductive particle is not particularly limited and examples thereof include metal particles. The metal in the metal particles is also not particularly limited, and examples thereof include gold, silver, copper, nickel, tin, any other metals, and an alloy of two or more of them. The production method of a bump-formed plate-like member according to the present invention may include the molding the plate-like member and the bump(s) at the same time by molding using a resin and may further include applying a conductive film to the surface of the bump(s) and the bump-formed surface of the bump-formed plate-like member. The conductive film is not particularly limited, and examples thereof include metal films. The metal in the conductive film is also not particularly limited, and examples thereof include gold, silver, copper, nickel, tin, and an alloy of two or more of them. The method for forming the conductive film is not particularly limited, and examples thereof include plating, coating, sputtering, and vapor deposition. The plating may be, for example, electroless plating or electroplating.

[0031] In the production method of a bump-formed plate-like member according to the present invention, the molding die may have the die surface corresponding to the shape of the bump-formed surface of the bump-formed plate-like member and a hole(s) corresponding to the shape of the bump(s) on the die surface, and in the molding, the molding may be performed by bringing a material for forming the bump-formed plate-like member into contact with the die surface and the inner surface of the hole(s). Also the molding die may have the die surface corresponding to the shape of the bump-formed surface of the bump-formed plate-like member and a projection(s) corresponding to the shape of the bump(s) on the die surface, and in the molding, the molding may be performed by bringing a material for forming the bump-formed plate-like member into contact with the die surface and the surface of the projection(s).

[0032] Furthermore, for example, the shape of the bump is not limited to particular shapes as mentioned above. The bump(s) may have a tapered shape formed to be thinner in diameter toward its end, for example. Such a shape of the bump allows the bump-formed plate-like member to be taken out from the molding die easily as will be described below.

[0033] The method for producing an electronic component according to the present

invention is described below with reference to examples.

[0034] In the production method of an electronic component according to the present invention, at least one bump may be a plate-like bump, there may be plural chips, and in the encapsulating, the substrate may be partitioned into plural regions with the plate-like bump(s), and the chips may be encapsulated in the resin in the plural regions.

[0035] In the encapsulating, the method used for the resin-encapsulation (molding method) is not limited to particular methods. For example, in the encapsulating, the chip(s) may be encapsulated in a resin by transfer molding or compression molding.

[0036] In the case where the chip(s) is encapsulated in a resin by compression molding in the encapsulating, the production method according to the present invention may further include placing the resin on the bump-formed surface of the bump-formed plate-like member. Moreover, in this case, the production method according to the present invention may further include transferring the bump-formed plate-like member to a die cavity of a molding die. The encapsulating may be performed by compression molding of the resin in the die cavity together with the bump-formed plate-like member and the chip(s) in the state where the chip(s) is immersed in the resin placed on the plate-like member.

[0037] The order of performing the placing the resin and the transferring the bump-formed plate-like member is not limited to particular orders. Either one of them may be performed prior to the other, or the both of them may be performed at the same time. For example, in the transferring the bump-formed plate-like member, the resin may be transferred to a die cavity of a molding die together with the bump-formed plate-like member in the state where the resin is placed on the bump-formed plate-like member. Also, in the transferring the bump-formed plate-like member, the bump-formed plate-like member may be transferred to a die cavity of a molding die in the state where the resin is not placed on the bump-formed plate-like member. In this case, the production method according to the present invention may further include heating the bump-formed plate-like member in the die cavity prior to the placing the resin. Then, the placing the resin may be performed in the die cavity in the state where the bump-formed plate-like member is heated.

[0038] In the transferring the bump-formed plate-like member, the bump-formed plate-like member may be transferred to the die cavity of the molding die in the state where the bump-formed plate-like member is placed on a release film so as to face the bump-formed surface upward. In this case, in the transferring the

5 bump-formed plate-like member, the bump-formed plate-like member may be transferred to the die cavity of the molding die in the state where a frame is placed on the release film together with the bump-formed plate-like member and the bump-formed plate-like member is surrounded by the frame. In the placing the resin, it is preferred that the resin is placed on the bump-formed surface by
10 supplying the resin to a space surrounded by the bump-formed plate-like member and the frame in the state where the frame is placed on the release film together with the bump-formed plate-like member and the bump-formed plate-like member is surrounded by the frame. In such a case, the order of performing the placing the resin and the transferring the bump-formed plate-like member is not limited to
15 particular orders. Either one of them may be performed prior to the other, or the both of them may be performed at the same time. However, it is preferred that the placing the resin is performed prior to the transferring the bump-formed plate-like member.

[0039] Moreover, the surface of the bump-formed plate-like member opposite to the
20 bump-formed surface may be fixed on the release film by a pressure-sensitive adhesive.

[0040] A transfer unit configured to perform the transferring the bump-formed plate-like member may be a unit configured to transfer the resin to a die cavity of a molding die in the state where the plate-like member on which the resin is placed is
25 placed on the release film. In this case, a resin-encapsulation unit configured to perform the resin-encapsulation may include a unit configured to attract a release film and may perform the compression molding in the state where the release film is attracted to the unit configured to attract a release film. The molding die is not limited to particular molding dies and the molding die can be, for example, a metal
30 die or a ceramic die.

[0041] In the production method of an electronic component according to the present invention, as described above, the plate-like member of the bump-formed plate-like member may have a resin containing portion. More specifically, for

example, the plate-like member may have a protuberance at the peripheral edge on the bump-formed surface side of the plate-like member to form the resin containing portion in the central portion of the plate-like member. Moreover, in the placing the resin of the production method of an electronic component according to the present invention, the resin may be placed in the resin containing portion of the plate-like member, and the encapsulating may be performed in the state where the resin is placed in the resin containing portion.

[0042] In the encapsulating, the substrate having the wiring pattern-formed surface on which the chip(s) is disposed may be placed on a substrate placement stage so as to face the wiring pattern-formed surface upward, and the resin may be further pressed in the state where the resin is placed on the wiring pattern-formed surface. More specifically, the bump-formed plate-like member may be pressed to the resin from the bump side in the above-described state. Thus, the bump(s) can be connected to the wiring pattern on the substrate in which the chip(s) is placed.

[0043] The plate-like member of the bump-formed plate-like member is not particularly limited as mentioned above, and the plate-like member may be a heat radiation plate and the heat radiation plate may have a heat radiation fin on the surface opposite to the bump-formed surface, for example.

[0044] In the production method of an electronic component according to the present invention, the resin is not limited to particular resins, and for example, the resin may either be a thermoplastic resin or a thermosetting resin. The resin may be at least one selected from the group consisting of a granular resin, a powdery resin, a liquid resin, a plate-like resin, a sheet-like resin, a film-like resin, and a paste-like resin, for example. Furthermore, the resin may be at least one selected from the group consisting of a transparent resin, a translucent resin, and an opaque resin, for example.

[0045] The specific examples of the present invention are described below with reference to the drawings. Each drawing is schematically illustrated by appropriately omitting, exaggerating, and the like for convenience of description.

Examples

[0046] [Example 1]

In the present example, an example of the bump-formed plate-like member according to the present invention, an example of the method for producing a

bump-formed plate-like member according to the present invention, an example of the electronic component according to the present invention using the bump-formed plate-like member, and an example of the method for producing the electronic component are described.

5 [0047] The structure of the bump-formed plate-like member according to the present example is schematically shown in the perspective view of FIG. 1. As shown in FIG. 1, this bump-formed plate-like member 10 is formed by forming a pattern of a bump(s) 12 on one surface of a plate-like member 11. The length (height) of the bump(s) 12 is not particular limited, and the length can be set
10 appropriately according to the thickness of a completed electronic component (molded package), for example. In the present invention, the pattern of the bump(s) is not limited to the pattern of the present example (FIG. 1) and can be any pattern.

[0048] The structure of the bump(s) 12 shown in FIG. 1 is not limited to particular structures. The bump 12 may have a deformable portion, for example. Each of
15 FIGs. 2A and 2B is a perspective view showing an example of the structure of the bump 12 having such a deformable portion. In the perspective view of each of FIGs. 2A and 2B, the vertical direction of the plane of paper indicates the direction perpendicular to the plane direction of the plate-like member 11. The bump 12 shown in FIG. 2A has a deformable portion 12A at the central part, and the part
20 other than the central part is composed of a rigid portion (end parts of the bump 12) 12B. As shown in FIG. 2A, the deformable portion 12A is zigzagged as viewed in the direction parallel with the plane direction of the plate-like member 11.

Furthermore, as shown in FIG. 2A, the bump 12 can be shrunk in the perpendicular direction by zigzagging the deformable portion 12A. On the other hand, the entire

25 bump 12 shown in FIG. 2B is composed of a deformable portion 12A. The deformable portion 12A shown in FIG. 2B also is zigzagged as viewed in the direction parallel with the plane direction of the plate-like member 11. The entire bump 12 shown in FIG. 2B is deformable by shrinking in the perpendicular direction by bending in a V shape. Accordingly, for example, even in the case where the height
30 of the bump 12 is designed higher than the thickness of the completed electronic component (electronic component obtained by encapsulating the chip(s) in a resin), the bump 12 suits the thickness without being damaged at the time of molding.

Thus, the height of the bump is not required to be designed according to the

thickness in advance. Therefore, an electronic component having both of a via electrode(s) (bump(s)) and a plate-like member can be produced simply and efficiently.

[0049] The shape of the bump(s) 12 is not limited to the structure having a zigzag deformable portion 12A as shown in FIGs. 2A and 2B. For example, the bump(s) 12 may have a through hole 12b. More specifically, for example, the bump(s) 12 may have any of the shapes shown in (A) to (C) in FIG. 3. In FIG. 3, the upper right drawing is a perspective view showing a part of the bump-formed plate-like member 10 of FIG. 1. Each of (A) to (C) in FIG. 3 is a perspective view schematically showing an example of the structure of the bump 12. As shown in each of (A) to (C) in FIG. 3, a lower part 12a (a part connected to the plate-like member 11) of the bump 12 has no hole. On the other hand, an upper part (a part on the side opposite to the side of connecting to the plate-like member 11) of the bump 12 has a hole (through hole) 12b penetrating the bump 12 in the direction parallel with the plate surface of the plate-like member 11. The upper end of the bump 12 (the end opposite to the end formed in the plate-like member 11) is partially projected upward (the direction perpendicular to the plate surface of the plate-like member 11) to form a projection 12c. The bump 12 can be in contact with a wiring pattern (substrate electrode) of a substrate at the tip of the projection 12c. In (A) in FIG. 3, the number of projections 12c is two. The bump 12 shown in (B) in FIG. 3 is the same as that shown in (A) in FIG. 3 except that the number of projections 12c is one and the width of the bump 12 is slightly narrower. The bump 12 shown in (C) in FIG. 3 is the same as that shown in (B) in FIG. 3 except that the bump 12 is further narrower. As described above, the number of projections 12c is not particularly limited and can be one or more. Although the number of projections 12c is one or two in (A) to (C) in FIG. 3, the number of projections 12c can be three or more. Also, although the number of holes (through holes) 12b is one in (A) to (C) in FIG. 3, the number of holes (through holes) 12b is not particularly limited and can be any number, and there may be plural holes 12b.

[0050] When the bump(s) has a projection(s) 12c, the bump(s) 12 can be in contact with the wiring pattern (substrate electrode) in the substrate easily without being interfered by the resin. That is, by the provision of the projection(s) 12c, the tip of the projection(s) 12c comes into contact with (is physically in contact with) and is

electrically connected to the wiring pattern 22 through the resin (e.g., a molten resin or a liquid resin) between the bump(s) 12 and the wiring pattern 22 shown in FIG. 12 that will be described below. Moreover, when the bump(s) 12 has a through hole(s) 12b, the resin-encapsulation of the chip(s) is performed more easily. That is, the resin can flow through the through hole(s) 12b so that the resin flows smoothly, and the efficiency of the resin-encapsulation is further improved. This effect is especially prominent in the case of producing an electronic component by transfer molding (encapsulating a chip in a resin together with a bump-formed plate-like member). Moreover, when the bump(s) 12 comes into contact with (is in contact with) the wiring pattern 22, the bump(s) 12 is bent around the hole(s) 12b as shown in (D) in FIG. 3. Thus, the height (length) of the bump(s) 12 can be reduced. That is, in the bump 12 shown in each of (A) to (D) in FIG. 3, the deformable portion which can be shrunk in the direction perpendicular to the plane direction of the plate-like member 11 surrounds the through hole 12b. Thus, the height of the bump(s) 12 can be adjusted according to the thickness of the resin (the thickness of the package) of the electronic component. By taking this point into consideration, the height (length) of the bump(s) 12 may be set longer than the thickness of the resin (the thickness of the package) in advance.

[0051] The bump(s) 12 may be, for example, a zigzag bump having a through hole. That is, the bump(s) 12 may have both of the deformable portion zigzagged as viewed in the direction parallel with the plane direction of the plate-like member 11 and the through hole penetrating in the direction parallel with the plane direction of the plate-like member 11. An example of the structure of such a bump(s) 12 is shown in each of (A) to (C) in FIG. 4. In FIG. 4, the upper right drawing is a perspective view showing a part of the bump-formed plate-like member 10 of FIG. 1. Each of (A) to (C) in FIG. 4 is a perspective view schematically showing an example of the structure of the bump 12. The bumps 12 shown in (A) to (C) in FIG. 4 are the same as those in (A) to (C) shown in FIG. 3 except that a lower part 12a (a part which is not bored on the side connecting to the plate-like member 11) and an upper part (a part having a through hole 12b on the side opposite to the side connecting to the plate-like member 11) of the bump 12 are integrated by connecting to each other via the deformable portion 12A. In each of (A) to (C) in FIG. 4, the deformable portion 12A is zigzagged as viewed in the direction parallel with the plane direction

of the plate-like member 11 as in FIG. 2A. Thus, the deformable portion 12A can be shrunk in the direction perpendicular to the plane direction of the plate-like member 11. As in (A) to (C) in FIG. 3, the height (length) of the bump(s) 12 shown in (A) to (C) in FIG. 4 can be reduced as shown in (D) in FIG. 4 by bending the bump(s) 12 around the hole 12b, for example.

[0052] The shape of the bump(s) 12 is not limited to the shapes shown in FIGs. 2A and 2B, (A) to (C) in FIG. 3, and (A) to (C) in FIG. 4. For example, although the shapes shown in FIGs. 2A and 2B, (A) to (C) in FIG. 3, and (A) to (C) in FIG. 4 are examples of the bump(s) 12 having the deformable portion(s) 12A, the bump(s) 12 is not limited to the bump(s) having the deformable portion(s) 12A. Also in the case of bump(s) 12 having the deformable portion(s) 12A, the shape of the bump(s) 12 is not limited to the shapes shown in FIGs. 2A and 2B, (A) to (C) in FIG. 3, and (A) to (C) in FIG. 4 and can be any shape in addition to or as substitute for the shapes shown in FIGs. 2A and 2B, (A) to (C) in FIG. 3, and (A) to (C) in FIG. 4. For example, as described above, at least one bump 12 may be a columnar bump. Examples of the shape of the columnar bump include, as mentioned above, a cylindrical shape, a prismatic shape, a cone shape, a pyramid shape, a truncated cone shape, and a truncated pyramid shape.

[0053] Moreover, as described above, at least one bump 12 may be a plate-like bump. In this case, as described above, in the encapsulating of the production method according to the present invention, the substrate may be partitioned into plural regions with the plate-like bump, and the resin-encapsulation of the chip(s) may be performed in each region. Moreover, the plate-like bump may have a through hole and a projection as the bumps shown in (A) to (C) in FIG. 3. The through hole may penetrates the plate-like bump in the direction parallel with the plate surface of the plate-like member as in (A) to (C) in FIG. 3. Moreover, it is preferred that the projection projects at the end opposite to the end formed in the plate-like member in the direction perpendicular to the plate surface of the plate-like member as in (A) to (C) in FIG. 3. Although the number of the through holes and the number of the projections of the plate-like bump are not particularly limited and can be any number, the plate-like bump preferably has plural through holes and plural projections. When the plate-like bump has the through hole and the projection, the same advantageous effect as the through hole 12b and the projection

12c shown in (A) to (C) in FIG. 3 can be obtained. That is, first, when the plate-like bump has the projection, the plate-like bump is more easily in contact with the wiring pattern (substrate electrode) in the substrate without being interfered by the resin. Also, when the plate-like bump has the through hole, the resin can flow
5 through the through hole so that the resin flows more smoothly, and the efficiency of the resin-encapsulation is further improved. This effect is especially prominent in the case of producing an electronic component by transfer molding (encapsulating a chip in a resin together with a bump-formed plate-like member). Moreover, when the plate-like bump is bent around the through hole, the height (length) of the
10 plate-like bump can be reduced. Thus, the height of the plate-like bump can be adjusted according to the thickness of the resin of the electronic component (the thickness of the package). By taking this point into consideration, the height (length) of the plate-like bump may be set slightly higher than the thickness of the resin (the thickness of the package) in advance.

15 [0054] Moreover, in the present invention, although it is preferred that the deformable portion of the bump(s) can be shrunk in the direction perpendicular to the plane direction of the plate-like member, the deformable portion may be deformed to any shape besides the shrinking in the perpendicular direction. For example, the deformable portion may be in the state of entirely enlarging in the
20 lateral direction including the plane direction (horizontal plane direction) and the oblique direction of the plate-like member in addition to the shrinking in the direction perpendicular to the plane direction of the plate-like member. The deformation depends on the material, shape, and the like of the plate-like member, for example.

25 [0055] An example of the method for producing the bump-formed plate-like member is described below.

[0056] As described above, the production method of a bump-formed plate-like member according to the present invention includes the molding the plate-like member and the bump(s) at the same time by molding using a molding die.

30 [0057] An example of the molding the plate-like member and the bump(s) at the same time by electroforming is shown in step cross-sectional views (A) to (C) in FIG. 5. First, as shown in (A) in FIG. 5, a molding die 10D for electroforming is provided. As shown in (A) in FIG. 5, one surface (upper side surface on the plane of paper) of

this molding die 10D is the die surface corresponding to the shape of the bump-formed surface of the plate-like member. On the die surface, a hole(s) 12D corresponding to the shape of the bump(s) is formed. The production method of the molding die 10D for electroforming is not limited to particular methods, and the molding die 10D for electroforming may be formed, for example, by machining a resin plate or a metal plate. For example, the hole(s) 12D may be formed by machining (milling) or the like. Also the molding die 10D may be produced by molding using a master die having the die surface corresponding to the shape of the molding die 10D (a master die having the die surface having an upside-down shape of the uneven shape of the surface of the molding die 10D). The molding using a master die is not particularly limited, and examples thereof include electroforming, compression molding, and transfer molding. The material of the molding die 10D is not limited to particular materials, and examples thereof include a resin, a metal, and ceramics. From the viewpoint of use as a molding die for electroforming, the material of the molding die 10D is preferably a conductive material. When the material for forming the molding die 10D is a resin, the resin is preferably a conductive resin. The conductive resin is not particularly limited, and the conductive resin may be, for example, a mixture of a resin and a conductive particle. The conductive particle is not particularly limited and examples thereof include metal particles. The metal in the metal particles is also not particularly limited, and examples thereof include gold, silver, copper, nickel, tin, any other metals, and an alloy of two or more of them. The molding die 10D may be a molding die to which a conductive film is applied to the surface of the conductive resin or the non-conductive resin. The conductive film is not particularly limited, and examples thereof include metal films. The metal in the conductive film is also not particularly limited, and examples thereof include gold, silver, copper, nickel, tin, and an alloy of two or more of them. The method for forming the conductive film is not particularly limited, and examples thereof include plating, coating, sputtering, and vapor deposition. The plating may be, for example, electroless plating or electroplating. [0058] As indicated by the arrows in (A) of FIG. 5, the material for forming the bump-formed plate-like member is brought into contact with the die surface of the molding die 10D and the inner surface of the hole(s) 12D by electroforming. That is, as shown in (B) in FIG. 5, the bump-formed plate-like member 10 is produced by

molding the plate-like member 11 and the bump(s) 12 at the same time by bringing the material for forming the bump-formed plate-like member 10 into contact with the die surface of the molding die 10D and the inner surface of the hole(s) 12D. In the case of producing the bump-formed plate-like member 10 by electroforming as mentioned above, the material for forming the bump-formed plate-like member 10 is not limited to particular materials, and examples thereof include metals such as nickel, copper, and the like and an alloy of two or more of them. Then, as shown in (C) in FIG. 5, the bump-formed plate-like member 10 is taken out from the molding die 10D to use. At that time, the bump-formed plate-like member 10 may be taken out from the molding die 10D while maintaining the shape of the molding die 10D. For example, the bump-formed plate-like member 10 may be taken out from the molding die 10D by melting the molding die 10D. In this case, the material for forming the molding die 10D is preferably a resin from the viewpoint of simplicity. The resin may be, for example, a conductive resin obtained by mixing a resin and a conductive particle. For example, when the molding die 10D is produced using a master die, the molding die 10D of the same size and shape can be produced over and over again in a simple manner. Thereby, even when the molding die 10D is an expendable die to be melted after the use, the bump-formed plate-like member 10 can be produced efficiently at a low cost. For example, the material obtained by melting the molding die 10D may be reused for the material for the molding die 10D.

[0059] The production method of a bump-formed plate-like member according to the present invention may include or not include steps other than the molding (molding the plate-like member and the bump(s) at the same time) as appropriate. For example, in the example shown in FIG. 5, the production method may include or not include removing the unnecessary part of the bump-formed plate-like member 10 by machining (e.g., cutting and polishing), etching, or the like after taking out the bump-formed plate-like member 10 from the molding die 10D as shown in (C) in FIG. 5.

[0060] FIGs. 6 to 9 show some variations of the molding (molding the plate-like member and the bump(s) at the same time) performed by electroforming.

[0061] First, FIG. 6 shows an example of the case where the molding die 10D is a convex die. That is, the case where the molding die 10D is a concave die is illustrated in (A) to (C) in FIG. 5. Here, as described with reference to FIG. 5, the

concave die has the die surface corresponding to the shape of the bump-formed surface of the plate-like member and a hole(s) corresponding to the shape of the bump(s) on the die surface. In contrast, the convex die has the die surface corresponding to the shape of the bump-formed surface of the plate-like member and a projection(s) corresponding to the shape of the bump(s) on the die surface. That is, as shown in FIG. 6, one surface (upper side surface on the plane of paper) of the molding die 10D (convex die) shown in FIG. 6 is the die surface corresponding to the shape of the bump-formed surface of the plate-like member. On the die surface, a projection(s) 12E corresponding to the shape of the bump(s) is formed. As shown in FIG. 6, in the molding, the plate-like member 11 and the bump(s) 12 are molded at the same time by bringing the material for forming the bump-formed plate-like member 10 into contact with the die surface and the surface of the projection(s) 12E. The production method of the bump-formed plate-like member 10 shown in FIG. 6 can be performed by electroforming. More specifically, the production method shown in FIG. 6 can be performed in the same manner as the production method shown in (A) to (C) in FIG. 5 except that the convex die shown in FIG. 6 is used instead of the concave die shown in FIG. 5(A), for example.

[0062] FIGs. 7 and 8 show examples of bumps 12 each having a tapered shape formed to be thinner in diameter toward its end (as it goes away from the plate-like member 11). FIG. 7 shows an example of the concave die and is the same as (B) in FIG. 5 except that the bump(s) 12 has a tapered shape formed to be thinner in diameter toward its end (as it goes away from the plate-like member 11). FIG. 8 shows an example of the convex die and is the same as FIG. 6 except that the bump(s) 12 has a tapered shape formed to be thinner in diameter toward its end (as it goes away from the plate-like member 11). As shown in FIGs. 7 and 8, the shape of the hole(s) 12D corresponds to the shape of the bump(s) 12 and the shape of the projection(s) 12E corresponds to the shape of the bump(s) 12. That is, each of the hole(s) 12D and the projection(s) 12E has a tapered shape formed to be thinner in diameter toward its end (as it goes away from the plate-like member 11). The production of the bump-formed plate-like member 10 using the molding die 10D shown in FIGs. 7 or 8 can be performed in the same manner as in FIGs. 5 or 6. It is preferred that the bump(s) 12 has such a tapered shape because it allows the bump-formed plate-like member 10 to be taken out from the molding die 10D easily.

[0063] The step cross-sectional views (A) to (D) of FIG. 9 show an example of the case where a molding die is divided into plural pieces. As shown in (A) in FIG. 9, the molding die is divided into plural pieces substantially in parallel with the plane direction of the plate-like member. Specifically, this molding die is divided into four pieces, namely molding dies 10D1, 10D2, 10D3, and 10D4 from the tip of the bump(s) toward the side of the plate-like member as shown in (A) in FIG. 9. The molding die 10D1 corresponds to the tip of the bump(s). The molding dies 10D2 and 10D3 correspond to the deformable portion of the bump at the central part. The molding die 10D4 corresponds to the plate-like member and the bump at the side of the plate-like member. The upper surface (upper side surface on the plane of paper) of the molding die 10D4 is the die surface corresponding to the bump-formed surface of the plate-like member. The molding dies 10D1, 10D2, 10D3, and 10D4 respectively have holes 12D1, 12D2, 12D3, and 12D4 corresponding to the shape of the bump(s). While the hole(s) 12D1 does not penetrate through the molding die 10D1, the holes 12D2, 12D3, and 12D4 are through holes respectively penetrating through the molding dies 10D2, 10D3, and 10D4. As shown in (B) in FIG. 9, a molding die having the die surface on which the hole(s) corresponding to the shape of the bump(s) is formed is obtained by assembling the molding dies 10D1, 10D2, 10D3, and 10D4. In this molding die, the holes 12D1, 12D2, 12D3, and 12D4 together form a hole(s) corresponding to the shape of the bump(s). By using this molding die, the bump-formed plate-like member can be produced by electroforming in the same manner as in (A) to (C) in FIG. 5. That is, by bringing the material for forming the bump-formed plate-like member into contact with the die surface of the molding die and the inner surface of the hole(s) shown in (B) in FIG. 9, the plate-like member 11 and the bump 12 are molded at the same time (molding) to form the bump-formed plate-like member 10 as shown in (C) in FIG. 9. As shown in (C) in FIG. 9, the bump-formed plate-like member 10 includes the bump(s) 12 having the deformable portion(s) 12A at the central part. Then, as shown in (D) in FIG. 9, the bump-formed plate-like member 10 is taken out from the molding die 10D to use.

[0064] The method of using the molding die, which is divided into plural pieces substantially in parallel with the plane direction of the plate-like member as shown in (A) to (D) in FIG. 9, is preferred in the case where the shape of the bump(s) 12 is complicated.

Specifically, the case where the shape of the bump(s) 12 is complicated is, for example, the case where the bump(s) 12 has the deformable portion(s) 12A as shown in (C) and (D) in FIG. 9. The shape of the bump(s) 12 having the deformable portion(s) 12A is not limited to particular shapes, and examples of the shape include those shown in FIGs. 2A and 2B, (A) to (C) in FIG. 3, and (A) to (C) in FIG. 4. Even in the case where the shape of the bump(s) 12 is complicated, it is easy to produce the molding die when the molding die, which is divided into plural pieces substantially in parallel with the plane direction of the plate-like member, is used. Although the method for taking out the bump-formed plate-like member 10 from the molding die 10D after the molding ((C) in FIG. 9) is not particularly limited, it is preferred that the bump-formed plate-like member 10 is taken out from the molding die 10D by melting the molding die 10D. Even when the shape of the bump(s) 12 is complicated, the bump-formed plate-like member 10 can be taken out from the molding die 10D easily by melting the molding die 10D. In this case, it is preferred that the molding die 10D is produced using a master die.

[0065] Examples of the method for producing the bump-formed plate-like member by electroforming were described with reference to FIGs. 5 to 9. By using the molding by electroforming, the bump-formed plate-like members of the same shape can be produced efficiently with a high degree of precision. Furthermore, even when the shape of the bump-formed plate-like member is complicated, fine, or the like, it is possible to reproduce the bump-formed plate-like member with a high degree of precision by electroforming.

[0066] The production method of an electronic component using the bump-formed plate-like member is not limited to particular methods. For example, the production method can be performed by the production steps shown in the step cross-sectional views of (A) to (C) in FIG. 12. The cross-sectional view of (C) in FIG. 12 is a schematic view of the structure of the electronic component according to the present example produced by the production steps shown in (A) to (C) in FIG. 12. First, as shown in (C) in FIG. 12, this electronic component 20 includes a substrate 21, chips 31, a resin 41, a plate-like member 11, and bumps 12 each having a deformable portion 12A. The bumps 12 are formed on one surface of the plate-like member 11, and the plate-like member 11 and the bumps 12 are integrated to form a bump-formed plate-like member. The chips 31 are fixed on the substrate 21 and

are encapsulated in the resin 41. A wiring pattern 22 is formed on the substrate 21 at the side on which the chips 31 are disposed. As also described with reference to FIG. 1, the bumps 12 are formed on one surface of the plate-like member 11.

Moreover, the bumps 12 are in contact with the wiring pattern 22 through the resin 41.

[0067] The production steps of (A) to (C) in FIG. 12 are described below. First, as shown in (A) in FIG. 12, a bump-formed plate-like member 10 and a substrate 21 are provided. As shown in (A) in FIG. 12, in the bump-formed plate-like member 10, bumps 12 are formed on one surface of a plate-like member 11, and the plate-like member 11 and the bumps 12 are integrated to form the bump-formed plate-like member 10. In (A) in FIG. 12, the length (height) of the bump(s) 12 in the direction perpendicular to the plane direction of the plate-like member 11 is indicated by the arrow and the character M. Chips 31 are fixed on the substrate 21. A wiring pattern 22 is formed on the substrate 21 at the side on which the chips 31 are disposed. Then, the bump-formed plate-like member 10 and the substrate 21 are disposed so that the bump 12-formed surface and the wiring pattern 22-formed surface are faced with each other as shown in (A) in FIG. 12.

[0068] Then, as shown in (B) in FIG. 12, the chips 31 are encapsulated in the resin 41 between the bump 12-formed surface of the plate-like member 11 and the wiring pattern 22-formed surface of the substrate 21 to form an electronic component 20'.

In (B) in FIG. 12, the bumps 12 each having a deformable portion 12A are not shrunk. That is, the length (height) of the bump(s) 12 in the direction perpendicular to the plane direction of the plate-like member 11 remains M that is the same as in (A) in FIG. 12. In this state, when the bumps 12 are in contact with the wiring pattern 22 and the length of the bump(s) 12 suits a predetermined thickness of the electronic component, the electronic component in this state may be regarded as the completed electronic component 20. When the length of the bump(s) 12 does not suit a predetermined thickness of the electronic component, the distance between the plate-like member 11 and the substrate 21 is reduced by pressing in the direction perpendicular to the plane direction of the plate-like member 11 so that the length of the bump(s) 12 suits a predetermined thickness of the electronic component. At that time, a pressure force is applied to the bumps 12 by a contact with the wiring pattern 22 of the substrate 21. By this pressure force,

the entire bumps 12 are relatively pressed in the direction perpendicular to the plane direction of the plate-like member 11. By this pressure, as shown in (C) in FIG. 12, the deformable portion 12A of each of the bumps 12 is bent, and thus, the bumps 12 are shrunk in the direction perpendicular to the plane direction of the plate-like member 11. That is, as shown in (C) in FIG. 12, the length (height) of the bump(s) 12 in the direction perpendicular to the plane direction of the plate-like member 11 becomes N which is a numerical value smaller than M in (A) and (B) of FIG. 12 ($M > N$). Accordingly, the length of the bump(s) 12 suits a predetermined thickness (distance between the plate-like member 11 and the substrate 21) of the electronic component. In the state of (C) in FIG. 12, the bumps 12 are in the state of being in contact with the wiring pattern 22. In this manner, the electronic component 20 shown in (C) in FIG. 12 can be produced. In FIG. 12, as a matter of convenience of description, the description is given with regard to the bumps 12 each having a zigzag deformable portion 12A. However, as mentioned above, the shape of the bump(s) 12 is not limited to this and may be any shape as mentioned above. Hereinafter, the same applies to the all cross-sectional views showing bumps 12.

[0069] The plate-like member 11 is not limited to particular members and may be, for example, as mentioned above, a heat radiation plate or a shield (shield plate). For example, in the case where plural chips are disposed in one IC (electronic component), each chip may be electromagnetically shielded with a shield (shield plate) due to the relationship among the functions of the chips.

[0070] Moreover, the bump-formed plate-like member may be a plate-like member corresponding to one substrate (one electronic component) or a (matrix-type) plate-like member corresponding to plural substrates (plural electronic components) as shown in FIG. 1. In the case of the matrix type, for example, plural substrates on each of which a chip(s) and a wiring pattern are fixed are subjected to resin-encapsulation together with the matrix-type bump-formed plate-like member. The matrix-type bump-formed plate-like member may thereafter be partitioned into regions corresponding to the respective substrates by cutting or the like. Moreover, for example, as mentioned above, at least one bump may be a plate-like bump. In this case, a required area (an area having a specific function) corresponding to one electronic component (one product unit) on the surface of the substrate can be partitioned (divided) with the plate-like bump.

[0071] Moreover, as substitute for the chips 31, electronic components in which chips are already subjected to resin-encapsulation may be used. In this case, the electronic component 20 is in the form in which the chips 31 have been further subjected to resin-encapsulation. Thus, chips are subjected to resin-encapsulation plural times.

[0072] In (A) to (C) in FIG. 12, the case where the bump(s) 12 has the deformable portion(s) 12A is described. In the case where the bump(s) 12 does not have the deformable portion(s) 12A, the length (height) of the bump(s) 12 in the direction perpendicular to the plane direction of the plate-like member 11 is not shrunk in the direction perpendicular to the plane direction of the plate-like member 11. Except for this, also in the case where the bump(s) 12 does not have the deformable portion(s) 12A, the bump-formed plate-like member 10 can be produced in the same manner as in (A) to (C) in FIG. 12. However, when the bump(s) 12 has the deformable portion(s) 12A, as described above, the height of the bump(s) is not required to be designed according to the thickness of a completed (resin-encapsulated) electronic component. Therefore, it is preferred that the bump(s) 12 has the deformable portion(s) 12A so that an electronic component having both of a via electrode(s) (bump(s)) and a plate-like member can be produced simply and efficiently. For example, as described above, by taking the shrinkage of the bump(s) 12 in the direction perpendicular to the plane direction of the plate-like member 11 into consideration, the height (length) of the bump(s) 12 may be set slightly longer than the thickness of the resin of the completed (resin-encapsulated) electronic component (the thickness of the package) in advance.

[0073] Although the production method of an electronic component using the bump-formed plate-like member is schematically illustrated in (A) to (C) in FIG. 12, the production method is not particularly limited to this method as mentioned above. Other specific examples of the production method of an electronic component will be described in the embodiments below.

[0074] [Example 2]

An example of the method for producing a bump-formed plate-like member by compression molding is described below.

[0075] The steps of producing a bump-formed plate-like member by compression molding of the present example are schematically shown in the step cross-sectional

views of (A) to (H) in FIG. 10 (only (A) in FIG. 10 is a plan view). Here, while the step cross-sectional views of (A) to (H) in FIG. 10 are divided into FIG. 10A ((A) to (D)) and FIG. 10B ((E) to (H)) for the sake of convenience, FIG. 10A and FIG. 10B together are simply referred to as FIG. 10.

5 [0076] First, as shown in the plan view of (A) in FIG. 10, a metal frame (frame) 3001 is provided. As shown in (A) in FIG. 10, this metal frame (frame) 3001 is rectangle and has a rectangular through hole (opening) 3001a at the central part. However, the shapes of the metal frame 3001 and the through hole 3001a are not limited to rectangles and can be any shape, and can be selected appropriately according to the shape of the bump-formed plate-like member.

10 [0077] Next, as shown in the cross sectional view of (B) in FIG. 10, the metal frame 3001 is applied to one surface of an adhesive sheet 3002 having the same size and shape as the metal frame 3001. A pressure-sensitive adhesive is applied to the adhesive sheet 3002 at the side to which the metal frame 3001 is applied. The surface of the adhesive sheet 3002 opposite to the surface to which the metal frame 3001 is applied can be attracted to the upper die by sucking via a suction hole (not shown) provided on the upper die of the molding die. Also, on the metal frame 3001-applied side of the adhesive sheet 3002, it is possible to bond the bump-formed plate-like member to the adhesive surface exposed from the through hole 3001a as will be described below.

20 [0078] Next, as shown in (C) to (G) in FIG. 10, the bump-formed plate-like member is produced by compression molding. First, as shown in (C) in FIG. 10, the adhesive sheet 3002 and the metal frame 3001 are attracted to an upper die 3003 of the molding die. This suction can be performed by depressurization (evacuation) by the suction from the suction hole (not shown) of the upper die 3003, for example.

25 This molding die is a part of a compression molding apparatus for producing a bump-formed plate-like member. The cross sectional view of (C) in FIG. 10 is a schematic view showing the structure of a part of this molding die. Also the cross sectional view of (C) in FIG. 10 shows the unclamping state of the molding die before clamping and after supply of a resin 4001.

30 [0079] As shown in (C) in FIG. 10, this molding die includes an upper die 3003 and a lower die 3004 disposed so as to face the upper die as main components. As shown in (C) in FIG. 10, an adhesive sheet 3002 to which a metal frame 3001 is

applied can be attracted (attached) and fixed to the die surface (lower surface) of the upper die 3003 in the state where the metal frame 3001-applied side faces downward.

[0080] The upper die 3003 is attached to the upper die base plate 3011 in the state of being vertically suspended from the upper die base plate 3011. An outside air-excluding member 3013 of the upper die is provided on the upper die base plate 3011 at the outer peripheral position of the upper die 3003. An O ring 3013a for excluding outside air is provided below the upper end surface of the outside air-excluding member 3013 of the upper die (portion sandwiched between the upper die base plate 3011 and the outside air-excluding member 3013 of the upper die). An O ring 3013b for excluding outside air is provided on the lower end surface of the outside air-excluding member 3013 of the upper die. The upper die base plate 3011 is provided with a hole (through hole) 3012 of the upper die for forcedly sucking and discharging air in a space of the die.

[0081] The lower die 3004 is formed of a lower die cavity bottom member 3005a, a lower die peripheral member 3006, and a lower die elastic member 3006a. The lower die cavity bottom member 3005a further includes a cavity (lower die cavity) 3005b that is a space for molding a resin on the die surface (upper surface). The lower die cavity bottom member 3005a is provided below the lower die cavity 3005b.

The die surface (upper surface) of the lower die cavity bottom member 3005a has a shape corresponding to the shape of the bump-formed surface of the bump-formed plate-like member. The lower die cavity 3005b has a hole(s) corresponding to the shape of the bump(s) of the bump-formed plate-like member. The lower die peripheral member (a frame of a lower die, a side member of a cavity) 3006 is disposed so as to surround the lower die cavity bottom member 3005a. The height of the upper surface of the lower die peripheral member 3006 is higher than the height of the upper surface of the lower die cavity bottom member 3005a.

Accordingly, the lower die cavity (concave portion) 3005b surrounded by the upper surface of the lower die cavity bottom member 3005a and the inner peripheral surface of the lower die peripheral member 3006 is formed. There is a gap (suction hole) 3006c between the lower die cavity bottom member 3005a and the lower die peripheral member 3006. The release film or the like can be attracted by depressurizing this gap 3006c with a vacuum pump (not shown) as will be described

below. The lower die 3004 (the lower die cavity bottom member 3005a, the lower die peripheral member 3006, and the lower die elastic member 3006a) is attached in the state where it is placed on the lower die base plate 3005. The lower die elastic member 3006a for buffer is provided between the lower die peripheral member 3006 and the lower die base plate 3005. Furthermore, the outside air-excluding member 3021 of the lower die is provided above the lower die base plate 3005 at the outer peripheral position of the lower die peripheral member 3006. An O ring 3021a for excluding outside air is provided on the lower end surface of the outside air-excluding member 3021 of the lower die (portion sandwiched between the lower die base plate 3005 and the outside air-excluding member 3021 of the lower die). The outside air-excluding member 3021 of the lower die is disposed immediately below the outside air-excluding member 3013 of the upper die and the O ring 3013b for excluding outside air. With the above-described configuration, at least the inside of the lower die cavity 3005b can be in the outside air-excluding state by joining the outside air-excluding member 3013 of the upper die including the O rings 3013a and 3013b and the air-excluding member 3021 of the lower die including the O ring 3021a at the time of clamping both of the upper die and the lower die.

[0082] Then, as shown in (C) in FIG. 10, a resin 4001 is supplied to the inside of the lower die cavity 3005b. As shown in (C) in FIG. 10, the resin 4001 is placed on a release film 5001. The release film 5001 is attracted to the upper surface (cavity surface) of the lower die cavity 3005b. The resin 4001 is disposed (set) in the lower die cavity 3005b via the release film 5001. The release film 5001 is attracted to the cavity surface of the lower die cavity 3005b by depressurization by suction from the suction hole 3006c of the lower die with a vacuum pump (not shown) as indicated by the arrows 3007 in (C) in FIG. 10. Thereby, the cavity surface of the lower die cavity 3005b is covered with the release film 5001. The method for supplying and setting the release film 5001 and the resin 4001 to the lower die cavity 3005b is not limited to particular methods, and can be the same as those shown in FIGs. 28 to 30 that will be described below, for example. That is, first, a rectangle frame (frame) having a through hole is placed on the release film 5001 and the resin 4001 is supplied to the through hole to form a "resin supply frame". The "resin supply frame" is transferred and caused to enter between the upper die 3003 and the lower die 3004 (position of the lower die cavity 3005b). Then, as described above, only the

rectangular frame (frame) is removed after attracting the release film 5001 to the cavity surface of the lower die cavity 3005b. In (C) in FIG. 10, the resin 4001 is in a molten state. For example, the resin 4001 may be transferred and caused to enter between the upper die 3003 and the lower die 3004 in a state of a resin granule as in the cases shown in FIGs. 28 to 30 that will be described below. Then, as described above, the resin 4001 can be melted by heating the lower die 3004 after setting the resin 4001 in the lower die cavity 3005b.

[0083] Subsequently, the upper die and the lower die are clamped. First, as shown in (D) in FIG. 10, intermediate clamping of holding a required gap between the lower surface of the metal frame 3001 (the side opposite to the side to which the adhesive sheet 3002 is bonded) and the upper surface of the lower die peripheral member 3006 covered with the release film 5001 is performed. That is, the lower die 3004 is caused to move upward in the direction indicated by the arrow 3031 from the state shown in (C) in FIG. 10. Accordingly, as shown in (D) in FIG. 10, the outside air-excluding member 3013 of the upper die and the outside air-excluding member 3021 of the lower die are closed together in the state of sandwiching the O ring 3013b between them. As described above, as shown in (D) in FIG. 10, an outside air-excluding space surrounded by the upper die 3003, the lower die 3004, the outside air-excluding member 3013 of the upper die, and the outside air-excluding member 3021 of the lower die is formed. In this state, as indicated by the arrow 3014 shown in (D) in FIG. 10, at least the outside air-excluding space is depressurized by suction with a vacuum pump (not shown) through the hole 3012 of the upper die provided on the upper die base plate 3011 to set to a predetermined degree of vacuum.

[0084] Furthermore, as shown in (E) in FIG. 10, the lower surface of the metal frame 3001 is joined to the upper surface of the lower die peripheral member 3006 covered with the release film 5001 to completely clamp the upper die and the lower die. That is, the lower die 3004 is caused to move further upward from the state shown in (D) in FIG. 10. Thereby, as shown in (E) in FIG. 10, the metal frame 3001 attached (attracted/fixed) to the upper die 3003 through the adhesive sheet 3002 is brought into contact with the lower die peripheral member 3006 through the release film 5001. Then, by further moving the lower die base plate 3005 upward, the lower die cavity bottom member 3005a is moved further upward. Note here that, at

that time, the resin 4001 is in the state of being flowable. By the pressure force caused by moving the lower die cavity bottom member 3005a upward, as shown in (E) in FIG. 10, the upper surface of the resin 4001 is bonded to the part of the adhesive sheet 3002 exposed from the through hole 3001a of the metal frame 3001.

5 At that time, the lower die elastic member 3006a, the O rings 3013a, 3013b, and 3021a are shrunk to serve as cushions. In this manner, the resin 4001 is pressurized to perform compression molding. Then, the resin 4001 is cured. Thereby, as shown in (E) to (H) in FIG. 10, the bump-formed plate-like member 10 in which bump(s) 12 is formed on one surface of the plate-like member 11 can be
10 formed.

[0085] The steps shown in (E) to (H) in FIG. 10 can be performed, for example, as follows. That is, first, from the state shown in (E) in FIG. 10, after the elapse of time required to cure the resin 4001, the vacuum pump is stopped to cancel the depressurization (evacuation) due to the suction through the hole 3012 of the upper
15 die provided on the upper die base plate 3011. At that time, although the depressurization (evacuation) of the gap between the lower die cavity bottom member 3005a and the lower die peripheral member 3006 may be canceled, it is preferred that the depressurization (evacuation) is not canceled and the release film 5001 is kept to be attracted to the lower die cavity bottom member 3005a. It is
20 because this allows the step of releasing the bump-formed plate-like member 10 from the release film 5001 to be performed easily. Subsequently, the lower die 3004 (lower die cavity bottom member 3005a, lower die peripheral member 3006, and lower die elastic member 3006a) is caused to move downward together with the lower die base plate 3005 in the direction indicated by the arrow 3032. Thereby, the
25 outside air-excluding space surrounded by the upper die 3003, the lower die 3004, the outside air-excluding member 3013 of the upper die, and the outside air-excluding member 3021 of the lower die is released to cancel the depressurization. Thereby, as shown in (F) in FIG. 10, the upper die 3003 and the lower die 3004 are unclamped. Then, as shown in (F) in FIG. 10, the bump-formed plate-like member
30 10 is released from the release film 5001 in the state where the surface opposite to the bump 12-formed surface of the plate-like member 11 is bonded to the adhesive sheet 3002.

[0086] Then, the depressurization (evacuation) by the suction from the suction hole

(not shown) of the upper die 3003 is canceled. Thereby, as shown in (G) in FIG. 10, the adhesive sheet 3002 is taken out from the upper die 3003 together with the metal frame 3001 and the bump-formed plate-like member 10. Furthermore, as shown in (H) in FIG. 10, the bump-formed plate-like member 10 (plate-like member 11) is peeled from the adhesive sheet 3002 and the metal frame 3001. In this manner, the bump-formed plate-like member 10 can be formed. Here, a mold-releasing agent (not particularly limited and, for example, a fluorine-based mold-releasing agent or the like) may be applied to the inner periphery of the metal frame 3001 (the part of the metal frame 3001 surrounding the through hole 3001a to be in contact with the plate-like member 11) in advance. This improves the releasability of the molding die with respect to the plate-like member 11 and allows the bump-formed plate-like member 10 to be removed easily.

[0087] The material for forming the bump-formed plate-like member 10 is not limited to particular materials, and the material may be, for example, a conductive resin or a non-conductive resin. The conductive resin is not particularly limited, and the conductive resin may be, for example, a mixture of a resin and a conductive particle. The conductive particle is not particularly limited and examples thereof include metal particles. The metal in the metal particles is also not particularly limited, and examples thereof include gold, silver, copper, nickel, tin, any other metals, and an alloy of two or more of them. Also, for example, after the molding using the molding die, a conductive film may be applied to the bump-formed surface of the bump-formed plate-like member formed of the conductive resin or the non-conductive resin (especially, non-conductive resin). The conductive film is not particularly limited, and examples thereof include metal films. The metal in the conductive film is also not particularly limited, and examples thereof include gold, silver, copper, nickel, tin, and an alloy of two or more of them. The method for forming the conductive film is not particularly limited, and examples thereof include plating, coating, sputtering, and vapor deposition. The plating may be, for example, electroless plating or electroplating.

[0088] Furthermore, the production method of a bump-formed plate-like member by compression molding is not limited to the present example ((A) to (H) in FIG. 10) and can be changed appropriately. For example, although the metal frame 3001 having the through hole 3001a is applied to the adhesive sheet 3002 in the present

example, a metal plate or a resin sheet not having a through hole may be used instead of the metal frame 3001 having the through hole 3001a. The metal plate or the resin sheet may be applied to the upper die 3003 not using the adhesive sheet 3002 but using a pressure-sensitive adhesive, suction (depressurization) with a vacuum pump, or the like, for example. Furthermore, a mold-releasing agent (not particularly limited and, for example, a fluorine-based mold-releasing agent or the like) may be applied to the metal plate or the resin sheet for improving the releasability with respect to the bump-formed plate-like member so that the metal plate or the resin sheet can be separated from the bump-formed plate-like member easily.

[0089] [Example 3]

An example of the method for producing a bump-formed plate-like member by transfer molding is described below.

[0090] An example of the method for producing the bump-formed plate-like member 10 in which bumps 12 are formed on one surface of the plate-like member 11 is schematically shown in the cross-sectional view of FIG. 11. This production method is, as mentioned above, a production method using transfer molding.

[0091] As shown in FIG. 11, this production method can be performed by using a molding die 6000 for common transfer molding. As shown in FIG. 11, the molding die 6000 is formed of an upper die 6001 and a lower die 6002. The molding die is configured such that the die surface of the upper die 6001 is provided with a die cavity 6003 for resin molding, and the die surface of the lower die 6002 is provided with a set part 6004 at which the same adhesive sheet 3002 to which the metal frame 3001 is bonded as in Example 2 (FIG. 10) is supplied and set. As shown in FIG. 11, the die cavity 6003 of the upper die has a shape corresponding to the uneven shapes of the plate-like member 11 and the bump(s) 12 (upside-down shapes of the uneven shapes).

[0092] The upper die 6001 is provided with a resin passage (hole) 6005 for supplying a resin material. The resin passage 6005 is connected to a pot 6006 and a plunger 6007 for resin pressurization.

[0093] The method for transfer molding using the apparatus shown in FIG. 11 is not particularly limited, and the transfer molding may be performed according to a common method for transfer molding. That is, first, as shown in FIG. 11, an

adhesive sheet 3002 to which a metal frame 3001 is applied is supplied to and set on a set part 6004 at the die surface (upper surface) of the lower die 6002 in the state where the metal frame 3001 faces upward (toward the opposite side of the die surface of the lower die 6002). Furthermore, a resin material such as a resin tablet, a liquid resin (e.g., a thermosetting resin) or the like is supplied to the pot 6006. Then the upper die 6001 and the lower die 6002 are clamped. Subsequently, the resin is heated and melted in the pot 6006, and a molten resin 4001 in the pot 6006 is pressurized by the plunger 6007 so that the molten resin 4001 can be injected into the die cavity 6003 of the upper die 6001 from the resin passage 6005 of the upper die 6001. At that time, a required resin pressure can be applied to the resin in the die cavity 6003 by the plunger 6007.

[0094] By unclamping the upper die 6001 and the lower die 6002 after the elapse of time required to cure, the bump-formed plate-like member 10 in which bumps 12 are formed on one surface of the plate-like member 11 can be molded in the die cavity 6003.

[0095] The conditions and the like of the transfer molding are not limited to those shown in FIG. 11, and any change can be made. For example, for improving the releasability of the upper die 6001 (the ability of releasing from the bump-formed plate-like member 10 after molting), for example, the die cavity 6003 of the upper die 6001 may be covered with a release film or the upper die 6001 may be provided with an ejector pin. Also, for example, although the metal frame 3001 and the die cavity 6003 face upward in FIG. 11, this may be reversed and the metal frame 3001 and the die cavity 6003 may face downward. That is, the lower die 6002 instead of the upper die 6001 may be provided with the die cavity 6003 and the upper die 6001 instead of the lower die 6002 may be provided with the set part 6004.

[0096] At the time of molding in transfer molding, for example, the transfer molding may be performed while setting the degree of vacuum in the die cavity at a predetermined degree. The method for setting the degree of vacuum at the predetermined degree is not limited to particular methods and may be, for example, performed according to the method that is common in transfer molding.

[0097] An apparatus for use in the transfer molding is not limited to particular apparatuses and may be, for example, the same as a common apparatus for transfer molding. Specific conditions of the encapsulating are not limited to particular

conditions and may be, for example, the same as those in common transfer molding.

[0098] [Example 4]

An example of the method for producing an electronic component using a bump-formed plate-like member according to the present invention is described below. In the present example, an example of the method for producing an electronic component by transfer molding is described.

[0099] The cross sectional view of FIG. 13 schematically shows an example of the production method of the electronic component shown in FIG. 12. This production method is, as mentioned above, a production method using transfer molding. In FIG. 13, the case where a bump(s) 12 has a deformable portion(s) 12A is described.

[0100] As shown in FIG. 13, this production method can be performed by using a molding die 50 for common transfer molding. As shown in FIG. 13, a molding die 50 is formed of an upper die 51 and a lower die 52. The molding die is configured such that the die surface of the upper die 51 is provided with a die cavity 56 for resin molding and the die surface of the lower die 52 is provided with a substrate set part 57 at which a substrate 21 provided with a chip 31 and a wiring pattern 22 is supplied and set.

[0101] The lower die 52 is provided with a pot (hole) 54 for supplying a resin material, and a plunger 53 for resin pressurization is fitted into the pot.

[0102] The method for transfer molding using the apparatus shown in FIG. 13 is not limited to particular methods, and transfer molding may be performed according to a common method for transfer molding. That is, the method is performed as follows. First, a resin material such as a resin tablet, a liquid resin (e.g., a thermosetting resin) or the like is supplied to the pot 54, the substrate 21 is supplied to and set on the substrate set part 57, and both of the upper die 51 and the lower die 52 are clamped. At that time, as shown in FIG. 13, the bumps 12 are shrunk in the direction perpendicular to the plane direction of the plate-like member 11 by bending the deformable portion 12A. Accordingly, the length of the bump(s) 12 suits a predetermined thickness of the resin-encapsulated component. Subsequently, the resin is heated and melted in the pot 54, and a molten resin 41 in the pot 54 is pressurized by moving the plunger 53 upward to cause the molten resin to pass through the resin passage (cull, runner, gate) 55 from the pot 54 of the lower die 52 so that the molten resin can be injected into the die cavity 56 of the upper die 51. At

that time, a required resin pressure can be applied to the resin in the die cavity 56 by the plunger 53.

[0103] By unclamping the upper die 51 and the lower die 52 after the elapse of time required to cure, the chips 31 and the like can be encapsulated and molded in the package (resin molded article) having a shape corresponding to the shape of the cavity in the die cavity 56 (see the electronic component 20 shown in FIG. 12).

[0104] In the present example, the production method shown in FIG. 13 (production of the electronic component 20 shown in FIG. 12) can be performed as described below, for example. That is, first, a substrate 21 provided with chips 31 and a wiring pattern 22 is disposed at a position corresponding to the position of a die cavity of an upper die 51 on the die surface (substrate set part) of a lower die 52. Then, a plate-like member 11 and bumps 12 are disposed thereon so as to be at the same position as the completed electronic component 20 (FIG. 12). At that time, as shown in FIG. 13, the surface of the substrate 21, opposite to the chip 31-disposed surface, is caused to be in contact with the lower die 52, so that a bump-formed plate-like member (the plate-like member 11 and the bumps 12) is placed on the chip 31-disposed surface, and the wiring pattern 22 is physically and electrically connected to the tips of the bumps 12.

[0105] The substrate 21, the chips 31, the plate-like member 11, and the bumps 12 may be placed on the die surface of the lower die 52 in the state of being upside down in FIG. 13. That is, the surface of the plate-like member 11, opposite to the bump 12-formed surface, may be caused to be in contact with the lower die 52, and the substrate 21 and the chips 31 may be disposed on the bump 12-formed surface.

[0106] Subsequently, as shown in FIG. 13, the upper die 51 and the lower die 52 are clamped. At that time, the upper die 51 is placed on the lower die 52, and the substrate 21, the chips 31, the plate-like member 11, and the bumps 12 are contained in the die cavity 56 of the upper die 51, and the plate-like member 11 comes into contact with the upper surface of the die cavity. At that time, as mentioned above, in the process of clamping, the deformable portion 12A of each of the bumps 12 is bent. Thus, the bumps 12 are shrunk in the direction perpendicular to the plane direction of the plate-like member 11. Thereby, the length of the bump(s) 12 suits the thickness of the electronic component.

[0107] In this state, as shown in FIG. 13, a resin 41 is injected from the pot 54 of

the lower die 52 into the die cavity 56 of the upper die 51 through the resin passage 55 by the plunger 53. Thus, the chips 31 disposed on the substrate 21 are subjected to resin-encapsulation together with the plate-like member 11 and the bumps 12. Accordingly, the electronic component 20 shown in FIG. 12 can be produced.

5 [0108] At the time of injecting the resin into the die cavity 56, in the die cavity 56, the resin (molten resin) 41A can flow between the bumps 12 and can pass through the holes 12b of the bumps 12.

[0109] Although the method in which clamping is performed after placing both of the substrate and the bump-formed plate-like member on the die surface of the

10 lower die is described above, the present invention is not limited thereto. For example, the substrate 21 may be supplied to and set on the die surface of the lower die 52, the bump-formed plate-like member (plate-like member 11) may be attached to the upper surface of the die cavity of the upper die 51, the upper die 51 and the lower die 52 may be clamped, and the resin may be injected into the die cavity. At
15 that time, as mentioned above, the plate-like member 11 and the substrate 21 may be upside down.

[0110] At the time of molding (resin-encapsulation) in transfer molding, for example, the transfer molding may be performed while setting the degree of vacuum in the die cavity at a predetermined degree. The method for setting the degree of
20 vacuum at the predetermined degree is not limited to particular methods and may be, for example, performed according to the method that is common in transfer molding.

[0111] An apparatus for use in the transfer molding is not limited to particular apparatuses and may be, for example, the same as a common apparatus for transfer
25 molding. Specific conditions of the encapsulating are not limited to particular conditions and may be, for example, the same as those in common transfer molding.

[0112] In order to connect the bumps 12 and the wiring pattern 22 more securely, solders may be disposed between the bumps 12 and the wiring pattern 22 in advance. In this case, for example, the solders may be melted by reflow or the like
30 after the encapsulating to join the bumps 12 and the wiring pattern 22. The same applies to the following examples.

[0113] Although the case where the bump(s) 12 has the deformable portion(s) 12A is described in FIG. 13, also in the case where the bump(s) 12 does not have the

deformable portion(s) 12A, the electronic component can be produced in the same manner as in FIG. 13 except that the bump(s) 12 is not shrunk. However, when the bump(s) 12 has the deformable portion(s) 12A, the height of the bump(s) 12 is not required to be designed according to the thickness of the resin of the electronic component in advance. Therefore, it is possible to produce an electronic component having both of a via electrode(s) (bump(s)) and a plate-like member simply and efficiently. The same applies to the following examples (the cases of producing an electronic component by compression molding).

[0114] According to the present invention, it is not required to bore a hole for via formation (a groove or a hole) in the resin as described above. Thus, for example, the following effects (1) to (5) can be obtained. These effects, however, are mere examples and do not limit the present invention.

(1) There is no possibility that the depth and the like of a hole for via formation are not correctly and appropriately formed on a wiring pattern of a substrate due to variations in thickness of the resin-encapsulated chip (package) and the like because there is no need to bore a hole for via formation in the resin.

(2) Fillers contained in a resin material do not remain on a wiring pattern of a substrate because there is no need to bore a hole for via formation in the resin.

(3) Damage is not caused to a wiring pattern on a chip-mounted substrate because there is no need to bore a hole for via formation in the resin.

(4) The conditions under which an electronic component is produced are not influenced by the filler density of the resin material because there is no need to bore a hole for via formation in the resin.

(5) By the effects (1) to (4), an electronic component can be produced simply and efficiently, and the yield is favorable. Moreover, the connection between the wiring pattern on the substrate and the bump(s) (via electrode(s)) and the like become favorable, which contributes to the improvement in performance of an electronic component, the reduction in defect rate, and the like.

[0115] [Example 5]

Another example of the present invention is described below with reference to FIGs. 14 to 17. In the present example, an example of the method for producing an electronic component using compression molding is described. A bump(s) of a bump-formed plate-like member used in the present example has a deformable

portion(s). However, as described in Example 3, also in the case where a bump(s) does not have a deformable portion(s), the electronic component can be produced in the same manner except that the bump(s) is not deformed (shrunk).

[0116] First, a compression molding apparatus (an apparatus for producing an electronic component) is provided. The step cross-sectional view of FIG. 14 shows the structure of a part of a molding die that is a part of the compression molding apparatus. As shown in FIG. 14, this compression molding apparatus includes, as main components, an upper die 101, a lower die 111, and an intermediate die (intermediate plate) 102. The lower die 111 includes a lower die cavity bottom member 111a and lower die peripheral members (main body of the lower die) 112 and 113. The lower die peripheral members (main body of the lower die) 112 and 113 are frame-shaped lower die cavity side members. More specifically, the lower die peripheral member 112 is disposed so as to surround the periphery of the lower die cavity bottom member 111a, and the lower die peripheral member 113 is disposed so as to surround the periphery of the lower die peripheral member 112. There is a gap (suction hole) 111c between the lower die cavity bottom member 111a and the lower die peripheral member 112. There is a gap (suction hole) 111d between the lower die peripheral members 112 and 113. A release film and the like can be attracted by depressurizing these gaps 111c and 111d with a vacuum pump (not shown) as will be described below. The height of the upper surface of the lower die peripheral member 112 is higher than the heights of the upper surfaces of the lower die cavity bottom member 111a and a lower die peripheral member 113. Thus, a lower die cavity (concave portion) 111b surrounded by the upper surface of the lower die cavity bottom member 111a and the inner peripheral surface of the lower die peripheral member 112 is formed. The upper die 101 has a hole (through hole) 103. As will be described below, at least the lower die cavity 111b can be evacuated by suction from the hole 103 with a vacuum pump (not shown) after clamping. The intermediate die (intermediate plate) 102 has a frame shape (ring shape) and is disposed so as to be positioned immediately above the lower die peripheral member 113. A release film 100 can be held between the lower surface of the intermediate die 102 and the upper surface of the lower die peripheral member 113, so that the release film 100 can be fixed. An O ring 102a having elasticity is attached to a peripheral edge of the upper surface of the inner mediate

die 102. As shown in FIG. 14, this compression molding apparatus has rolls 104 on both sides in FIG. 14. Both ends of one long release film 100 are wound onto the rolls 104 on the both sides. The release film 100 can be delivered from right to left or from left to right in FIG. 14 by the rolls 104 on the both sides. Thus, as will be described below, the bump-formed plate-like member can be transferred to the position of the lower die cavity in the state where the bump-formed plate-like member is placed on the release film 100. That is, the rolls 104 correspond to a transfer unit configured to transfer the bump-formed plate-like member to the position of a die cavity of a molding die. This compression molding apparatus (apparatus for producing an electronic component) further includes a resin placement unit, although it is not shown. The resin placement unit causes a resin to be placed on the bump-formed surface of the bump-formed plate-like member. [0117] Subsequently, as shown in FIG. 14, a substrate 21 having a surface on which chips 31 are fixed is fixed to the lower surface of the upper die 101 by a clamper 101a. At that time, the fixation is performed so that the chip 31-fixed surface of the substrate 21 faces downward. The substrate 21 and the chips 31 are the same as those in Example 1, and a wiring pattern 22 is formed on the substrate 21 as in Example 1. Further, by the resin placement unit, as shown in FIG. 14, a resin material (resin) 41a is placed on the bump 12-formed surface of a plate-like member 11 (placing the resin). The plate-like member 11, the bumps 12, and the resin 41a are the same as those in Example 1. Although the form of the resin material 41a is not limited to particular forms, it is preferred that the resin material 41a is not fallen from the bump 12-formed surface of the plate-like member 11 in the placing the resin. For example, in the placing the resin, a sheet-like resin material 41a may be laminated and pressed on the bump 12-formed surface of the plate-like member 11. Moreover, as shown in FIG. 14, the plate-like member 11 on which the resin material 41a is placed is placed on the release film 100. At that time, as shown in FIG. 14, the placement is performed so that the resin material 41a-placed surface (the bump 12-formed surface) of the plate-like member 11 faces upward (i.e., the surface opposite to the bump 12-formed surface is in contact with the upper surface of the release film 100). A pressure-sensitive adhesive (adhesive layer) may be present between the upper surface of the release film 100 and the plate-like member 11, and the plate-like member 11 may be fixed on the upper surface of the

release film 100 by the pressure-sensitive adhesive (adhesive layer), although it is not shown. As described above, the presence of the pressure-sensitive adhesive (adhesive layer) is preferable because there is an advantage in that the resin 41a is less prone to be leaked from the hole even in the case where the plate-like member 11 has the hole and the like, for example. Furthermore, as shown in FIG. 14, the resin material 41a is transferred to the position of the lower die cavity 111b together with the plate-like member 11, the bumps 12, and the release film 100 by the transfer unit.

[0118] Subsequently, as indicated by the arrow 114 of FIG. 15, a space (gap 111c) between the lower die cavity bottom member 111a and the lower die peripheral member 112 is depressurized with a vacuum pump (not shown). Along with the depressurization, as indicated by the arrow 115 of FIG. 15, a space (gap 111d) between the lower die peripheral member 112 and the lower die peripheral member 113 is depressurized with a vacuum pump (not shown). Moreover, the intermediate die 102 is caused to move downward together with an O ring 102a, and the release film 100 is held between the lower surface of the intermediate die 102 and the upper surface of the lower die peripheral member 113. Thus, the release film 100 is fixed on the upper surfaces of the lower die peripheral members 112 and 113. The surface of the lower die cavity 111b can be covered with the release film 100 by the depressurization (indicated by the arrow 114) of the lower die cavity 111b. Thus, as shown in FIG. 15, the resin material 41a can be placed on the surface of the lower die cavity in the state where the resin material 41a is placed on the plate-like member 11.

[0119] Subsequently, the encapsulating is performed as shown in FIGs. 16 and 17. In FIG. 16, illustration of a clamper 101a is omitted as a matter of convenience.

[0120] That is, first, as shown in FIG. 16, a lower die 111 (lower die cavity bottom member 111a and lower die peripheral members 112 and 113) is lifted together with an intermediate die 102 and an O ring 102a for exclusion of outside air. At that time, by joining the die surface of an upper die 101 and the upper surface side of the O ring 102a, the inside of at least the lower die cavity 111b can be set in the state of excluding outside air, and an outside air-excluding space can be formed in each of the upper die, the lower die, and the intermediate die (three dies). In this state, as indicated by the arrow 107, at least the lower die cavity 111b (outside air-excluding

space) is subjected to suction through a hole 103 of the upper die 101 with a vacuum pump (not shown) to depressurize. Furthermore, the lower die 111 and the intermediate die 102 are integrally lifted. At that time, the upper surface of the lower die peripheral member 112 (lower die 111) and the surface of the substrate 21 can be joined via a release film 100.

[0121] Subsequently, the lower die cavity bottom member 111a is lifted. At that time, as shown in FIG. 16, a resin material (resin) 41a is caused to be in the state of being a flowable resin (resin) 41b by heating or the like. Thereby, first, the chips 31 can be immersed in the flowable resin 41b in the lower die cavity 111b, and then, the flowable resin 41b in the lower die cavity 111b can be pressurized by the lower die cavity bottom member 111a. Accordingly, as shown in FIG. 17, the chips 31 (including bumps and a wiring pattern 22) attached to the substrate 21 in the lower die cavity 111b can be subjected to compression molding (resin-molding) in an encapsulation resin (resin) 41 composed of a curable resin to obtain a molded package (resin molded article) corresponding to the shape of the lower die cavity 111b. At that time, the plate-like member 11 is in the state of being attached to the upper surface side of the molded package, opposite to the substrate 21. Note here that, at that time, there may be a small clearance (gap) between the substrate 21 and the release film 100.

[0122] As mentioned above, as indicated by the arrow 107, at least the lower die cavity 111b is subjected to suction through the hole 103 of the upper die 101 with a vacuum pump (not shown) to depressurize. Then, in that state, the flowable resin 41b is subjected to compression molding together with the plate-like member 11, the bumps 12, the chips 31, and the substrate 21 to perform resin-encapsulation of the chips 31. At that time, the entire bumps 12 are relatively pressured in the perpendicular direction by the pressure force caused by bringing the bumps 12 into contact with the wiring pattern 22 of the substrate 21. By the pressure, as shown in FIG. 16, the deformable portion 12A of each of the bumps 12, designed to have a height higher than the thickness of the flowable resin 41b, is bent. Accordingly, the bumps 12 are shrunk in the direction perpendicular to the plane direction of the plate-like member 11 (i.e., the length in the direction perpendicular to the plane direction is reduced), and the length of the bump(s) 12 suits a predetermined thickness of the resin-encapsulated component. At that time, the bumps 12 are

caused to be in contact with the wiring pattern 22 formed on the substrate 21. Furthermore, the flowable resin 41b is cured to be an encapsulation resin (resin) 41 composed of a curable resin as shown in FIG. 17. An electronic component can be produced by performing the “encapsulating” as described above.

5 [0123] As mentioned above, when the chips 31 are immersed in the resin that is in the lower die cavity 111b, the resin is in the state of being a flowable resin 41b. The flowable resin 41b may be, for example, a liquid resin (thermosetting resin or the like before being cured) or a resin in the molten state obtained by heating a solid resin such as a granular resin, a powdery resin, or a resin paste to melt. The resin
10 material 41a can be heated through heating the lower die cavity bottom member 111a or the like, for example. For example, in the case where the resin material 41a is a thermosetting resin and has flowability (i.e., in the state of being a flowable resin 41b), the resin material 41a (flowable resin 41b) in the lower die cavity 111b may be heated and then thermally cured by pressurization. Thus, resin-encapsulation
15 molding (compression molding) of the chips 31 can be performed in the resin molded article (package) corresponding to the shape of the lower die cavity. As described above, for example, the resin-encapsulation molding can be performed in the state where the plate-like member 11 is exposed to the upper surface (the surface on the side opposite to the substrate) of the resin molded article (package).

20 [0124] After the compression molding (resin-encapsulation), i.e., forming an encapsulation resin 41 by curing the flowable resin 41b, as shown in FIG. 17, the depressurization (evacuation) of the gap between the lower die cavity bottom member 111a and the lower die peripheral member 112 is canceled. In contrast, as indicated by the arrow 116, the air may be delivered to the gap. Subsequently, the
25 lower die 111 (lower die cavity bottom member 111a and lower die peripheral members 112 and 113) is caused to move downward together with the intermediate die 102 and the O ring 102a. Thereby, the depressurization is cancelled by releasing the lower die cavity 111b. Accordingly, as shown in FIG. 17, the release film 100 is separated from the upper surface of the lower die cavity bottom member
30 111a. At that time, the depressurization (evacuation) of the gap between the lower die peripheral members 112 and 113 is not canceled. Moreover, the intermediate die 102 still holds the release film 100 together with the lower die peripheral member 113. Therefore, the release film 100 is, as shown in FIG. 17, continuously

attracted to (fixed on) the upper surfaces of the lower die peripheral members 112 and 113. Moreover, the substrate 21 is continuously fixed on the lower surface (die surface) of the upper die 101 by a clumper 101a. Then, the resin 41 for encapsulation and the plate-like member 11 are subjected to compression molding together with the substrate 21 and the chips 31. Thus, the release film 100 is removed from the electronic component formed of the substrate 21, the plate-like member 11, the bumps 12, the chips 31, and the resin 41 for encapsulation by causing the lower die 111 to move downward. Subsequently, by the rolls 104, the release film 100 is unreeled (or reeled) in the right or left direction of FIG. 17.

[0125] In the present invention, for example, as shown in the present example, when resin-encapsulation of chips is performed, the entire bumps 12 are present in the flowable resin 41b (a molten resin or a liquid resin) in the lower die cavity 111b. In this state, as mentioned above, when the lower die cavity bottom member 111a is caused to move upward, the tips of the bumps 12 and the wiring pattern 22 of the substrate 21 physically come into contact with each other and are connected to each other in the flowable resin 41b. Thus, for example, the tips of the bumps and the wiring pattern of the substrate can be connected easily to each other without causing the resin to enter between them, as compared to the method in which a hole for via formation is bored after the resin-encapsulation of the chips. That is, there is an advantage in that the bumps and the wiring pattern of the substrate are electrically connected easily to each other. This is advantageous in view of shielding performance in the case where the plate-like member is a shield plate, for example. Furthermore, as described above, it is preferred that the bump(s) 12 has a deformable portion(s) 12A because there is no need to design the height of the bump(s) 12 strictly according to the thickness of a completed electronic component, although it is optional. For example, as substitute for or in addition to bending the zigzag deformable portion, as shown in (A) to (D) in FIG. 3 and (A) to (D) in FIG. 4, the bumps 12 may be configured to be shrunk (the height may be reduced). That is, even when the height of the bump(s) 12 is slightly higher than the thickness of the resin 41, it is possible to shrink the bumps 12 by elastically moving the projection 12c to the gap on the hole 12b side (downward) in the case where the tip of the projection 12c comes into contact with the wiring pattern 22. Thus, as mentioned above, the

height of the bump(s) 12 can be adjusted according to the thickness of the resin (the thickness of the package) in the electronic component.

[0126] The present invention is described below with reference to FIGs. 18 and 19.

The method, in which placing a resin material 41a on a plate-like member 11 is

performed and thereafter transferring a bump-formed plate-like member to a die cavity is performed, is described above with reference to FIGs. 14 to 17. As

mentioned above, the order of performing the placing the resin and the transferring the bump-formed plate-like member, however, is not limited to particular orders.

Each of FIGs. 18 and 19 shows an example of the method for producing an electronic

component, including performing the placing the resin after the transferring the

bump-formed plate-like member. As shown in FIGs. 18 and 19, a compression molding apparatus (apparatus for producing an electronic component) for use in this method is the same as the compression molding apparatus (apparatus for producing an electronic component) shown in FIGs. 14 to 17 except for having a resin supply

unit 60. In FIGs. 18 and 19, illustration of an upper die 101, a hole (through hole) 103 in the upper die, a clamper 101a, a substrate 21, a wiring pattern 22, and chips

31 are omitted for simplifying the drawings. As shown in FIGs. 18 and 19, the resin supply unit 60 is composed of a resin supply section 61 and a lower shutter 62. The resin supply section 61 has a frame shape in which openings are formed at the upper

end and the lower end. The opening at the lower end of the resin supply section (frame) 61 is closed with the lower shutter 62. Thus, as shown in FIG. 18, a resin material 41a can be contained in a space surrounded by the resin supply section

(frame) 61 and the lower shutter 62. In this state, as shown in FIG. 18, the resin supply unit 60 is caused to enter immediately above a lower die cavity 111b (space

between a lower die 111 and an upper die 101). Then, as shown in FIG. 19, the opening at the lower end of the resin supply section (frame) 61 is opened by pulling the lower shutter 62 to cause the resin material 41a to move downward from the

opening. Thus, the resin material 41a can be supplied to (placed in) the lower die cavity 111b. Although the resin material 41a is a granule resin in FIGs. 18 and 19,

the resin 41 is not limited thereto. In the placing the resin prior to the steps in FIGs. 14 to 17, the resin supply unit 60 composed of the resin supply section 61 and the lower shutter 62 may be used in the same manner as in FIGs. 18 and 19.

[0127] In the method shown in FIGs. 18 and 19, first, in the transferring the bump-formed plate-like member, the same steps as in FIGs. 14 and 15 are performed except that the resin material 41a is not placed on the plate-like member 11. Thus, as shown in FIG. 18, a bump-formed plate-like member (plate-like member 11 and bumps 12) is placed on the cavity surface of the lower die cavity 111b (via a release film 100) in the same state as in FIG. 15 except that the resin material 41a is not placed on.

[0128] Then, prior to the placing the resin, the bump-formed plate-like member is heated in the lower die cavity in the state shown in FIG. 18 (heating). The heating can be performed by heating a lower die cavity bottom member 111a or the like. It is preferred that the bump-formed plate-like member is subjected to sufficient thermal expansion in this heating. That is, it is preferred that the bump-formed plate-like member is not expanded by heating in encapsulating performed later. Thus, in the encapsulating, positions of the bumps 12 and the wiring pattern 22 are less prone to be deviated, and the positions are easily aligned.

[0129] Furthermore, as shown in FIG. 19, in the lower die cavity 111b, the resin material 41a is placed on the bump 12-formed surface of the plate-like member 11 (placing the resin). In this placing, for example, the opening at the lower end of the resin supply section (frame) 61 is opened by pulling the lower shutter 62 to cause the resin material 41a to move downward from the opening, and thus, the resin material 41a is supplied to (placed in) the lower die cavity 111b. Thereafter, the encapsulating is performed in the same manner as in FIGs. 16 and 17. Although the resin material 41a is a granule resin in FIG. 19, the resin material 41a is not limited thereto. For example, the resin material 41a may be a thermoplastic resin (e.g., a granule resin, a powder resin), and may be melted by the heat of the bump-formed plate-like member to be a flowable resin 41b, and then, the flowable resin 41b may be solidified by cooling. The resultant may be used as an encapsulation resin 41. As mentioned above, the resin material 41a may be a liquid thermosetting resin before being cured and may be cured by the heat of the bump-formed plate-like member.

[0130] In the present example, the structure of the compression molding apparatus is not limited to the structures shown in FIGs. 14 to 17, may be any structure, and may be the same as the structure of a common compression molding apparatus, for

example. Specifically, the structure of the compression molding apparatus may be the same as or according to any of the structures shown in JP 2013-187340 A, JP 2005-225133 A, JP 2010-069656 A, JP 2007-125783 A, JP 2010-036542 A, and the like, for example. For example, the structure of the compression molding apparatus
5 may be the same structure as in FIGs. 2 to 6 of JP 2013-187340 A (structure in which a film retainer is attached to the upper die as substitute for having an intermediate die) as a substitute for the structure shown in FIGs. 14 to 17. A compression molding method using such a compression molding apparatus (method for producing an electronic component) can be performed in the same manner as the
10 method described in JP 2013-187340 A, for example. The resin supply unit may have any alternative configuration to the resin supply unit 60 shown in FIGs. 18 and 19. For example, the resin supply unit may be a resin material distribution unit (including a resin material introduction unit, a measurement unit, a hopper, a linear oscillatory feeder, and the like) described in JP 2010-036542 A. The resin supply
15 unit may have a configuration including a storage section, a measurement section, an introduction section, a supply section, a shutter, a tray, a slit, and the like as in a resin supply mechanism described in JP 2007-125783 A. For example, an upward-and-downward motion mechanism of a lower die and the like that are not shown in FIGs. 14 to 17 may be the same as or according to JP 2005-225133 A, JP
20 2010-069656 A, or the like, and for example, an elastic member may be connected to the lower part of the lower die cavity bottom member.

[0131] In the present example, a method in which compression molding is performed by depressurizing the lower die cavity is used. The present invention, however, is not limited thereto, and another compression molding may be used.

25 [0132] The production method of the present invention is, as mentioned above, the production method including the encapsulating and may include any other steps as shown in the present example.

[0133] In the present example, as mentioned above, the bump-formed plate-like member is placed on the release film, and in that state, the bump-formed plate-like
30 member is transferred to the die cavity of the molding die. Thus, for example, the structures of the plate-like member and the transfer unit can be simplified. In the present example, as mentioned above, the resin is placed on the bump-formed plate-like member in the state where the bump-formed plate-like member is placed

on the release film. Thus, for example, in FIGs. 14 to 17, it can be prevented that the resin (resin material 41a, flowable resin 41b, and encapsulation resin 41) and the lower die cavity bottom member 111a are in contact with each other, and the resin is entered into the gap between the lower die 111 and the lower die peripheral member 112.

[0134] In the present invention, a unit (mechanism) configured to transfer the bump-formed plate-like member (in the state where a resin is or is not placed thereon) is not limited to the configuration shown in FIGs. 14 to 17 and may be a transfer unit (transfer mechanism) having any other configurations. For example, although the release film is a release film having a shape in which a long release film is rolled in FIGs. 14 to 17, the release film is not limited thereto. For example, the shape of the release film may be any shape such as a short release film, a long release film, or a rolled release film. For example, the long release film or the rolled release film may be a short release film obtained by cutting (pre-cutting) the long release film or the rolled release film prior to being subjected to the production method of the present invention. In the case of using a pre-cut release film, the transferring the bump-formed plate-like member (transferring the bump-formed plate-like member to a die cavity of a molding die) is, for example, performed in the same manner as in FIG. 1 and the description thereof in JP 2013-187340 A.

[0135] [Example 6]

Still another example of the present invention is described below. In the present example, another example of the method for producing an electronic component using compression molding is described.

[0136] The production method of the present example is schematically shown in the step cross-sectional views of FIGs. 20 to 23. As shown in FIGs. 20 to 23, the present example is different from Example 5 (FIGs. 14 to 17) in that a release film 100 is not used, and the shape of a plate-like member 11 is different.

[0137] In the present example, the peripheral edge of the plate-like member 11 has a protuberance, so that the central portion of the plate-like member 11 becomes a resin containing portion. More specifically, as shown in FIGs. 20 to 23, the peripheral edge of the plate-like member 11 has a protuberance on the bump 12-formed surface of the plate-like member 11, so that a wall-like member 11b is formed. Thus, the resin containing portion 11c is formed in the central portion of

the plate-like member 11. That is, the peripheral edge of the plate-like member 11 has a protuberance to form a wall-like member 11b. Thus, the plate-like member 11 has a tray shape (box shape in which the upper surface is opened). The central portion of the plate-like member 11 forms a resin containing portion (tray-shaped concave portion) 11c surrounded by the main body (bottom surface) and the wall-like member (peripheral edge) 11b of the plate-like member 11. The bumps 12 are formed on the main body (bottom surface) of the plate-like member 11 on the resin containing portion (concave portion) 11c side as shown in FIGs. 20 to 23. The wall-like member 11b is a part of the plate-like member 11 and is different from the bumps 12. For example, the wall-like member 11b may have a function as a heat radiation member or a shielding member that shields an electromagnetic wave. In the case where the plate-like member 11 has a wall-like member 11b, the shapes of the bumps 12 are not limited to particular shapes and may be any shape. However, it is preferred that at least one bump 12 is the plate-like bump. In the present example, because of the resin containing portion 11c, it can be suppressed or prevented that the resin (resin material 41a, flowable resin 41b, and encapsulation resin 41) and the bottom member of a lower die cavity are in contact with each other, and the resin is entered into the gap between the lower die peripheral member and the bottom member of a lower die cavity without using a release film. This allows the reduction of the costs because a release film is not used and allows the omission of the attaching and attracting a release film. Accordingly, efficiency of producing an electronic component is improved.

[0138] In the present example, as a compression molding apparatus including a molding dies (an upper die and a lower die), the same compression molding apparatus as in Example 5 except for having no roll for a release film and intermediate die can be used as shown in FIGs. 20 to 23. Specifically, as shown in FIGs. 20 to 23, the compression molding apparatus includes, as main components, an upper die 1001 and a lower die 1011. The lower die 1011 includes a lower die cavity bottom member 1011a and a lower die peripheral member (main body of a lower die) 1012. The lower die peripheral member (main body of a lower die) 1012 is a frame-shaped lower die cavity side member. More specifically, the lower die peripheral member 1012 is disposed so as to surround the lower die cavity bottom member 1011a. There is a gap (suction hole) 1011c between the lower die cavity

bottom member 1011a and the lower die peripheral member 1012. This gap 1011c is, as indicated by the arrow 1014 of FIGs. 21 and 22, depressurized with a vacuum pump (not shown), so that the plate-like member can be attracted. After the compression molding, as indicated by the arrow 1016 of FIG. 23, the plate-like member can be detached by delivering air from this gap 1011c. The height of the upper surface of the lower die peripheral member 1012 is higher than the height of the upper surface of the lower die cavity bottom member 1011a. Accordingly, a lower die cavity (concave portion) 1011b surrounded by the upper surface of the bottom member 1011a of the lower die cavity and the inner peripheral surface of the lower die peripheral member 1012 is formed. The upper die 1001 has a hole (through hole) 1003. Thus, as indicated by the arrow 1007 of FIG. 22, at least lower die cavity 1011b can be depressurized by sucking from the hole 1003 with a vacuum pump (not shown) after the clamping. An O ring 1012a having elasticity is attached to the peripheral edge of the upper surface of the lower die peripheral member 1012. The compression molding apparatus (apparatus for producing an electronic component) further includes a resin placement unit and a transfer unit although they are not shown. The resin placement unit places a resin on the bump-formed surface of the bump-formed plate-like member. The transfer unit transfers the bump-formed plate-like member to a die cavity of a molding die.

[0139] In the production method of the present example, as shown in FIGs. 20 to 23, the plate-like member 11 in which the resin material 41a is placed on the resin containing portion 11c is transferred to the position of the lower die cavity 1011b without using a release film. A gap 1011c between the lower die peripheral member 1012 and the lower die cavity bottom member 1011a is depressurized with a vacuum pump (not shown) as indicated by the arrow 1014 of FIG. 21 as substitute for causing a release film to be attracted to the lower die and the lower die peripheral member. Thus, the plate-like member 11 is attracted to the lower die cavity 1011b (the upper surface of the lower die cavity bottom member 1011a and the inner peripheral surface of the lower die peripheral member 1012). Except for this, the production method of the present example (FIGs. 20 to 23) can be performed in the same manner as in FIGs. 14 to 17 of Example 5.

[0140] The steps (encapsulating) shown in FIGs. 22 and 23 can be, for example, more specifically, performed as follows. That is, first, the lower die 1011 in the state

of FIG. 21 is caused to move upward to cause the die surface of an upper die 1001 to come into contact with the upper end of an O ring 1012a of a lower die. At that time, a required gap between the surface of the upper die (the die surface of the upper die 1001) and the surface of the lower die (the die surface of the lower die 1011) is held.

5 That is, prior to completely clamping the upper die 1001 and the lower die 1011, intermediate clamping of holding them with a required gap therebetween is performed. At the time of this intermediate clamping, using the O ring 1012a, an outside air-excluding space can be formed by setting the gap at least between the surface of the upper die and the surface of the lower die and the cavity space to be in
10 an outside air-excluding state. Moreover, at that time, as indicated by the arrow 1007 of FIG. 22, the outside air-excluding space can be set to have a predetermined degree of vacuum by forcibly sucking and discharging air in the outside air-excluding space from the hole 1003 of the upper die. Subsequently, the surface of the upper die (the die surface of the upper die 1001) and the surface of the lower
15 die (the die surface of the lower die 1011) are closed together to perform complete clamping. Moreover, a cavity bottom member 1011a is caused to move upward.

At that time, as shown in FIG. 22, the resin material 41a is caused to be in the state of being a flowable resin 41b. Accordingly, as shown in FIG. 22, the bumps 12 and the wiring pattern 22 are joined to each other, chips 31 are immersed in the resin 41,
20 and the flowable resin 41b in the lower die cavity 1011b is pressurized.

Furthermore, as will be described below, the flowable resin 41b is cured to cause the flowable resin 41b to be an encapsulation resin (resin) 41 composed of a curable resin as shown in FIG. 23. Thus, chips 31 attached on the substrate 11 can be subjected to compression molding (encapsulation molding) in the encapsulation resin (cured
25 resin) 41 having a required shape. More specifically, as shown in FIG. 23, chips 31 attached on the substrate 21 in the lower die cavity 1011b (including bumps and a wiring pattern 22) can be subjected to compression molding (resin molding) in the encapsulation resin (resin) 41 composed of a curable resin to obtain a molded package (resin molding) corresponding to the shape of the lower die cavity 1011b.

30 At that time, the plate-like member 11 is in the state of being attached on the upper surface side of the molded package, opposite to the substrate 21. At that time, by the pressure force caused by moving the cavity bottom member 1011a upward, the entire bumps 12 are relatively pressed in the direction perpendicular to the plane

direction of the plate-like member 11. By the pressure, as shown in FIG. 23, the deformable portion 12A of each of the bumps 12, designed to have a height higher than the thickness of the flowable resin, 41b is bent. Accordingly, the bumps 12 are shrunk in the direction perpendicular to the plane direction of the plate-like member 11, and the length of the bump(s) 12 suits a predetermined thickness of the resin-encapsulated component. Then, after an elapse of required time necessary to cure the flowable resin 41b, as shown in FIG. 23, unclamping the upper die and the lower die is performed. Specifically, the lower die 1011 (the lower die cavity bottom member 1011a, and the lower die peripheral member 1012) are caused to move downward together with the O ring 1012a. Thus, the lower die cavity 1011b is opened to cancel the depressurization. At that time, the depressurization (evacuation) of the gap between the bottom member 1011a of a lower die cavity and the lower die peripheral member 1012 is canceled. As indicated by the arrow 1016, air may be delivered to the gap. Accordingly, an electronic component (molded article) having a plate-like member 11 that has a resin containing portion 11c, a substrate 21, chips 31, a wiring pattern 22, and bumps 12 can be obtained.

[0141] The present example is not limited thereto, and for example, the placing the resin may be performed after the transferring the bump-formed plate-like member as in FIGs. 18 and 19 of Example 5. In this case, it is preferred that the bump-formed plate-like member is heated in the lower die cavity prior to the placing the resin as in Example 5 (heating). Moreover, it is preferred that the bump-formed plate-like member is sufficiently subjected to thermal expansion in this heating for the same reason as in Example 5.

[0142] In the present invention, the shape of the plate-like member is not limited to the shapes of the present example and Examples 1 to 5 and may be any shape. For example, the plate-like member may have the same shape as the plate-like member shown, as an example, in JP 2013-187340 A except that bumps are formed on one surface of the plate-like member. FIGs. 24 and 25 show examples of the production method (modification) in which the shape of a plate-like member is modified. FIG. 24 is the same as FIGs. 14 to 17 (Example 5) except that the plate-like member 11 has a heat radiation fin 11a on the surface opposite to the surface in which the bumps 12 are formed (the surface facing the lower die cavity bottom member 111a in FIG. 24), and the production method can be performed in the same manner as in

Example 5 using the same compression molding apparatus as in FIGs. 14 to 17.

FIG. 25 is the same as FIGs. 20 to 23 (Example 6) except that the plate-like member 11 has a heat radiation fin 11a on the surface opposite to the bump 12-formed surface (the surface facing the lower die cavity bottom member 1011a in FIG. 25),

5 and the production method can be performed in the same manner as in Example 6 using the same compression molding apparatus as in FIGs. 20 to 23. In the compression molding apparatus of FIG. 25, as shown in FIG. 25, the upper surface of the lower die cavity bottom member 1011a has an uneven shape that can be fit in the uneven shape of the heat radiation fin 11a. This brings about an advantage
10 that the plate-like member 11 is stable in the lower die cavity, and the upper surface of the lower die cavity bottom member 1011a is less prone to be damaged by the heat radiation fin 11a. Moreover, it is preferred that the heat radiation fin 11a has a shape in which a space is not formed between the lower die peripheral member 1012 and the plate-like member 11 as shown in FIG. 25. This allows the suction of the
15 lower die cavity by depressurization (arrow 1014) to be performed effectively.

[0143] [Example 7]

Yet another example of the present invention is described with reference to FIGs. 26 and 27 below. In the present example, another example of the method for producing an electronic component is described.

20 [0144] The production method of the present example is schematically shown in the cross-sectional view of FIG. 26. As shown in FIG. 26, this production method is performed using a lower die 121, an upper die (mounter) 122, and a vacuum chamber 123. The upper surface of the lower die 121 is a flat surface, and the substrate of the electronic component can be placed on the upper surface. The
25 vacuum chamber 123 has a columnar shape corresponding to the shape of the electronic component and can be placed on the substrate of the electronic component. The upper die 122 can be fit in the inner wall of the vacuum chamber 123.

[0145] In the production method according to the present example, first, with reference to a substrate 21 having one surface on which chips 31 and a wiring
30 pattern 22 are fixed, a resin material (resin) 41a composed of a liquid resin (thermosetting resin) is printed on the surface on which chips 31 and a wiring pattern 22 are fixed. Subsequently, bumps 12 of a bump-formed plate-like member in which the bumps 12 are formed on one surface of a plate-like member 11 is caused

to be in contact with the wiring pattern 22 by causing the bumps 12 to penetrate the liquid resin 41a. Thereby, the substrate 21, the chips 31, the liquid resin 41a, the plate-like member 11, and the bumps 12 are disposed so as to have the same positional relationship as in a completed resin-encapsulated electronic component 20 (FIG. 12). Then, for example, as shown in FIG. 26, the substrate 21, the chips 31, the liquid resin 41a, the plate-like member 11, and the bumps 12 are disposed on the upper surface of the lower die 121 so as to have the positional relationship (arrangement). At that time, as shown in FIG. 26, the surface of the substrate 21, opposite to the chip 31-disposed surface is caused to be in contact with the upper surface of the lower die 121, and the bump-formed plate-like member (plate-like member 11 and bumps 12 each having a deformable portion 12A) is disposed on the chip 31-disposed surface.

[0146] Subsequently, a vacuum chamber 123 is placed on a portion of the peripheral edge of the upper surface of the substrate 21, on which the liquid resin 41a is not disposed (placed). Accordingly, the chips 31, the resin 41, the plate-like member 11, and the bumps 12 are surrounded by the vacuum chamber 123. Then, the upper die 122 is caused to move downward from the upper side of the chips 31, the liquid resin 41a, the plate-like member 11, and the bumps 12 to cause the upper die 122 to fit in the inner wall of the vacuum chamber 123. Thus, the chips 31, the liquid resin 41a, and the bumps 12 are contained in an inner space sealed by being surrounded by the plate-like member 11, the vacuum chamber 123, and the upper die 122. Moreover, the inner space is depressurized with a vacuum pump (not shown). Accordingly, the chips 31, the liquid resin 41a, the plate-like member 11, and the bumps 12 are pressed by the upper die 122. At that time, the bumps 12 each having a deformable portion 12A comes into contact with the wiring pattern 22 of the substrate 21. Furthermore, the entire bumps 12 are relatively pressed in the direction perpendicular to the plane direction of the plate-like member 11 by a pressure force of the upper die 122. By this pressure, the deformable portion 12A of each of the bumps 12 designed to have a height higher than the thickness of the liquid resin 41a is bent. Accordingly, the bumps 12 are shrunk in the direction perpendicular to the plane direction of the plate-like member 11, and the length of the bump(s) 12 suits a predetermined thickness of the resin-encapsulated component. Then, in this state, the liquid resin (thermosetting resin) 41a is heated

and cured, and the chips 31 are subjected to resin-encapsulation together with the plate-like member 11 and the bumps 12. The heating of the liquid resin 41a can be performed by heating the lower die 121, for example. As described above, an electronic component that is the same as the electronic component 20 shown in FIG. 5 12 can be produced.

[0147] In the present example, for example, depressurization with a vacuum chamber may be omitted. However, for example, it is preferred that depressurization with a vacuum chamber is performed when air and the space between the plate-like member and the resin are not allowed to be present or the like.

10 In the case where depressurization with a vacuum chamber is omitted, pressing with the upper die (moulder) may or may not be performed.

[0148] A modification of the production method of the present example is schematically shown in the cross-sectional view of FIG. 27. The production method shown in FIG. 27 is the same as the production method shown in FIG. 26 except that 15 the liquid resin (thermosetting resin) 41a is applied to the surface of the substrate 21, on which the chips 31 and the wiring pattern 22 are fixed as substitute for printing, and the plate-like member 11 has a heat radiation fin 11a on the surface opposite to the bump 12-formed surface (the surface facing the upper die 122 in FIG. 27). In the production method of FIG. 26, a bump-formed plate-like member having a heat 20 radiation fin may be used as in FIG. 27. In contrast, in the production method shown in FIG. 27, a bump-formed plate-like member having no heat radiation fin may be used as in FIG. 26. For example, in FIG. 26 or 27, a liquid resin 41a may be disposed on the surface of the substrate 21 on which the chips 31 and the wiring pattern 22 are fixed by a laminate of a sheet resin, spin coating of a resin, or the like 25 as substitute for printing or applying of a resin.

[0149] [Example 8]

Yet another example of the present invention is described below. In the present example, yet another example of the method for producing an electronic component using compression molding is described.

30 [0150] In the present example, a method for producing an electronic component using a pre-cut release film and a rectangle frame that has a through hole (resin supply section) and a compression molding apparatus (apparatus for performing resin-encapsulation of chips) are described. In the present example, a resin

material (granule resin) is transferred to and set in the lower die cavity in the state where the resin material (granule resin) is placed on the bump-formed plate-like member.

[0151] In the present example, a frame is disposed on a pre-cut release film, and a bump-formed plate-like member on which a granule resin is placed is disposed on the release film in a frame through hole (resin supply section). Thereby, the granule resin can be prevented from being fallen from the bump-formed plate-like member. Although the case where the resin material is a granule resin is described in the present example, the present example can be performed in the same manner as in the case where the resin material is any resin other than a granule resin (e.g., a powdery resin, a liquid resin, a plate-like resin, a sheet-like resin, a film-like resin, a paste-like resin).

[0152] The present example is described in more detail below with reference to FIGs. 28 to 31.

[0153] The compression molding apparatus (apparatus for producing an electronic component) in the present example is described with reference to FIG. 28. FIG. 28 is a schematic view showing a structure of a part of a molding die that is a part of the compression molding apparatus. FIG. 28 shows the unclamping state before supplying the resin material to this molding die.

[0154] The compression molding apparatus of FIG. 28 is the same as that in Example 6 (FIGs. 20 to 23) in that the molding die includes an upper die and a lower die and is different from that in Example 6 (FIGs. 20 to 23) in that the molding die includes an outside air-excluding member of an upper die and an outside air-excluding member of a lower die. More specifically, the compression molding apparatus is as follows. That is, the compression molding apparatus of FIG. 28 includes, as main components, an upper die 2001 and a lower die 2011 disposed so as to face the upper die. The upper die 2001 is attached to the upper die base plate 2002 in the state of being vertically suspended from the upper die base plate 2002. The outside air-excluding member 2004 of the upper die is provided below the upper die base plate 2002 at the outer peripheral position of the upper die 2001. An O ring 2004a for excluding outside air is provided on the upper end surface of the outside air-excluding member 2004 of the upper die (portion sandwiched between the upper die base plate 2002 and the outside air-excluding member 2004 of the

upper die). An O ring 2004b for excluding outside air is provided on the lower end surface of the outside air-excluding member 2004 of the upper die. The upper die base plate 2002 is provided with a hole 2003 for forcibly sucking and discharging air in a space of the mold. A substrate set part 2001a at which the chip 31-attached substrate 21 is supplied and set (attached) in the state where the chip 31-attached surface side faces downward is provided on the die surface (lower surface) of the upper die 2001. The substrate 21 can be attached to the substrate set part 2001a by a clamper (not shown) or the like, for example. A wiring pattern 22 is provided on the chip 31-attached surface of the substrate 21 as in the aforementioned examples.

[0155] The lower die 2011 is formed of the lower die cavity bottom member 2011a, an lower die peripheral member 2012, and an elastic member 2012a. The lower die 2011 further includes a cavity (lower die cavity) 2011b that is a space for resin molding on the die surface. The lower die cavity bottom member 2011a is provided below the lower die cavity 2011b. The lower die peripheral member (a frame of a lower die, a side member of a cavity) 2012 is disposed so as to surround the lower die cavity bottom member 2011a. The height of the upper surface of the lower die peripheral member 2012 is higher than the height of the upper surface of the lower die cavity bottom member 2011a. Accordingly, a lower die cavity (concave portion) 2011b surrounded by the upper surface of the lower die cavity bottom member 2011a and the inner peripheral surface of the lower die peripheral member 2012 is formed. There is a gap (suction hole) 2011c between the lower die cavity bottom member 2011a and the lower die peripheral member 2012. The release film or the like can be attracted by depressurizing this gap 2011c with a vacuum pump (not shown) as will be described below. The lower die 2011 (the lower die cavity bottom member 2011a, the lower die peripheral member 2012, and the elastic member 2012a) is attached in the state where it is placed on a lower die base plate 2010. The buffer elastic member 2012a is provided between the lower die peripheral member 2012 and the lower die base plate 2010. Furthermore, the outside air-excluding member 2013 of the lower die is provided above the lower die base plate 2010 at the outer peripheral position of the lower die peripheral member 2012. An O ring 2013a for excluding outside air is provided on the lower end surface of the outside air-excluding member 2013 of the lower die (portion sandwiched between the lower die base plate

2010 and the outside air-excluding member 2013 of the lower die). The outside air-excluding member 2013 of the lower die is disposed immediately below the outside air-excluding member 2004 of the upper die and the O ring 2004b for excluding outside air. With the above-described configuration, at least the lower die
5 cavity can be in the outside air-excluding state by joining the outside air-excluding member 2004 of the upper die, including the O rings 2004a and 2004b and the air-excluding member 2013 of the lower die, including the O ring 2013a at the time of clamping both of the upper die and the lower die.

[0156] The method for producing an electronic component of the present example
10 using this compression molding apparatus is described below. That is, first, as shown in FIG. 28, the substrate 21 is attached to the die surface (substrate set part 2001a) of the upper die 2001 as mentioned above. Furthermore, as shown in FIG. 28, the resin granule (resin material) 41a is supplied to the lower die cavity 2011b using a rectangle frame 70 that has a through hole. More specifically, as shown in
15 FIG. 28, the frame 70 is placed on the release film 100 cut to have a required length in advance (pre-cut). At that time, the pre-cut release film 100 may be attracted and fixed on the lower surface of the frame 70. Subsequently, a bump-formed plate-like member in which bumps 12 are formed on one surface of the plate-like member 11 is placed on the release film 100 from the opening (resin supply section)
20 on the upper side of the through hole of the frame 70. At that time, the bumps 12 are in the state of facing upward (side opposite to the release film 100). In the present example, the bump-formed plate-like member does not include a wall-like member 11b and a resin containing portion (concave portion) 11c as in Example 5 (FIGs. 14 to 17). The granule resin 41a is supplied (placed) on the bump 12-formed
25 surface of the plate-like member 11 in the state where the granule resin 41a is flattened. As described above, as shown in FIG. 28, a "resin supply frame" can be formed by supplying the resin 41 to the space surrounded by the plate-like member 11 and the frame 70, and placing the plate-like member 11 and the frame 70 on the release film 100. Moreover, the resin supply frame is transferred and, as shown in
30 FIG. 28, caused to enter between the upper die 2001 and the lower die 2011 (position of the lower die cavity 2011b) in the unclamping state.

[0157] Subsequently, the resin supply frame is placed on the die surface of the lower die 2011. At that time, as shown in FIG. 29, the release film 100 is

sandwiched between the frame 70 and the lower die peripheral member 2012, and an opening on the lower side of the through hole of the frame 70 is caused to correspond to an opening (the surface of the lower die) of the lower die cavity 2011b. Moreover, as indicated by the arrow 2014 of FIG. 29, the suction hole 2011c of the lower die is sucked with a vacuum pump to evacuate. Accordingly, as shown in FIG. 29, the release film 100 is attracted to cover the cavity surface of the lower die cavity 2011b, and the granule resin 41a is supplied to and set in the lower die cavity 2011b. Moreover, the lower die 2011 is heated to melt the granule resin 41a, and thus, the granule resin 41a is in the state of a flowable resin 41b as shown in FIG. 29.

Thereafter, the frame 70 is removed while attracting the release film 100 to the cavity surface of the lower die cavity 2011b by depressurization indicated by the arrow 2014.

[0158] Subsequently, the upper die and the lower die are clamped. First, as shown in FIG. 30, intermediate clamping of holding a required gap between the surface of the substrate (chip 31-fixed surface of the substrate 21) and the surface of the lower die is performed. That is, first, in the state where the frame 70 is removed from FIG. 29, the lower die 2011 is caused to move upward. Accordingly, as shown in FIG. 30, the outside air-excluding member 2004 of the upper die and the outside air-excluding member 2013 of the lower die are closed together in the state of sandwiching an O ring 2004b between them. As described above, as shown in FIG. 30, an outside air-excluding space surrounded by the upper die 2001, the lower die 2011, the outside air-excluding member 2004 of the upper die, and the outside air-excluding member 2013 of the lower die is formed. In this state, as indicated by the arrow 2007 of FIG. 30, at least the outside air-excluding space is depressurized by suction with a vacuum pump (not shown) through the hole 2003 of the upper die base plate 2002 to set at a predetermined degree of vacuum.

[0159] Moreover, as shown in FIG. 31, the surface of the substrate and the surface of the lower die are joined to each other to completely clamp. That is, the lower die 2011 is caused to move further upward from the state of FIG. 30. Accordingly, as shown in FIG. 31, the upper surface of the lower die peripheral member 2012 comes into contact with the surface (the chip 31-fixed surface) of the substrate 21 supplied to and set on the upper die 2001 via the release film 100 (so as to sandwich the release film 100). Then, the lower die cavity bottom member 2011a is caused to

move further upward by further moving the lower die base plate 2010 upward. At that time, as mentioned above, the resin is caused to be in the state of a flowable resin 41b. Accordingly, as shown in FIG. 31, the tips of the bumps 12 come into contact with (are caused to be in contact with) the wiring pattern 22 of the substrate 21, and the chips 31 are immersed in the flowable resin 41b in the lower die cavity 2011b, and the flowable resin 41b is pressurized. At that time, the entire bumps 12 are relatively pressed in the direction perpendicular to the plane direction of the plate-like member 11 by a pressure force of the lower die cavity bottom member 2011a. By this pressure, as shown in FIG. 31, the deformable portion 12A of each of the bumps 12 designed to have a height higher than the thickness of the flowable resin 41b is bent. Accordingly, the bumps 12 are shrunk in the direction perpendicular to the plane direction of the plate-like member 11, and the length of the bump(s) 12 suits a predetermined thickness of the resin-encapsulated component. At that time, as shown in FIG. 31, the elastic member 2012a and the O rings 2004a, 2004b, and 2013a are shrunk to function as a cushion. Accordingly, as mentioned above, the flowable resin 41b is pressurized to perform compression molding. Then, the flowable resin 41b is cured to cause the flowable resin 41b to be an encapsulation resin. In this manner, the chips 31 are encapsulated in the encapsulation resin between the bump 12-formed surface of the plate-like member 11 and the wiring pattern 22-formed surface of the substrate 21, and the bumps 12 can be caused to be in contact with the wiring pattern 22 (encapsulating). After the elapse of time required to cure the flowable resin 41b, the upper die and the lower die are unclamped in the same manner as in Example 1, 5, or 6 ((F) in FIG. 10, FIG. 17, or 23). Thus, a molded article (electronic component) composed of the substrate 21, the chips 31, the wiring pattern 22, the resin (encapsulation resin) 41, the bumps 12, and the plate-like member 11 can be obtained in the lower die cavity 2011b.

[0160] In the present example, the structure of the compression molding apparatus (apparatus for producing an electronic component) is not limited to the structure shown in FIGs. 28 to 31 and may be the same as or according to the structure of a common compression molding apparatus, for example. Specifically, for example, the structure of the compression molding apparatus may be the same as or according to the structure shown in any of JP 2013-187340 A, JP 2005-225133 A, JP 2010-069656 A, JP 2007-125783 A, JP 2010-036542 A, and the like.

[0161] The present invention is not limited to the aforementioned Examples; and arbitrary and suitable combinations, changes, or selective adoption thereof can be made as necessary without departing from the spirit and scope of the present invention.

5 [0162] For example, the shapes of the bumps in the bump-formed plate-like member are not limited to the shapes shown in FIGs. 2A and 2B, (A) to (C) in FIG. 3, and (A) to (C) in FIG. 4 and may be any shapes. As an example, as mentioned above, at least a part of the bumps may have a plate-like shape. A required area corresponding to one electronic component (one product unit) on the surface of the
10 substrate may be partitioned with the plate-like electrode.

Explanation of reference numerals

[0163]

10	bump-formed plate-like member
10D	molding die
15 10D1, 10D2, 10D3, 10D4	divided molding die
11	plate-like member
11a	heat radiation fin
11b	wall-like member
11c	resin containing portion
20 12	bump
12a	lower part of bump 12
12b	through hole
12c	projection
12A	deformable portion
25 12D	hole (hole having a shape corresponding to the shape of bump 12)
12D1, 12D2, 12D3, 12D4	hole having a shape corresponding to the shape of a part of bump 12
12E	bump (bump having a shape corresponding to the shape of bump 12)
30 20	electronic component (completed resin-encapsulated electronic component)
21	substrate
22	wiring pattern

31	chip (electronic component obtained by encapsulating a chip in a resin)	
	41	resin (encapsulation resin)
5	41a	resin (resin material such as liquid resin or resin granule)
	41b	resin (flowable resin)
	41A	resin (molten resin)
10	50	molding die
	51	upper die
	52	lower die
	53	plunger
	54	pot (hole)
	55	resin passage
	56	die cavity
	57	substrate set part
	60	resin supply unit
	61	resin supply section
15	62	lower shutter
	70	rectangle frame (frame)
	100	release film
	101	upper die
	101a	clamper
	102	intermediate die (intermediate plate)
	102a	O ring
	103	hole (through hole)
	104	roll
	107	depressurization (evacuation)
25	111	lower die
	111a	lower die cavity bottom member
	111b	lower die cavity
	111c, 111d	gap (suction hole)
	112, 113	lower die peripheral member (main body of lower die)
30	114, 115	suction by depressurization
	116	air

	121	lower die
	122	upper die (mounter)
	123	vacuum chamber
	1001	upper die
5	1001a	clamper
	1003	hole of upper die (through hole)
	1007	depressurization (evacuation)
	1011	lower die
	1011a	lower die cavity bottom member
10	1011b	lower die cavity
	1011c, 1011d	gap (suction hole)
	1012	lower die peripheral member (main body of lower die)
	1012a	O ring
	1014	suction by depressurization
15	1016	air
	2001	upper die
	2001a	substrate set part
	2002	upper die base plate
	2003	hole of upper die (through hole)
20	2004	outside air-excluding member of upper die
	2004a, 2004b	O ring
	2007	depressurization (evacuation)
	2010	lower die base plate
	2011	lower die
25	2011a	lower die cavity bottom member
	2011b	lower die cavity
	2011c	gap (suction hole)
	2012	lower die peripheral member
	2012a	elastic member
30	2013	outside air-excluding member of lower die
	2013a	O ring
	2014	suction by depressurization
	3001	metal frame

	3001a	through hole (opening)
	3002	adhesive sheet
	3003	upper die
	3004	lower die
5	3005	lower die base plate
	3005a	lower die cavity bottom member
	3005b	lower die cavity
	3006	lower die peripheral member
	3006a	lower die elastic member
10	3006c	gap (suction hole)
	3007	suction by depressurization
	3011	upper die base plate
	3012	hole of upper die (through hole)
	3013	outside air-excluding member of upper die
15	3013a, 3013b, 3021a	O ring
	3014	suction by depressurization
	3021	outside air-excluding member of lower die
	3031	arrow showing direction of upward movement of lower die
	3032	arrow showing direction of downward movement of lower die
20	4001	resin (molten resin)
	5001	release film
	6000	molding die
	6001	upper die
	6002	lower die
25	6003	die cavity
	6004	set part
	6005	resin passage
	6006	pot
	6007	plunger

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WHAT IS CLAIMED IS:

1. A method for producing a bump-formed plate-like member used for producing an electronic component obtained by encapsulating at least one chip in a resin, the bump-formed plate-like member being provided with at least one bump on one side, the method comprising:
molding the plate-like member and the at least one bump at a same time by molding using a molding die.
2. The method according to claim 1, wherein the molding is performed by electroforming.
3. The method according to claim 2, wherein the at least one bump includes a deformable portion.
4. The method according to claim 2 or 3, wherein the molding die is a molding die produced by molding using a master die.
5. The method according to claim 4, wherein the molding die is divided into plural pieces and the molding is performed in a state where the divided pieces are assembled as a molding die.
6. The method according to claim 5, wherein the molding die is divided into plural pieces substantially in parallel with a plane direction of the plate-like member.
7. The method according to claim 1, wherein the molding is performed by compression molding.
8. The method according to claim 1, wherein the molding is performed by transfer molding.
9. The method according to any one of claims 1 to 8, wherein

the molding is performed using a metal.

10. The method according to any one of claims 1 to 8, wherein the molding is performed using a conductive resin.

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11. The method according to claim 10, wherein the conductive resin is a mixture of a resin and a conductive particle.

12. The method according to any one of claims 1 to 8, wherein the molding is performed using a resin, and the method further comprises: applying a conductive film to a surface of the at least one bump and a bump-formed surface of the bump-formed plate-like member.

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13. The method according to any one of claims 1 to 12, wherein the molding die has a die surface corresponding to a shape of the bump-formed surface of the bump-formed plate-like member and at least one hole corresponding to a shape of the at least one bump on the die surface, and the molding is performed by bringing a material for forming the bump-formed plate-like member into contact with the die surface and an inner surface of the at least one hole.

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14. The method according to any one of claims 1 to 12, wherein the molding die has a die surface corresponding to a shape of the bump-formed surface of the bump-formed plate-like member and at least one projection corresponding to a shape of the at least one bump on the die surface, and the molding is performed by bringing a material for forming the bump-formed plate-like member into contact with the die surface and a surface of the at least one projection.

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15. The method according to any one of claims 1 to 14, wherein the at least one bump has a tapered shape formed to be thinner in diameter toward its end.

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16. A bump-formed plate-like member produced by the method according to any one of claims 1 to 15.

17. The bump-formed plate-like member according to claim 16, wherein
5 the at least one bump includes a deformable portion.

18. The bump-formed plate-like member according to claim 16, wherein
the at least one bump is a zigzag bump, and
in the zigzag bump, the deformable portion is configured to be shrunk in a
10 direction perpendicular to the plane direction of the plate-like member by zigzag
bending of at least the deformable portion as viewed in a direction parallel with the
plane direction of the plate-like member.

19. The bump-formed plate-like member according to any one of claims 16 to 18,
15 wherein

the at least one bump has a through hole penetrating in a direction parallel
with the plane direction of the plate-like member, and

the at least one bump having a through hole has a projection projecting at
the end opposite to an end formed in the plate-like member in a direction
20 perpendicular to a plate surface of the plate-like member.

20. The bump-formed plate-like member according to claim 19, wherein
the deformable portion surrounds the through hole.

21. The bump-formed plate-like member according to any one of claims 16 to 20,
25 wherein
the at least one bump is a columnar bump.

22. The bump-formed plate-like member according to any one of claims 16 to 21,
30 wherein
the at least one bump may be a plate-like bump.

23. The bump-formed plate-like member according to claim 22, wherein

the plate-like bump has a through hole and a projection,
the through hole penetrates the plate-like bump in a direction parallel with
a plate surface of the plate-like member, and

the projection projects at the end opposite to an end formed in the plate-like
5 member in a direction perpendicular to the plate surface of the plate-like member.

24. The bump-formed plate-like member according to claim 23, wherein
the deformable portion surrounds the through hole of the plate-like bump.

10 25. The bump-formed plate-like member according to any one of claims 16 to 24,
wherein
the plate-like member is a heat radiation plate or a shield plate.

26. The bump-formed plate-like member according to any one of claims 16 to 25,
15 wherein
the plate-like member includes a resin containing portion.

27. The bump-formed plate-like member according to claim 26, wherein
the plate-like member has a protuberance at a peripheral edge on a
20 bump-formed surface side of the plate-like member to form the resin containing
portion in a central portion of the plate-like member.

28. A method for producing an electronic component comprising: a substrate, at
least one chip, a resin, a plate-like member having at least one surface, at least one
25 bump, and a wiring pattern, the method comprising:
disposing the at least one chip on the surface; and
encapsulating the at least one chip in the resin, wherein
the encapsulating comprises:

encapsulating the at least one chip in the resin between a
30 bump-formed surface of the bump-formed plate-like member according to any one of
claims 16 to 27 and a wiring pattern-formed surface of the substrate on which the
wiring pattern is formed; and

bringing the at least one bump into in contact with the wiring

pattern.

29. The method according to claim 28, wherein

the at least one bump is a plate-like bump,

5 the electronic component comprises a plurality of chips, and
the encapsulating comprises:

partitioning the substrate into plural regions with the plate-like
bump; and

encapsulating the chips in the resin in the plural regions.

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30. The method according to claim 28 or 29, wherein

the encapsulating is performed by transfer molding.

31. The method according to claim 28 or 29, wherein

15 the encapsulating is performed by compression molding.

32. The method according to claim 31, further comprising:

placing the resin on the bump-formed surface of the bump-formed plate-like
member; and

20 transferring the bump-formed plate-like member to a die cavity of a molding
die, wherein

the encapsulating is performed by compression molding of the resin in the
die cavity together with the bump-formed plate-like member and the at least one
chip in a state where the at least one chip is immersed in the resin placed on the
25 plate-like member.

33. The method according to claim 32, wherein

the transferring the bump-formed plate-like member comprises:

transferring the resin to the die cavity of the molding die together

30 with the bump-formed plate-like member in a state where the resin is
placed on the bump-formed plate-like member.

34. The method according to claim 32, further comprising:

heating the bump-formed plate-like member in the die cavity prior to the placing the resin, wherein

the transferring the bump-formed plate-like member comprises:

- 5 transferring the bump-formed plate-like member to the die cavity of the molding die in a state where the resin is not placed on the bump-formed plate-like member, and
- the placing the resin is performed in the die cavity in a state where the bump-formed plate-like member is heated.

10 35. The method according to any one of claims 32 to 34, wherein

the transferring the bump-formed plate-like member comprises:

transferring the bump-formed plate-like member to the die cavity of the molding die in a state where the bump-formed plate-like member is placed on a release film so as to face the bump-formed surface upward.

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36. The method according to claim 35, wherein

the transferring the bump-formed plate-like member comprises:

placing a frame on the release film together with the bump-formed plate-like member; and

- 20 transferring the bump-formed plate-like member to the die cavity of the molding die in a state where the bump-formed plate-like member is surrounded by the frame.

37. The method according to claim 36, wherein

25 the placing the resin comprises:

placing the resin on the bump-formed surface by supplying the resin to a space surrounded by the bump-formed plate-like member and the frame in a state where the frame is placed on the release film together with the bump-formed plate-like member and the bump-formed plate-like member is surrounded by the frame.

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38. The method according to claim 36, wherein

the placing the resin is performed prior to the transferring the bump-formed

plate-like member.

39. The method according to any one of claims 35 to 38, wherein
a surface of the bump-formed plate-like member opposite to the
5 bump-formed surface is fixed on the release film by a pressure-sensitive adhesive.

40. The method according to any one of claims 32 to 39, wherein
the plate-like member includes a resin containing portion,
the placing the resin comprises:
10 placing the resin in the resin containing portion, and
the encapsulating is performed in a state where the resin is placed in the
resin containing portion.

41. The method according to any one of claims 31 to 40, wherein
15 the encapsulating comprises:
placing the substrate having the wiring pattern-formed surface on
which the at least one chip is disposed on a substrate placement stage so as
to face the wiring pattern-formed surface upward; and
pressing the resin in a state where the resin is placed on the wiring
20 pattern-formed surface.

42. The method according to any one of claims 28 to 41, wherein
the plate-like member is a heat radiation plate, and
the heat radiation plate includes a heat radiation fin on a surface opposite to
25 the bump-formed surface.

43. The method according to any one of claims 28 to 42, wherein
the resin is a thermoplastic resin or a thermosetting resin.

30 44. The method according to any one of claims 29 to 43, wherein
the resin is at least one selected from the group consisting of a granular
resin, a powdery resin, a liquid resin, a plate-like resin, a sheet-like resin, a film-like
resin, and a paste-like resin.

45. The method according to any one of claims 29 to 44, wherein
the resin is at least one selected from the group consisting of a transparent
resin, a semi-transparent resin, and an opaque resin.

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46. An electronic component, comprising:
a substrate;
at least one chip;
a resin; and

10 the bump-formed plate-like member according to any one of claims 16 to 27,
wherein

the at least one chip is disposed on the substrate and encapsulated in the
resin,

15 a wiring pattern is formed on the substrate on a side on which the at least
one chip is disposed, and

the at least one bump penetrates the resin and is in contact with the wiring
pattern.