

TITLE OF THE INVENTION

ELECTRONIC PART, ELECTRONIC PART MATERIAL AND  
METHOD OF MOUNTING THE ELECTRONIC PART

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an electronic part having a printed circuit board, on which an IC chip, an LSI or the like is mounted, for use in personal or industrial electronic apparatuses, an electronic part material and a method of manufacturing the electronic parts.

Description of the Prior Art

In recent years, significant progress established in the electronic technology has resulted in that the size, weight and the thickness of a variety of personal and industrial electronic apparatuses have been reduced, and the performance of the same has been improved rapidly. In order to enlarge the circuit scale and to increase the number of the electronic parts, which can be mounted, the mounting density and the operation speed have been intended to be raised by developing a variety of mounting techniques for connecting the electronic parts, as well as the technique for thinning the printed circuit board, that for finely patterning the same, employment of a multilayer structure and size reduction in the electronic part. As a technique for establishing the connection between an IC chip, an LSI or the like and the substrate, a chip-carrier-type electronic part structured as shown in Fig. 14 has been known.

Fig. 14A is a plan view of a chip-carrier-type electronic part when viewed from the upper surface thereof on which a semiconductor device is mounted. Fig. 14B is a cross sectional view taken along line A-A' of Fig. 14A. As shown in Fig. 14B,

the electronic part is structured such that a semiconductor device 1 is caused to dia-touch a substrate 6 previously cut to have an outline passing through near the centers of through holes 7. Furthermore, the semiconductor device 1 and circuit patterns 3 formed on the substrate 6 are electrically connected to one another by wires 2. The circuit patterns 3 are connected to the through holes (the external electrodes) 7 and connection lands 8 formed on the reverse side of the substrate 6. Furthermore, the connection between the circuit patterns 3 and a mother board (not shown) is, by usually soldering, established through the through holes 7 and the connection lands 8. Although the substrate 6 is usually a printed circuit board, a ceramic substrate is sometimes employed. The semiconductor device 1 caused to dia-touch the substrate 6 is connected to the circuit patterns 3 by wire bonding, followed by being molded by molding resin 5.

A molding frame 4 constituting a dam is formed in the periphery of the surface of the substrate 6, the molding frame 4 raising the molding resin 5 to the level of the semiconductor device 1. Furthermore, undesirable flow of the molding resin 5 from the through holes 7 into the reverse side of the substrate 6 can be prevented. If the molding frame 4 is not used, the substrate 6 is so designed as to locate the through holes 7 away from the semiconductor device 1 because of the same reason. Furthermore, the molding resin 5 of a type exhibiting excellent thixotropy (having a high thixotropic ratio, that is, resin flow is limited, and as well as having excellent banking characteristic) has been employed.

However, the foregoing conventional chip-carrier-type electronic part encounters a problem in that the molding frame 4 must be formed on the substrate 6 and, thus, the cost for forming the molding frame 4 cannot be reduced, and another problem in that the molding frame 4 causes the size of the chip-

carrier-type electronic part to be enlarged excessively.

In a case where the molding frame 4 is not used, the necessity for the through holes 7 to be located away from the semiconductor device 1 causes the size of the chip-carrier-type electronic part to be enlarged undesirably. Furthermore, since the molding resin 5 must have excellent thixotropy, that is, a molding material having a poor fluidity must be used, the molding resin 5 cannot easily be introduced into gaps adjacent to the semiconductor device 1. As a result, there arises a problem in that portions, which are not filled with the molding resin 5, are generated, and thus the reliability of the chip-carrier-type electronic part deteriorates.

#### SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide a leadless package type electronic part, which is capable of overcoming the foregoing problems, the cost and the size of which can be reduced and which exhibits excellent reliability, an electronic part material for manufacturing the electronic parts, and a method therefor.

In order to achieve the foregoing object, the electronic part according to the present invention is characterized by comprising the following means. Note that the element part placed on the following substrate includes, in the concept thereof, active devices, represented by a semiconductor device, and so-called passive devices, such as an inductance device and a capacity device.

An electronic part as claimed in claim 1 is an electronic part of a leadless package type comprising: a rectangular substrate having a plurality of external electrodes in the periphery thereof; an element part placed on the surface of the substrate while being electrically connected to the external electrodes; and molding resin for molding the element part onto the surface

of the substrate, wherein the surface of the molding resin is formed to be flat, and each side surface of the molding resin and each side surface of the substrate have the same surface. It is preferable that the electronic part according to claim 1 has a structure such that the external electrodes are formed by cutting through holes in the axial direction of the through holes.

It is preferable that the electronic part according to claim 2 has a structure such that the external electrodes are filled with conductive paste or metal material that has solderability. It is preferable that the electronic part according to claim 4 has a structure such that the metal material is solder or gold. It is preferable that the electronic part according to claim 2 further comprises a covering member for covering openings of the external electrodes formed adjacent to the molding resin, wherein the covering member is, by the molding resin, molded onto the surface of the substrate, and the side surfaces of the covering member are formed to have the same surface with each side surface of the molding resin and the substrate.

It is preferable that the electronic part according to claim 7 further comprises a pad disposed between the substrate and the element part and made of the same material as that of the covering member.

It is preferable that the electronic part according to claim 8 has a structure such that the pad has a penetrating hole that penetrates the covering member, and a conductive member for conducting the element part and a circuit region of the substrate to each other is included in the penetrating hole.

It is preferable that the electronic part according to any of claims 7 to 9 has a structure such that the covering member is an adhesive sheet, a dry film, a glass epoxy plate or a ceramic plate.

It is preferable that the electronic part according to any of

claims 1 to 13 has a structure such that the external electrodes are disposed at the corners of the substrate.

An electronic part material according to claim 15 comprises: a substrate material having through holes disposed on lattice-like imaginary lines, the through holes being cut at lines passing through substantially the centers thereof to form external electrodes; element parts mounted on regions of the substrate material surrounded by the imaginary lines; and molding resin introduced into the entire surface of the substrate material to mold the element parts.

It is preferable that the electronic part material according to claim 15 further comprises dams disposed in the periphery of the substrate material to prevent discharge of the introduced molding resin.

It is preferable that the electronic part material according to claim 15 or 16 further comprises plating leads provided for the substrate material and connected to the corresponding through holes.

It is preferable that the electronic part material according to claim 17 has a structure such that the plating leads are disposed on the two sides of the substrate material.

It is preferable that the electronic part material according to any of claims 15 to 18 has a structure such that conductive paste or metal material having solderability is filled in each of the through holes.

It is preferable that the electronic part material according to claim 20 has a structure such that the metal material is solder or gold.

It is preferable that the electronic part material according to any of claims 15 to 18 further comprises a covering material placed on the surface of the substrate material to cover an opening portion of each of the through holes, the covering material being molded by the molding resin.

It is preferable that the electronic part material according to claim 23 further comprises pads disposed between the substrate material and each element part and made of the same material as that of the covering material.

It is preferable that the electronic part material according to claim 23 or 24 wherein the covering material is an adhesive sheet, a dry film, a glass epoxy plate or a ceramic plate.

It is preferable that the electronic part material according to according to any of claims 15 to 28 has a structure such that the through holes are formed at intersection portions of lattice-like imaginary lines.

A method of manufacturing electronic parts as claimed in claim 30 comprises: a substrate manufacturing step for forming through holes in a substrate material along lattice-like imaginary lines, the through holes being caused to have external electrodes formed by cutting the through holes along centers thereof; a mounting step for mounting element parts in regions of the substrate material surrounded by the imaginary lines; a connection step for establishing the electrical connection among the element parts and the corresponding through holes; a molding step for introducing molding resin into the entire surface of the substrate material to mold the element parts; and a cutting step for cutting the substrate material, the molding resin and the through holes along the imaginary lines after the molding resin has been hardened.

It is preferable that the method of manufacturing electronic parts according to claim 30 further comprises a dam forming step for forming dams in the periphery of the substrate material to prevent discharge of the introduced molding resin prior to performing the molding step.

It is preferable that the method of manufacturing electronic parts according to claim 30 or 31 has a structure such that a jig for horizontally holding the substrate material is used, and

the molding resin is hardened in a state where the substrate material is held horizontally by the jig.

It is preferable that the method of manufacturing electronic parts according to claim 32 has a structure such that the molding resin to be introduced is controlled by weight.

It is preferable that the method of manufacturing electronic parts according to any of claims 30 to 33 further comprises an injection step for injecting conductive paste into each of the through holes prior to performing the molding step.

It is preferable that the method of manufacturing electronic parts according to claim 34 has a structure such that the injection step is performed such that the conductive paste is injected into each of the through holes, and then the conductive paste is heated and hardened.

It is preferable that the method of manufacturing electronic parts according to any of claims 30 to 33 further comprises an injecting step for injecting metal material having solderability into each of the through holes prior to performing the molding step.

It is preferable that the method of manufacturing electronic parts according to claim 36 has a structure such that the metal material is solder, and the injecting step is performed such that soldering paste is injected into each of the through holes, and then the soldering paste is heated and melted.

It is preferable that the method of manufacturing electronic parts according to claim 36 has a structure such that the metal material is solder, and the injecting step is performed such that opening portions of the through holes are brought into contact with the solder which has been melted and caused to wave.

It is preferable that the method of manufacturing electronic parts according to claim 36 has a structure such that the metal material is solder, and the injecting step is performed such that portions of the substrate material except opening portions

of the through holes are masked, and then the substrate material is immersed in molten solder.

It is preferable that the method of manufacturing electronic parts according to claim 36 has a structure such that the injecting step is performed such that thick plating is applied to the through holes.

It is preferable that the method of manufacturing electronic parts according to any of claims 30 to 33 further comprises: a closing step for, by using a closing member, closing an opening portion of each of the through holes opened in the reverse surface of the substrate material prior to performing the molding step; and an opening step for removing the closing member after the molding resin has been hardened.

It is preferable that the method of manufacturing electronic parts according to claim 41 has a structure such that the closing member is a non-adhesive flat member that is capable of covering the entire surface of the reverse side of the substrate material, and the closing step is performed such that the flat members is pressed against the reverse side of the substrate material.

It is preferable that the method of manufacturing electronic parts according to claim 42 has a structure such that the flat member is made of silicon rubber.

It is preferable that the method of manufacturing electronic parts according to claim 41 has a structure such that the closing member is an adhesive sheet that is capable of covering the entire surface of the reverse side of the substrate material, and the closing step is performed by applying and bonding the adhesive sheet to the reverse side of the substrate material.

It is preferable that the method of manufacturing electronic parts according to claim 44 has a structure such that the sheet is an ultraviolet hardening sheet, the adhesive property of which deteriorates when irradiated with ultraviolet rays, and

the ultraviolet hardening sheet is irradiated with ultraviolet rays between the closing step and the opening step.

It is preferable that the method of manufacturing electronic parts according to claim 44 has a structure such that the sheet is a thermosetting sheet, the adhesive property of which deteriorates when heated, and the thermosetting sheet is heated between the closing step and the opening step.

It is preferable that the method of manufacturing electronic parts according to claim 41 has a structure such that the closing member is made of soluble resin that is dissolved in an alkali water solution, the closing step is performed such that the soluble resin is introduced into and hardened in each of the through holes, and the opening step is performed such that the soluble resin is washed off with an alkali water solution.

It is preferable that the method of manufacturing electronic parts according to any of claims 30 to 33 further comprises a covering step for attaching, to the surface of the substrate material, a covering material for closing the opening portion of each of the through holes prior to performing the molding step.

It is preferable that the method of manufacturing electronic parts according to claim 48 has a structure such that the covering material is an adhesive sheet, and the covering step is performed such that the adhesive sheet is applied and bonded to the surface of the substrate material.

It is preferable that the method of manufacturing electronic parts according to claim 48 has a structure such that the covering member is a dry film, and the covering step is performed such that the dry film is applied and bonded to the surface of the substrate material.

It is preferable that the method of manufacturing electronic parts according to claim 48 has a structure such that the covering member is a glass epoxy molded plate, and the covering step is performed such that the molded plate is bonded to the

surface of the substrate material.

It is preferable that the method of manufacturing electronic parts according to claim 48 has a structure such that the covering member is made of glass epoxy prepreg, and the covering step is performed such that the prepreg is, with heat, forcibly applied to the surface of the substrate material.

It is preferable that the method of manufacturing electronic parts according to claim 48 has a structure such that the covering member is a ceramic molded plate, and the covering step is performed such that the molded plate is bonded to the surface of the substrate material.

It is preferable that the method of manufacturing electronic parts according to claim 48 has a structure such that the covering member is a ceramic green sheet, and the covering step is performed such that the green sheet is, with heat, forcibly applied to the surface of the substrate material.

It is preferable that the method of manufacturing electronic parts according to any of claims 30 to 54 further comprises the steps of: attaching, to the substrate material, flatness-maintaining means for maintaining the flatness of the substrate material prior to performing the molding step; and removing the flatness-maintaining means prior to performing the cutting step and as well as after the molding resin has been hardened.

It is preferable that the method of manufacturing electronic parts according to claim 55 has a structure such that the substrate material is heated and then gradually cooled prior to removing the flatness-maintaining means and as well as after the molding resin has been hardened.

It is preferable that the method of manufacturing electronic parts according to any of claims 30 to 54 further comprises the steps of: attaching, to the substrate material, flatness-maintaining means for maintaining the flatness of the substrate material prior to performing the cutting step and as well as

after the molding resin has been hardened; heating and gradually cooling the substrate material; and removing the flatness-maintaining means.

It is preferable that the method of manufacturing electronic parts according to any of claims 55 to 57 has a structure such that the flatness-maintaining means comprises a flatness maintaining plate that is placed on the reverse side of the substrate material, and a holding member for holding both the flatness maintaining plate and the substrate material.

It is preferable that the method of manufacturing electronic parts according to any of claims 30 to 58 has a structure such that the through holes and plating leads connected to the corresponding through holes are integrally formed on the substrate material in the substrate manufacturing step.

It is preferable that the method of manufacturing electronic parts according to claim 59 further comprises: a semi-cutting step for semi-cutting the substrate material and the molding resin to separate the plating leads from the through holes prior to performing the cutting step; and an inspection step for electrically inspecting the element parts. It is preferable that the method of manufacturing electronic parts according to claim 60 has a structure such that the semi-cutting in the semi-cutting step is performed along the imaginary lines.

It is preferable that the method of manufacturing electronic parts according to any of claims 30 to 61 further comprises the step of: applying and bonding an adhesive sheet to the entire surface of either side of the substrate material prior to performing the cutting step, wherein the cutting step is performed such that the sheet is not completely cut.

According to the electronic part as claimed in claim 1, the surface of the molding resin having a flat shape enables the total thickness to be equal. Since each side surface of the

molding resin has the same surface with each side surface of the substrate, the space can be used efficiently because a dam or the like can be omitted. Therefore, the area of the overall plane shape can be reduced.

According to the electronic part as claimed in claim 2, the external electrodes are formed by cutting through holes in the axial direction of the through holes. If solder or the like is not filled in the external electrodes or the like, use of the external electrodes as the holes for locating a probe pin facilitates an electrical inspection.

According to the electronic part as claimed in claims 3 and 4, the external electrodes are filled with the conductive paste or the metal material having solderability so that handling easiness is improved. In a case where the external electrodes are soldered to a mother board or the like, fillets can easily be formed in the lower portions of the external electrodes adjacent to the mother board. Thus, soldering can easily be performed. Furthermore, the molding resin is not introduced into the external electrodes in the molding step, thus resulting in manufacturing being performed easily. In addition, members corresponding to the conventional dams can be omitted from the structure. Furthermore, the element parts and external electrodes are disposed closely. As a result, the manufacturing cost can be reduced and a compact overall shape can be realized. Furthermore, a molding material having low thixotropy, that is, exhibiting easy introduction capability can be used.

According to the electronic part as claimed in claims 5 and 6, solder or gold is used as the metal material so that easiness of soldering to the mother board is further improved.

The electronic part according to claim 7 comprises a covering member for covering openings of the external electrodes formed adjacent to the molding resin, wherein the side surfaces of the covering member are formed to have the same surface with each

side surface of the molding resin and the substrate. Therefore, similarly to claims 3 and 4, introduction of the molding resin into the external electrodes in the molding step can be prevented. Thus, the manufacturing cost can be reduced, and a compact overall shape can be realized. Furthermore, a molding material having low thixotropy can be used.

The electronic part according to claim 8 comprises the pad disposed between the substrate and the element part and made of the same material as that of the covering member. Thus, the pad can be used as the locating reference at the time of mounting the element parts. Furthermore, a problem of a type that an end of the element part is placed on the covering member, and thus the element part is mounted while being inclined undesirably can be prevented.

Since the electronic part according to claim 9 has the structure that the pad has a penetrating hole, and a conductive member is included in the penetrating hole, the element part requiring a die pad and the die pad can be electrically conducted to each other so that their potentials are made to be the same.

The electronic part according to any of claims 10 to 13 has the structure that the covering member is an adhesive sheet, a dry film, a glass epoxy plate or a ceramic plate so that machining and attaching are easily performed. In particular, a photoprocess for use in the process for manufacturing a substrate can be applied to the dry film or the like. Therefore, machining and attaching can be performed more easily.

Since the electronic part according to claim 14 comprises the external electrodes at the corners of the substrate thereof, the printed patterns of the substrate can be disposed while being dispersed. Therefore, the corners of the substrate, that easily become dead spaces, can be used efficiently. Therefore, the printing pattern can be made adequately, and a compact overall shape can be realized because the dead space can be eliminated.

According to the electronic part material as claimed in claim 15, the electronic part material is cut along the imaginary lines so that leadless type electronic parts each comprising the substrate having external electrodes in the periphery thereof is constituted on which an element part is mounted and which is molded. The electronic part obtained by cutting has a structure that each side surface of the molding resin and each side surface of the substrate have the same surface so that electronic parts similarly to that according to claim 2 are manufactured. In the foregoing case, although the electronic part material may be of a type from which one electronic part can be obtained by cutting, it is preferable that the electronic part material be of a type in which a multiplicity of electronic part elements are included in a lattice configuration to enable a multiplicity of electronic parts to be obtained by cutting. Thus, compact electronic parts can be easily and quickly manufactured.

The electronic part material according to claim 16 comprises the dams in the periphery of the substrate material thereof so that discharge of the molding resin from the substrate material is prevented in the molding step. Therefore, introduction (application) of the molding resin can be performed efficiently, and molding material having low thixotropy can be used.

The electronic part material according to claim 17 further comprises the plating leads so that a plurality of electronic part elements can be simultaneously applied with plating. Since the electronic part elements are concentrically disposed, plating can be performed uniformly and efficiently.

Since the electronic part material according to claim 18 has the plating leads disposed on the two sides of the substrate material, local flow of the plating electric current can be prevented, and thus the thickness of plating can be equalized over the entire surface.

Since the electronic part material according to claims 19 and 20 has the structure that conductive paste or the metal material having solderability is filled in each of the through holes, the metal material can be collectively injected into a plurality of electronic part elements by a printing process or a plating process in the technology for manufacturing substrates. In the molding step, undesirable introduction of the molding resin into the through holes can be prevented, and therefore manufacturing can easily be performed. Furthermore, the through holes (the external electrodes) of the electronic part obtained by cutting are filled with the foregoing metal material. Thus, electronic parts similar to those according to claim 3 or 4 can be manufactured.

Since the electronic part material according to claim 21 and 22 comprises solder or gold as the metal material, the electronic parts obtained by cutting exhibit excellent soldering easiness similarly to claims 5 and 6.

The electronic part material according to claim 23 comprises a covering material placed on the surface of the substrate material to cover an opening portion of each of the through holes. Therefore, covering materials can collectively be provided for a plurality of electronic part elements. Furthermore, undesirable introduction of the molding resin into the through holes can be prevented in the molding step, and therefore manufacturing can be performed easily. Moreover, the electronic parts obtained by cutting can be made to be similar to that according to claim 7.

Since the electronic part material according to claim 24 comprises pads disposed between the substrate material and each element part and made of the same material as that of the covering material, pads can easily be attached, and the yield can be improved. Furthermore, the electronic parts obtained by cutting can be made to be similar to that according to claim 8.

The electronic part material according to any of claims 25 to 28 has the structure that the covering material is an adhesive sheet, a dry film, a glass epoxy plate or a ceramic plate. Therefore, machining and attaching can easily be performed, and the electronic parts obtained by cutting can be made to be similar to that according to any of claims 10 to 13.

Since the electronic part material according to claim 29 has the structure that the through holes are formed at intersection portions of lattice-like imaginary lines, the electronic parts obtained by cutting can be made to be similar to the electronic part according to claim 14 which comprises the through holes (the external electrodes) formed at the corners of the substrate.

The method of manufacturing electronic parts according to claim 30 causes the molding resin to be hardened through the substrate manufacturing step, the mounting step, the connection step and the molding step so that electronic part material similar to that according to claim 15 is manufactured. Furthermore, the following cutting step enables electronic parts similar to that according to claim 2 to be obtained by cutting. Therefore, previous forming of a multiplicity of the electronic part elements on the electronic part material will enable a multiplicity of electronic parts to be manufactured collectively. Furthermore, cutting causes each electronic part to have the same surface consisting of the side surface of the molding resin and the side surface of the substrate. Note that the cutting positions (lines) may be on the imaginary lines or slightly deviated from the imaginary lines if cutting is performed along the imaginary lines. Although it is preferable that the cutting method be dicing, breaking or the like may be employed.

The method of manufacturing electronic parts according to claim 31 has the arrangement that dams are formed in the periphery of the substrate material to prevent discharge of the introduced molding resin prior to performing the molding step.

Thus, discharge of the molding resin to the outside of the substrate material can be prevented, and therefore introduction (application) of the molding resin can be performed efficiently. In addition, molding material having low thixotropy can be used. Furthermore, the molding resin can be applied uniformly.

The method of manufacturing electronic parts according to claim 32 has the structure such that the jig is used and the molding resin is hardened in a state where the substrate material is held horizontally so that the molding resin can be applied more equally.

The method of manufacturing electronic parts according to claim 33 has the structure such that the molding resin to be introduced is controlled by weight. Therefore, as compared with the conventional method in which the molding resin has been controlled by the time of discharge from a supply apparatus, the thickness accuracy of the molding resin can significantly be improved. It leads to a fact that the thicknesses of the electronic parts can be controlled accurately.

The method of manufacturing electronic parts according to claims 34 and 35 has the arrangement such that conductive paste is injected into the through holes prior to performing the molding step. Thus, an electronic part material similar to that according to claim 19 can be manufactured. By cutting the electronic part material, electronic parts similar to that according to claim 3 can be manufactured.

Since the method of manufacturing electronic parts according to claim 36 has the arrangement that the metal material having solderbility is injected into the through holes prior to performing the molding step, an electronic part material similar to that according to claim 19 can be manufactured. By cutting the electronic part material, electronic parts similar to that according to claim 4 can be manufactured.

According to the method of manufacturing electronic parts

according to claim 37, the solder paste is injected into the through holes, and then the solder paste is heated and melted so that the through holes are filled with solder. With the foregoing method, the substrate manufacturing technology using a stencil or a dry film can be applied so that injection of the solder can accurately and easily be performed.

The method of manufacturing electronic parts according to claim 38 has the arrangement such that opening portions of the through holes are brought into contact with the solder which has been melted and caused to wave. As a result, the solder is introduced into the through holes due to capillary phenomenon so as to be injected into the same. With the foregoing method, solder can quickly be injected, and the solder for mounting the electronic part onto a mother board can be previously supplied to the electronic part.

The method of manufacturing electronic parts according to claim 39 has the arrangement such that the substrate material is masked, and then the substrate material is immersed in molten solder. As a result, the solder is introduced and filled in only the through holes. The foregoing method enables the solder to be injected accurately and easily. By also employing the method according to claim 38, the solder can be injected accurately and quickly.

With the method of manufacturing electronic parts according to claim 40, the through holes are plated thickly so that the through holes are filled with the solder and a state is realized in which the through holes are filled with the plating material. The foregoing method enables a plating process for printing a pattern on the substrate material to be employed simultaneously. As a result, injection of the solder can significantly easily be performed.

The method of manufacturing electronic parts according to claim 41 comprises the closing step for, by using a closing

member, closing an opening portion of each of the through holes opened in the reverse surface of the substrate material prior to performing the molding step; and an opening step for removing the closing member after the molding resin has been hardened. Therefore, air in each through holes is enclosed in the molding step to prevent undesirable introduction of the molding resin into the through holes. Therefore, covering members and injecting members, that are integrated with the electronic part, are not used to prevent introduction of the molding resin into the through holes.

The method of manufacturing electronic parts according to claims 42 and 43 has the arrangement that the closing step is performed such that the flat member is abutted to cover the entire surface of the reverse side of the substrate material. Thus, closing of all through holes can be performed collectively, and the opening step can significantly easily be performed. By using a silicon rubber flat member as the flat member at this time, close contact can be maintained even if the temperature is changed. Thus, a problem, such as undesirable discharge of enclosed air, can be prevented.

The method of manufacturing electronic parts according to claim 44 has the arrangement that the closing member comprises the adhesive sheet capable of covering the entire surface of the reverse side of the substrate material. Thus, desired close contact can be maintained without a necessity of pressing the adhesive sheet. As a result, the adhesive sheet can easily be attached to the substrate material.

The method of manufacturing electronic parts according to claims 45 and 46 has the arrangement that the sheet is the sheet, the adhesive property of which deteriorates with ultraviolet rays or heat. Thus, irradiation of the sheet with ultraviolet rays or heating of the same after the molding resin has been hardened enables the sheet to be separated easily even if the

sheet has strong adhesiveness.

The method of manufacturing electronic parts according to claim 47 has the arrangement that the closing member is made of resin introduced into and hardened in each through hole, the resin being resin that is dissolved in an alkali water solution. Therefore, washing with an alkali water solution after the molding resin has been hardened, preferably after the cutting step has been performed, enables the closing member to be removed easily and completely from the electronic part.

The method of manufacturing electronic parts according to claim 48 has the arrangement that the covering material for closing the through holes is attached to the surface of the substrate material prior to performing the molding step. Thus, an electronic part material similar to that according to claim 23 can be formed after the molding resin has been hardened. Furthermore, the following cutting step enables electronic parts similar to that according to claim 7 to be manufactured.

The method of manufacturing electronic parts according to any of claims 49 to 54 has the arrangement that the covering material is the adhesive sheet, the dry film, the glass epoxy molded plate or the ceramic molded plate. Thus, machining and attaching can easily be performed. Furthermore, the electronic parts obtained by cutting can be made to be similar to that according to claims 10 to 13. By using glass epoxy prepreg or a ceramic green sheet and by heating and forcibly applying the same to be the covering material, machining can be performed further easily.

The method of manufacturing electronic parts according to claim 55 has the arrangement that the flatness-maintaining means for maintaining the flatness of the substrate material is attached prior to performing the molding step. Thus, warp of the substrate material occurring due to the difference in the coefficient of thermal expansion between the molding resin and

the substrate material when the molding resin is hardened can be relaxed. As a result, the electronic parts obtained by cutting are free from warp and have excellent soldering easiness.

The method of manufacturing electronic parts according to claims 56 and 57 has the arrangement that the substrate material is again heated and then gradually cooled together with the hardened molding resin prior to removing the flatness-maintaining means. As a result, a relaxing phenomenon (the creeping phenomenon) due to the viscous component of the molding resin can be generated. Thus, the warp of the substrate material can further be relaxed. If the flatness-maintaining means is attached after the molding resin has been hardened, followed by heating and gradually cooling the substrate material, the creeping phenomenon can be generated.

The method of manufacturing electronic parts according to claim 58 has the arrangement that the flatness-maintaining means comprises a flatness maintaining plate and a holding member for holding both the flatness maintaining plate and the substrate material. Therefore, the flatness of the substrate material can be maintained, and the flatness-maintaining means does not interrupt the molding process. If the holding member is formed into a frame shape, the foregoing dam function is realized. The flatness maintaining plate may serve as the flat member according to claim 42.

The method of manufacturing electronic parts according to claim 59 enables an electronic part material similar to that according to claim 17 to be formed by previously integrating the plating leads with the substrate material. Thus, a plurality of electronic part elements can collectively be applied with plating.

The method of manufacturing electronic parts according to claim 60 has the arrangement that the plating leads are, by half cutting, separated from the through holes prior to performing

the cutting step, followed by performing electrical inspection of the element parts. Thus, the electronic part elements can be made electrically independent in the state of the electronic part material. As a result, each electronic part element can be inspected in the foregoing state. Therefore, the inspection process can be simplified.

The method of manufacturing electronic parts according to claim 61 has the arrangement that semi-cutting is performed along the imaginary lines. Therefore, the cutting lines in the semi-cutting step and the complete cutting lines in the cutting step can be made to be the same. Thus, cutting can be performed efficiently.

The method of manufacturing electronic parts according to claim 62 has the arrangement that the adhesive sheet is applied to the entire surface of either side of the substrate material prior to performing the cutting step. Thus, dispersion of the cut electronic parts can be prevented similar to the process for dicing semiconductor wafer. As a result, a post process can be performed easily.

Other and further objects, features and advantages of the invention will be appear more fully from the following description.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a structural view of an electronic part according to an embodiment of the present invention;

Fig. 2 is a diagram showing a manufacturing method corresponding to the embodiment of the present invention shown in Fig. 1;

Fig. 3 is an explanatory diagram showing another manufacturing method corresponding to the embodiment of the present invention shown in Fig. 1;

Fig. 4 is a structural view of an electronic part according

to another embodiment of the present invention;

Fig. 5 is an explanatory diagram showing a manufacturing method corresponding to the embodiment shown in Fig. 4;

Fig. 6 is an explanatory diagram showing a manufacturing method corresponding to the embodiment of the present invention shown in Fig. 4;

Fig. 7 is a structural view of an electronic part according to another embodiment of the present invention;

Fig. 8 is a structural view of an electronic part according to another embodiment of the present invention;

Fig. 9 is a structural view of an electronic part according to another embodiment of the present invention;

Fig. 10 is an explanatory diagram showing a manufacturing method corresponding to the embodiments of the present invention shown in Figs. 7 to 9;

Fig. 11 is an explanatory diagram showing a method of manufacturing an electronic part according to an embodiment of the present invention;

Fig. 12 is a structural view of a substrate of an electronic part according to an embodiment of the present invention;

Fig. 13 is an explanatory diagram showing a method of manufacturing an electronic part according to an embodiment of the present invention; and

Fig. 14 is a structural view of a conventional electronic part.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will now be described with reference to the drawings. Fig. 1 is structural view of a chip-carrier-type (a lead-less package type) electronic part according to an embodiment of the present invention. Fig. 1B is a reverse view of the chip-carrier-type electronic part. Fig. 1A is a cross sectional view taken along

line C-C' of Fig. 1B. As shown in Fig. 1A, the electronic part is structured such that a semiconductor device 1 is caused to dia-touch a substrate 6 previously cut to have an outline passing through near the centers of through holes (external electrodes) 7. Furthermore, the semiconductor device 1 and circuit patterns 3 formed on the substrate 6 are electrically connected to one another by wires 2.

Although the semiconductor device 1 will now be described as the element part, the element part may be so-called passive devices, such as an inductance device and a capacity device, as well as the active device, such as the semiconductor device (IC, LSI or the like). Any device that is placed on a substrate may be employed here.

A portion of the circuit patterns 3 serves as the bonding pads for use in wire bonding. The circuit patterns 3 are, by way of the through holes 7, connected to connection lands 8 (the external electrodes), the circuit patterns 3 being connected to a mother board (not shown) through the through holes 7 and the connection lands 8 by soldering. In the foregoing case, the through holes 7 are filled with solder 9 to easily form solder fillets (solder hems) of the through holes 7 (on the side surfaces of the electronic part). As a result, the reliability of the electronic part can be improved as known, and the appearance inspection to be performed in a process of mounting the electronic part can easily be conducted.

Although the substrate 6 is usually a printed circuit board, a ceramic substrate is sometimes used. The molding resin 5 is, by a method to be described later, cut to have the same outline as that of the substrate 6. The dia-touch of the semiconductor device 1 is usually established by an epoxy adhesive agent or silver paste. The wires 2 are usually gold wires or aluminum wires which are connected by a known wire bonding method. In a case where the substrate 6 is a printed circuit board, both

surface and inside of the circuit patterns 3 and the through holes 7 usually have a structure such that copper foil is usually gold plated. In a case of the ceramic substrate, the circuit patterns 3 usually have a structure such that copper, silver or tungsten paste is gold plated or are made of gold paste. In the foregoing case, the through holes 7 are, similarly to the printed circuit board, nickel or gold plated on plated copper. As an alternative to this, the through holes 7 may be filled with the foregoing conductive paste.

In the foregoing case, the material of the conductive paste may be a material containing copper, silver, gold or the like. In a particular case where an organic substrate is used as the substrate 6, it is preferable that a material containing copper be used as the material of the conductive paste in the viewpoint that its baking temperature is low. It is more preferable that conductive paste of a type such that copper particles are silver plated be used. The conductive paste is filled by a method comprising the steps of filling the through holes 7 with the conductive paste by a squeegee 24; and heating and hardening the conductive paste, similarly to the method for the solder 9 shown in Fig. 2.

Although the through holes 7 are filled with the solder 9 in this embodiment, any material having solderability may be used. For example, gold or the like may be enclosed or conductive paste may be enclosed.

Referring to Fig. 2, a method of manufacturing the chip-carrier-type electronic part having the structure shown in Fig. 1 will now be described. As shown in Fig. 2A, the substrate (the substrate material) 6, which has the through holes 7 previously formed at connection portions of the chip carrier, is prepared. Then, stencils 23 having apertures 22, which correspond to the through holes 7, are located such that the through holes 7 and the apertures 22 align to one another. Then,

cream solder 21 is, by a squeegee 24, printed on a frame (not shown) which receives the substrate 6. At this time, the diameter of each aperture 22 of the stencil 23 is made to be the same as or slightly smaller than the diameter of the through holes 7 and/or the speed, at which the squeegee 24 is moved, and the pressure applied by the squeegee 24 are controlled to cause the cream solder 21 to be injected into only the through holes 7. Thus, the solder 9 can be injected into only the through holes 7 even if the solder 9 is melted later. Although the stencil 23 usually has a thickness of 100  $\mu\text{m}$  to 200  $\mu\text{m}$ , the quantity of the solder 9 to be injected is determined dependently on the volume of the through holes 7, and as well as the thickness of the stencil 23 and the diameter of the aperture are determined.

The solder 9 may be applied by any of known methods that have been employed in the surface mounting process. For example, a method using a dispenser may be employed. Then, the through holes 7 of the substrate 6 are heated by a reflow furnace, hot air or infrared rays to melt the cream solder 21 so that a state in which the through holes 7 are filled with the solder 9 is realized. If necessary, the through holes 7 are cleaned so that flux contained in the cream solder 21 is removed.

Note that a mask having openings corresponding to only the through holes 7 and formed on either or both sides of the substrate 6 by a resist or dry film, followed by printing the cream solder 21 to the substrate 6 will cause the solder 9 to be filled in only the through holes 7 further reliably. The resist or dry film or the like is required to be removed after the solder 9 has been enclosed or the solder 9 has been melted. The foregoing method enables use of the stencil 23 to be omitted to fill only the through holes 7 with the cream solder 21 by placing the cream solder 21 directly on the substrate 6 and by squeegeeing with the squeegee 24.

Then, dia-touch of the semiconductor device 1 is established,

as shown in Fig. 2B, and then the semiconductor device 1 caused to dia-touch and the circuit patterns 3 formed on the substrate 6 are electrically connected to one another by wires 2.

Furthermore, as shown in Fig. 2C, potting (applying) of the molding resin 5 to the substrate 6 is performed. At this time, since the through holes 7 have been filled with the solder 9, undesirable introduction of the molding resin 5 into the through holes 7 can be prevented, and therefore penetration of the molding resin 5 to appear on the reverse side of the substrate 6 can be prevented. As a matter of course, transfer molding using a costly mold which has a structure capable of relieving from the through holes 7 is not required, but the foregoing potting molding process using no mold is sufficient to achieve the foregoing object. Even if the transfer mold is used, the structure, in which the through holes 7 are filled with the solder 9, eliminates the necessity of employing the structure capable of relieving from the through holes 7. Furthermore simultaneous molding can be performed including the through holes 7.

If the potting molding is employed, the periphery of the substrate 6 is required to have a relatively wide area or a dam is required in the periphery of the substrate 6 to eliminate the necessity of using a molding material that exhibits excellent thixotropy. As a result, the molding resin 5 can satisfactorily be introduced into the gaps around the semiconductor device 1, and therefore portions that are not filled with the molding resin 5 are not generated. Thus, the reliability can be improved. If also vacuum defoaming is performed in the process for applying the molding resin 5, generation of the portions that are not filled with the molding resin 5 can be prevented completely. If the surfaces of the substrate 6 and the semiconductor device 1 are activated with oxygen or argon plasma immediately before the process for applying the molding resin 5

is performed, further excellent contact of the molding resin 5 can be established. As a result, the reliability of the electronic part can be improved more satisfactorily.

Then, the molding resin 5 is hardened by a hardening method, such as heating, irradiation with ultraviolet rays or allowing to stand in a wet environment. As a result of the foregoing processes, the material for the electronic part can be manufactured. The material for the electronic part has a structure such that a plurality of the semiconductor devices 1 are mounted on the substrate 6 (the material for the substrate) 6 including the through holes 7 and having a large area, and then the molding resin 5 is applied to the upper surfaces of the foregoing elements. That is, the electronic part elements sharing the through holes 7 are formed on the substrate 6. Although a small number (one or two) of the electronic part elements may be formed as illustrated, it is preferable that a plurality of the electronic part elements be formed in the form of a matrix.

Finally, the material for the electronic part is cut by a dicing blade 20 along the through holes 7 which constitute the outline of the chip-carrier-type electronic part, that is, along imaginary lines each of which passes through near the centers of the through holes 7. Thus, independent electronic parts can be obtained. The final cutting process may be, in place of performing dicing, carried out by a breaking process in which the substrate 6 is broken. In the foregoing case, the substrate 6 is previously provided with V-grooves or perforations along the imaginary lines passing through near the centers of the through holes 7.

The structure may be constituted such that a plurality of the electronic parts are taken from one substrate 6, as described. In this case, it is preferable that the through holes 7 be shared with the adjacent electronic parts if the positions of

the through holes 7 of the adjacent electronic parts coincide with one another. In a case where the through holes 7 are collapsed because the dicing blade 20 has an excess thickness, the substrate 6 is cut at positions slightly deviated from the centers of the through holes 7 to use only either side of the cut substrate 6 (see Fig. 13).

Referring to Fig. 3, another method of manufacturing the chip-carrier-type electronic part having the structure shown in Fig. 1 will now be described. As shown in Fig. 3A, a substrate 6 having through holes 7 at the connection portions of the chip carrier as shown in Fig. 3A is prepared. Then, flux is, by a flux applying apparatus (not shown), applied to only the opening portions of the through holes 7 of the substrate 6. Then, the substrate 6 is placed near and caused to face the liquid level of molten solder 31, followed by jetting out a solder stream 30 through nozzles or the like disposed to correspond to the through holes 7 so that the molten solder 31 is brought into contact with the opening portions of the through holes 7. In the foregoing case, if the diameter of each of the through holes 7 is about 0.5 mm or less, the capillary phenomenon causes the solder 9 to be injected into only the through holes 7.

If a mask made of a resist or dry film and having openings corresponding to only the through holes 7 is placed on the surface of the substrate 6 to which the solder stream 30 is jetted or on the two sides of the substrate 6, the solder 9 can accurately be injected into only the through holes 7. After the solder 9 has been injected, the resist or the dry film is removed. As a result of the foregoing manufacturing method, even if the substrate 6 is directly immersed in a soldering chamber, the solder 9 can be injected into only the through holes 7. Use of a solder resist to prevent excess extension of the solder 9 enables the solder 9 to be accurately injected into only the through holes 7. In the foregoing case, cleaning is

performed as the need arises to remove the flux.

The following processes are, as shown in Figs. 3B and 3C, the same as those described with reference to Fig. 2. Since the connection lands 8 on the reverse side of the substrate 6 are not masked with the resist or dry film in the processes shown in Figs. 3B and 3C, the solder 9 is supplied to the connection lands 8, as well as to the through holes 7. By previously supplying the solder 9 to also the connection lands 8 as described above, the soldering easiness can be improved when the electronic part obtained by cutting is mounted on the mother board by soldering. As an alternative to this, supply of the solder 9 to the connection lands 8 may be performed simultaneously with printing of the cream solder 21 performed as described with reference to Fig. 2. The supply may be performed simultaneously with performing the process of plating the through holes 7 to be described later.

Note that the through holes 7 may be previously and partially plugged with solder or by gold plating, or conductive paste may be used to plug the same, in place of the methods shown in Figs. 2 and 3. Since the connection with the mother board is usually established by soldering, it is preferable that the metal material to be injected into the through holes 7, which are the connection portions, be a material exhibiting excellent solderability. Specifically, it is preferable to use gold paste as the conductive paste rather than copper paste.

Another embodiment of the present invention will now be described. Fig. 4B is a reverse view of a chip-carrier-type electronic part. Fig. 4A is a cross sectional view taken along line B-B' of Fig. 4B. As shown in Fig. 4, the electronic part according to this embodiment has the same structure as that shown in Fig. 1 except that the through holes 7 (the external electrodes) of the electronic part shown in Fig. 1 are not filled with the solder 9. Since the solder 9 is not injected

into the through holes 7, the structure can be simplified and the cost can be reduced. Since no metal material is injected into the through holes 7, the through hole 7 can be used as the locating hole for an inspection probe pin for use at the time of performing an electrical inspection of the electronic part to be performed as a latter process. Thus, the electric conduct can assuredly be established.

Referring to Fig. 5, a method of manufacturing the chip-carrier-type electronic part shown in Fig. 4 will now be described. As shown in Fig. 5A, a substrate 6 having through holes 7 formed at the connection portions of the chip carrier is prepared. Furthermore, an adhesive sheet 40 is applied to the overall reverse surface of the substrate 6. The adhesive sheet 40 may be any adhesive sheet if it does not allow air to pass through. An adhesive sheet for use in the dicing process for the semiconductor device 1 is preferable to be employed because of its reliability attained due to a small quantity of impurities contained therein. Although the adhesive sheet 40 may be an adhesive sheet of a type that maintains its adhesiveness, it is preferable that it be a known adhesive sheet, the adhesiveness of which deteriorates with ultraviolet rays or heat because it can easily be separated in the latter process. In the foregoing state, the semiconductor device 1 is caused to dia-touch, as shown in Fig. 5B. Furthermore, the semiconductor device 1 and the circuit patterns 3 formed on the substrate 6 are electrically connected to one another by wires 2.

Then, potting of the molding resin 5 to the substrate 6 is performed in such a manner that the opening portions of the through holes 7 formed on the reverse side of the substrate 6 are covered with the adhesive sheet 40, and the molding resin 5 is applied in the foregoing state. Therefore, air is sealed in the through holes 7 so that undesirable introduction of the molding resin 5, which is adhesive fluid, into the through holes

7 can be prevented. Therefore, any special cover member is not required to prevent undesirable introduction of the molding resin 5 into the through holes 7. In a case of the molding resin 5 is a usual type molding resin having viscosity of 20,000 to 50,000 centipoise, the foregoing effect being attained has been confirmed if each through hole 7 has a diameter of 0.5 mm or less, though results of experiments are omitted here. Even if each through hole 7 has a diameter of 0.5 mm or less, the foregoing effect can be obtained by using a molding resin 5 having high viscosity.

In the foregoing state, the molding resin 5 is hardened, and then the adhesive sheet 40 is separated as shown in Fig. 5C. Then, the substrate 6 is, by a dicing blade 20, cut along the through holes (the imaginary lines) 7 so that independent electronic parts are obtained. It is preferable that the adhesive sheet 40 be of a type whose adhesive property deteriorates with heat or the like because it can easily be separated, as described above. The molding process may be performed by potting molding that requires no mold, and the molding resin 5 may be a molding resin having usual thixotropy, similarly to the embodiment shown in Fig. 2. If vacuum defoaming is, in the foregoing state, performed after the molding process has been performed, there is a risk that the molding resin 5 is undesirably introduced into the through holes 7. Therefore, vacuum defoaming must be, before the molding process is performed, limited to only the molding resin 5 to remove bubbles in the molding resin 5.

By employing the foregoing manufacturing method, the gold-plated through holes (the external electrodes) 7 appear on the side surfaces of the electronic parts taken by cutting. Thus, solder fillets can easily be formed in the through holes 7 when the connection with the mother board is established, causing the electronic part to have improved soldering easiness. If a

ceramic substrate is used, a similar effect to that obtainable from the foregoing printed board can be obtained if the through holes 7 have the hollow structure. If the conductive paste is injected, the same structure described with reference to Fig. 1 is employed.

Another method of manufacturing the chip-carrier-type electronic part having the structure as shown in Fig. 4 will now be described with reference to Fig. 6. As shown in Fig. 6A, a substrate 6 having through holes 7 previously formed in the connection portions of the chip carrier is prepared, followed by causing the semiconductor device 1 to dia-touch the upper surface of the substrate 6. Furthermore, the semiconductor device 1 and the circuit patterns 3 formed on the substrate 6 are electrically connected to one another by wires 2. Then, as shown in Fig. 6B, silicon rubber 50 is pressed against the reverse side of the substrate 6 to cover the through holes 7, followed by potting the molding resin 5, which is then hardened as it is. The reason why the molding resin 5 is not introduced into the through holes 7 is due to the same principle as that in the foregoing case where the adhesive sheet 40 is used. As shown in Fig. 6C, the following process is the same as that described with reference to Fig. 5.

In order to improve the contact between the through holes 7 and the silicon rubber 50 to reliably maintain air in the through holes 7, each of the portions of the silicon rubber 50 which is in contact with the through holes 7 and that with the connection lands 8 may previously be formed into concave shape to receive their convex shape. As an alternative to this, pin-like projections may be formed on the surface of the silicon rubber 50 to plug the inside portions of the through holes 7.

To prevent introduction of the molding resin 5 into the through holes 7, the through holes 7 may be plugged by a known method of plugging a hole with resin that is employed by a known

step of the method of manufacturing a substrate 6, followed by removing the plugging resin after the dicing process has been completed. In the foregoing case, resin of a type that is dissolved in an alkali water solution is usually used to remove the resin after the dicing process has been completed, the removal being performed such that the resin is washed the resin off.

Another embodiment of the present invention will now be described. Fig. 7 is a structural view of a chip-carrier-type electronic part according to this embodiment of the present invention. Fig. 7B is a reverse view of the chip-carrier-type electronic part. Fig. 7A is a cross sectional view taken along line D-D' of Fig. 7B. As shown in Fig. 7, the electronic part according to this embodiment has through-hole covering members 70 previously placed on the through holes (the external electrodes) 7. The semiconductor device 1 is caused to dia-touch the upper surface of the substrate 6 cut to have an outer shape passing through near the centers of the through holes 7. Furthermore, the semiconductor device 1 and the circuit patterns 3 formed on the substrate 6 are electrically connected to one another by wires 2.

The through-hole covering members 70 are disposed on only the through holes 7 and comprise, for example, dry films, glass epoxy plates or ceramic plates each of which has adhesiveness and is used in the process for manufacturing a substrate. In this case, the through-hole covering members 70 are manufactured by, with a pattern, punching to have shapes that can be placed on the through holes 7, followed by being applied to the substrate 6. As a matter of course, if the dry film is used, it is applied to the entire surface of the substrate 6, followed by leaving the required portions corresponding to the through holes 7 in a photoprocess similar to that employed in the conventional technology of manufacturing a substrate.

The glass epoxy plate, previously formed, may be applied to the substrate 6 by an adhesive agent, or a prepreg of an unformed glass epoxy plate may be previously formed by pattern drawing or the like, followed by being located, and then it is heated and forcibly applied to the surface. If the substrate 6 is made of ceramics, a non-sintered green sheet may be previously formed by pattern drawing or the like, followed by being located, and then the green sheet is, together with the substrate 6, heated and pressurized so that the green sheet is sintered to the substrate 6. Note that the basic structure except the through-hole covering members 70 is the same as that of the electronic parts shown in Figs. 1 and 4.

Another embodiment of the present invention will now be described. Fig. 8 is a structural view of a chip-carrier-type electronic part according to another embodiment of the present invention. Fig. 8B is a reverse view of the chip-carrier-type electronic part. Fig. 8A is a cross sectional view taken along line E-E' of Fig. 8B. As shown in Fig. 8, the electronic part according to this embodiment has a structure such that the through-hole covering members 70 are disposed between the semiconductor device 1 and the substrate 6, as well as the through holes (the external electrodes) 7. That is, the semiconductor device 1 is not caused to directly dia-touch the substrate 6, but is caused to dia-touch the upper surface of the through-hole covering members (pads) 70. The residual structures are the same as those shown in Fig. 7.

Therefore, the through-hole covering members 70 are required to be opened in the portions in which the wires 2 are connected to the circuit patterns 3. In the case where the through-hole covering members 70 comprise the sheets having adhesiveness, the glass epoxy plates or the ceramic plates, the necessity of forming the punched openings by using a costly pattern, as is required in the case shown in Fig. 7, can be eliminated. The

punched openings may be formed by a drill bit. Furthermore, the semiconductor device 1 can easily be located. If the structure shown in Fig. 8 is employed, the through-hole covering members 70 can easily be manufactured and the semiconductor device 1 can easily be mounted as compared with the structure shown in Fig. 7. Thus, the cost of the electronic part can be lowered.

Another embodiment of the present invention will now be described. Fig. 9 is a structural view of a chip-carrier-type electronic part according to this embodiment of the present invention. Fig. 9B is a reverse view of the chip-carrier-type electronic part. Fig. 9A is a cross sectional view of the chip-carrier-type electronic part taken along line F-F' of Fig. 9B. As shown in Fig. 9, the electronic part according to this embodiment has a structure such that the through-hole covering members (pads) 70 disposed between the semiconductor device 1 and the substrate 6 shown in Fig. 8 have penetrating holes 73. The penetrating holes 73 is filled with silver paste 72. The silver paste 72 establishes electrical connection between a die pad 71 formed on the substrate 6 and the reverse side of the semiconductor device 1.

In general, the die pad 71 is usually connected to a certain fixed potential. Therefore, the structure shown in Fig. 9 is effective in a case where the potential of the die of the semiconductor device 1 must be fixed. Also in this case, the through-hole covering members 70 are required to have openings to correspond to the portions, in which the wires 2 are connected to the circuit patterns 3, and the portions of the foregoing penetrating holes 73. Therefore, if the sheet having adhesiveness, the glass epoxy plate or the ceramic plate is used as the through-hole covering members 70, the through-hole covering members 70, which have been machined by a drill bit and the cost of which can therefore be reduced, may be applied similarly to the structure shown in Fig. 8.

A method of manufacturing the chip-carrier-type electronic part having the structure shown in Figs. 7 to 9 will now be described with reference to Fig. 10. As shown in Fig. 10A, the substrate (the substrate material) 6 having the through holes 7 formed at the connection portions of the chip carrier is prepared. Then, the through-hole covering members 70 are attached onto the through holes 7. The through-hole covering members 70 are required to be formed by punching with a pattern or the like to locate the dry film, the glass epoxy plate or the ceramic plate, each of which is used in the technique for manufacturing substrates, on only the through holes 7; followed by being applied to the substrate 6. In the case where the dry film is used, it is applied to the entire surface of the substrate 6, followed by leaving only the portions corresponding to the through holes 7 in a process similar to that employed in the conventional technique for manufacturing substrate.

As shown in Fig. 10A, the through-hole covering members 70 may be disposed to correspond to only the through holes 7, or may be further disposed between the semiconductor device 1 and the substrate 6 to serve as the pad for the semiconductor device 1, as described with reference to Figs. 8 and 9. Then, the semiconductor device 1 is caused to dia-touch. The semiconductor device 1, which has been brought to the dia-touch, and the circuit patterns 3 formed on the substrate 6 are electrically connected to one another by the wires 2. Furthermore, potting (applying) of the molding resin 5 onto the substrate 6 is performed, as shown in Fig. 10B. Since the through holes 7 are covered with the through-hole covering members 70 at this time, undesirable introduction of the molding resin 5 into the through holes 7 can be prevented. Thus, undesirable penetration of the molding resin 5 to appear on the reverse side of the substrate 6 can be prevented. Finally, similarly to Fig. 2C, the electronic part material is cut by the

dicing blade 20 along the portion of the through holes 7, which is the outline of the chip-carrier-type electronic part, that is, along imaginary lines passing through near the centers of the through holes 7. Thus, independent electronic parts can be obtained.

Referring to Fig. 11, a method of manufacturing another electronic part will now be described. Similarly to the plurality of the embodiments above, the semiconductor device 1 is caused to dia-touch and wire bonded. Then, potting (applying) of the molding resin 5 onto the substrate 6 is performed. In this embodiment, a flatness-maintaining means for maintaining the flatness of the substrate 6 when the molding resin 5 is hardened is attached to the substrate 6. The flatness-maintaining means comprises a flatness-maintaining plate 80, which is placed onto the reverse side of the substrate 6, and holding members 81 for holding both the flatness-maintaining plate 80 and the substrate 6 therebetween, the holding members 81 each having a U-shape cross sectional shape facing side. The holding members 81 are detachably attached to the substrate 6. In the foregoing state, the molding resin 5 is hardened by a method adaptable to the employed material for the molding resin 5. Since the molding resin 5 is composed of thermosetting-type epoxy resin in general, the molding resin 5 is hardened while being injected into a thermostatic chamber.

The coefficient of thermal expansion (which is  $2$  to  $3 \times 10^{-5}/^{\circ}\text{C}$  for a usual resin) of the molding resin 5 is larger than the coefficient of thermal expansion (which is about  $1.5 \times 10^{-5}/^{\circ}\text{C}$  for FR-4, which is a typical example) of the substrate. Furthermore, the molding resin 5 is contracted by several to tens of % when hardened. Therefore, if the substrate 6, to which the molding resin 5 has been applied, is hardened as it is, the substrate 6 is warped in the shape of concave relative to the molding resin 5. However, if the molding resin 5 is

hardened in a state where the flatness-maintaining means is attached to the substrate 6, the relaxing phenomenon (the creeping phenomenon) of the viscous component of the molding resin 5 relaxes the degree of the warp of the substrate (in the foregoing state, it is the electronic part material) 6. Consequently, the warp of the substrate 6, from which the flatness-maintaining means has been removed, can be prevented satisfactorily. Therefore, an advantage can be attained in latter processes, such as the dicing process, the probing electrical characteristic inspection and the like, which require the flatness of the substrate 6. Note that also the warp of the electronic parts, which are the products, can, of course, be prevented satisfactorily.

If the flatness-maintaining means is attached to the warped substrate 6 as shown in Fig. 11 after the molding resin 5 has been hardened, and as well the substrate (the electronic part material) 6 is again heated followed by being cooled gradually, the warp of the substrate 6 can be relaxed. The foregoing process is a process generally called "annealing", which is also due to the relaxing phenomenon (the creeping phenomenon) of the viscous component of the molding resin 5. As a matter of course, combination of the process for hardening the molding resin 5, in a state where the flatness-maintaining means is attached to the substrate 6, and a process for annealing the substrate 6, in a state where the flatness-maintaining means is attached to the substrate 6, will further prevent the warp of the substrate 6.

An effective method of applying the molding resin in the method of manufacturing the electronic parts according to this embodiment will now be described. Although illustration is omitted here, the method of applying the molding resin has an arrangement that the quantity of the molding resin to be introduced (applied) into the substrate is controlled by weight. Namely, the area, to which the molding resin is applied, is

determined by the subject substrate. The specific gravity of the molding resin (the thermosetting epoxy resin) is about 1.8. Therefore, the control of the molding resin to be applied by weight will enable the thickness of the applied molding resin to be controlled. By considering the volume of the part elements to be molded, such as the semiconductor device, the thickness of the applied molding resin can be controlled accurately. Thus, the molding resin can be applied with a thickness accuracy of 0.8 mm to 0.9 mm on a substrate having a thickness of 0.4 mm. As a result, generation of cracks during the molding process can be prevented, and the thickness of the electronic part can be minimized.

Furthermore, the method of applying the molding resin according to this embodiment has the arrangement that the substrate, to which the molding resin has been applied, is held horizontally during the process for hardening the molding resin. That is, jigs for horizontally holding the substrate is used such that the molding resin is hardened in a state where the substrate is held horizontally in a thermostable chamber. As a result, the thickness of the applied molding resin for the electronic part material can be made equal. Thus, the thickness of the molding resin applied to the electronic parts obtained by cutting can be made equal, causing the thicknesses of the electronic parts to be made equal. As a means for weighing the foregoing molding resin, any of adequate balances, exemplified by an electronic balance, may be employed. As the foregoing jigs, it might be considered feasible to employ a three-point-suspension (three legs, the height of each of which can be adjusted) frame having a level.

Another embodiment of the present invention that can be applied to any of the foregoing structures of the electronic parts will now be described. Fig. 12 is a structural view of the substrate of a chip-carrier-type electronic part according

to this embodiment of the present invention. A drawing, in which two types of substrate structures are superimposed to be subjected to a comparison. Referring to Fig. 12, reference numeral 61 represents a dia-touch portion of the semiconductor device common to the two types of the substrate structure. Then, the substrate 6, the circuit patterns 3 and the through holes 7 are designated by continuous lines in a substrate structure 62, while the same are designated by an alternate long and two short dashes line in another substrate structure 63. The continuous line designates the substrate structure 62 according to this embodiment in which the four corners of the substrate 6 have through holes 7 and circuit patterns 3 that also serve as bonding pads for use in the wire bonding process. The alternate long and two short dashes line designates the conventional substrate structure 63 in which the four corners of the substrate 6 have the through holes 7 and the circuit patterns 3.

In a particular case where the semiconductor device 1 and the circuit patterns 3 are connected by lines, the number of which is four or less, the size of the electronic part is minimized and the electronic part has a regular size, it is, as can be understood from Fig. 12, advantageous to reduce the size of the substrate in a case where the through holes 7 be formed at the four corners of the substrate 6 in place of forming the same on the sides of the substrate 6 to validly use the four corners of the substrate 6, which easily become dead spaces. If the semiconductor device 1 and the circuit patterns 3 are connected by three or less lines, use of all four corners of the substrate 6 is not required. When the electronic part having the substrate structure 62 is manufactured, a substrate (substrate material) 6 having through holes (through hole material) 7 formed at intersections of imaginary lines, which become cut lines later, is prepared so that electronic part material is manufactured, followed by being cut along the imaginary lines.

Referring to Fig. 13, another manufacturing method that can be applied to any chip-carrier-type electronic part will now be described. The process for cutting the substrate 6 to be described below is performed after the semiconductor device 1 is mounted and the molding resin 5 has been applied, as described above. To simplify the description, the semiconductor device 1 and the wires 2 are omitted from illustration. Fig. 13A is a reverse view of the substrate (the substrate material) 6 for use in a chip-carrier-type electronic part according to the present invention. Fig. 13B is a plan view of the substrate 6.

Referring to Fig. 13B, reference numeral 71 represents a die pad to which the semiconductor device 1 dia-touches. The semiconductor device 1 and the circuit patterns 3 are connected to one another, followed by being connected to the reverse side of the substrate 6 by way of the through holes 7. A dashed line in Fig. 13B represents a full dicing line (an imaginary line) 91. A region surrounded by the lines 91 is the outline of the chip-carrier-type electronic part. As a matter of course, the molding resin 5 is, in the actual process, applied to the entire surface of the substrate 6, and therefore the circuit patterns 3, the through holes 7 and the like shown in Fig. 13B cannot be seen. The appearance of the reverse side of the substrate 6 shown in Fig. 13A is, before the dicing process, not changed before and after the mounting process.

As shown in Fig. 13A, the periphery of the reverse side of the substrate 6 has plating leads 92 that are connected to through holes 7. The plating leads 92 causes the circuit patterns 3 on the surface of the substrate 6, the through holes 7 and the connection lands 8 on the reverse side of the substrate 6 to be subjected to electric plating. Therefore, the plating leads 92 electrically short-circuit all of the through holes 7, the circuit patterns 3 connected to the through holes 7, and the outer wiring portions of the semiconductor device 1.

After plating has been applied, the short-circuit state is canceled by cutting the plating leads 92 by half dicing lines 90 in this embodiment. Half dicing is, in this embodiment, performed at a depth at least exceeding the thickness of the plating lead 92 and as well as smaller than the total thickness of the electronic part including the mold. In the foregoing case, it is preferable that scattering of the chip-carrier-type electronic parts occurring in the latter full dicing process be prevented by applying a sheet having adhesiveness to the surface of the molded substrate 6. Since the plating leads 92 is cut in the half dicing process, the electrical short circuit of all of the through holes 7, the circuit patterns 3 connected to the through holes 7, and the outer wiring portions of the semiconductor device 1 is canceled. Thus, the portion from the through holes 7 to the semiconductor device 1 is, similar to the final chip-carrier-type electronic part, an electronic part element that is electrically independent. As a result, by standing erect a pin probe in the through hole 7, the portion from the reverse side of the substrate 6 to the semiconductor device 1 can be electrically inspected. After the inspection has been completed, cutting along the full dicing lines 91 is performed to have the final shape of the chip-carrier-type electronic part.

As a result, the chip-carrier-type electronic part can be inspected in the state of the outline of the substrate. Therefore, the inspection and locating can easily be performed as compared with the case where an independent electronic part is inspected. The half dicing lines 90 and the full dicing lines 91 may be superimposed. That is, a similar effect can be obtained if half dicing is performed at the outline position of the final chip-carrier-type electronic parts and full dicing is performed at the same position after the parts have been inspected, followed by being manufactured to the final chip-

carrier-type electronic parts.

Half dicing may be omitted to perform full dicing along the foregoing full dicing lines 91, followed by being manufactured to the final chip-carrier-type electronic parts. Also in this case, a sheet having adhesiveness is applied to the surface of the substrate 6. As a result, scattering of the electronic parts which have been fully diced can be prevented, and as well as the plating leads 92 can be cut. Therefore, the chip-carrier-type electronic parts can be inspected in a state of the outline state of the substrate.

Although omitted from illustration, the plating leads 92 may be formed on each of the two sides of the substrate 6. In the foregoing case, local passing of the plating electric current can be restricted. Thus, the thickness of plating can be made equal. In the foregoing case, it is preferable that full dicing be directly performed.

Although the foregoing embodiments have been described about the method in which the semiconductor device is mounted on the substrate by a so-called wire bonding method, it may, of course, be mounted by another known method, such as a TAB method, a flip chip method or the like. If the semiconductor device is mounted by the flip chip method using the face-down method, the area required to arrange the wire can be reduced. Therefore, the size of the electronic part can, of course, be reduced. Furthermore, although the foregoing embodiment have been described about the structure in which the semiconductor device is mounted on the chip-carrier-type electronic part, the part to be mounted is not limited to the semiconductor device. Any element part, such as a capacitor, an inductor or the like, may be mounted. Furthermore, a plurality of elements may be mounted on the substrate according to each embodiment, as well as the single element. As a matter of course, the substrate may be used as a package on which a so-called an MCM (Multi-Chip

Module) is mounted.

Since the present invention is structured as described above, the following effects can be obtained.

Since the electronic part as claimed in claim 1 has the structure such that the surface of the molding resin is formed to be flat, the total thickness can be made equal and decreased. Furthermore, since no dam is provided, the structure can be simplified and the area of the plane shape can be reduced. In addition, the through holes are used to facilitate the electrical inspection. As a result, the electronic part can be manufactured with a low cost while reducing the size. By injecting metal material having solderbility into the through holes, a dam can be omitted from the structure and soldering facility can be improved. Thus, the size of the electronic part can be reduced, and the reliability can be improved. Similarly, the size can be reduced by providing the covering members for covering the opening portions of the through holes. In addition, the through holes are formed at the corners of the substrate so that the size of the electronic part can be reduced.

The electronic part material as claimed in claim 15 of the present invention enables a multiplicity of electronic part elements, to be formed into independent electronic parts, can be manufactured simultaneously. Furthermore, the electronic parts according to claim 2 can be manufactured (obtained by cutting) efficiently. By providing the dams for the substrate material, the molding resin can be equally and satisfactorily applied to each electronic part element. Furthermore, the provided plating leads enable each electronic part element to be simultaneously subjected to plating.

According to the method of manufacturing electronic parts as claimed in claim 30, a multiplicity of the electronic parts according to claim 2 can be manufactured simultaneously. That is, electronic parts can be efficiently manufactured with a

reduced cost while reducing the size thereof. By controlling the molding resin by weight and by hardening the same in a state where it is held horizontally, the electronic parts can be formed to have the minimum thickness while maintaining the molding reliability. When the molding resin is hardened, the flatness-maintaining means is used so that the flatness of the substrate can be maintained accurately with a simple method. Thus, the reliability of the electronic part can be improved. Furthermore, the electrical inspection can be performed in a state before cutting the same to be formed into individual electronic parts. Therefore, the inspection process can be simplified.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form can be changed in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.



WHAT IS CLAIMED IS

1. An electronic part of a leadless package type comprising:
  - a rectangular substrate having a plurality of external electrodes in the periphery thereof;
  - an element part placed on the surface of said substrate while being electrically connected to said external electrodes; and
  - molding resin for molding said element part onto the surface of said substrate,wherein the surface of said molding resin is formed to be flat, and each side surface of said molding resin and each side surface of said substrate have the same surface.
2. An electronic part according to claim 1, wherein said external electrodes are formed by cutting through holes in the axial direction of said through holes.
3. An electronic part according to claim 2, wherein said external electrodes are filled with conductive paste.
4. An electronic part according to claim 2, wherein said external electrodes are filled with metal material that has solderability.
5. An electronic part according to claim 4, wherein said metal material is solder.
6. An electronic part according to claim 4, wherein said metal material is gold.
7. An electronic part according to claim 2 further comprising a covering member for covering openings of said external electrodes formed adjacent to said molding resin,



wherein

said covering member is, by said molding resin, molded onto the surface of said substrate, and the side surfaces of said covering member are formed to have the same surface with each side surface of said molding resin and said substrate.

8. An electronic part according to claim 7 further comprising a pad disposed between said substrate and said element part and made of the same material as that of said covering member.

9. An electronic part according to claim 8, wherein said pad has a penetrating hole that penetrates said covering member, and a conductive member for conducting said element part and a circuit region of said substrate to each other is included in said penetrating hole.

10. An electronic part according to any of claims 7 to 9, wherein said covering member is an adhesive sheet.

11. An electronic part according to any of claims 7 to 9, wherein said covering member is a dry film.

12. An electronic part according to any of claims 7 to 9, wherein said covering member is a glass epoxy plate.

13. An electronic part according to any of claims 7 to 9, wherein said covering member is a ceramic plate.

14. An electronic part according to any of claims 1 to 13, wherein said external electrodes are disposed at the corners of said substrate.



15. An electronic part material comprising:  
a substrate material having through holes disposed on a lattice-like imaginary lines, said through holes being cut at lines passing through substantially the centers thereof to form external electrodes;

element parts mounted on regions of said substrate material surrounded by said imaginary lines; and

molding resin introduced into the entire surface of said substrate material to mold said element parts.

16. An electronic part material according to claim 15 further comprising dams disposed in the periphery of said substrate material to prevent discharge of said introduced molding resin.

17. An electronic part material according to claim 15 or 16 further comprising plating leads provided for said substrate material and connected to the corresponding through holes.

18. An electronic part material according to claim 17, wherein said plating leads are disposed on the two sides of said substrate material.

19. An electronic part material according to any of claims 15 to 18, wherein conductive paste is filled in each of said through holes.

20. An electronic part material according to any of claims 15 to 18, wherein metal material having solderbility is filled in each of said through holes.

21. An electronic part material according to claim 20, wherein said metal material is solder.



22. An electronic part material according to claim 20, wherein said metal material is gold.

23. An electronic part material according to according to any of claims 15 to 18 further comprising a covering material placed on the surface of said substrate material to cover an opening portion of each of said through holes, said covering material being molded by said molding resin.

24. An electronic part material according to claim 23 further comprising pads disposed between said substrate material and each element part and made of the same material as that of said covering material.

25. An electronic part material according to claim 23 or 24, wherein said covering material is an adhesive sheet.

26. An electronic part material according to claim 23 or 24, wherein said covering material is a dry film.

27. An electronic part material according to claim 23 or 24, wherein said covering material is a glass epoxy plate.

28. An electronic part material according to according to claim 23 or 24, wherein said covering material is a ceramic plate.

29. An electronic part material according to any of claims 15 to 28, wherein said through holes are formed at intersection portions of lattice-like imaginary lines.

30. A method of manufacturing electronic parts comprising:



a substrate manufacturing step for forming through holes in a substrate material along lattice-like imaginary lines, said through holes being caused to have external electrodes formed by cutting said through holes along centers thereof;

a mounting step for mounting element parts in regions of said substrate material surrounded by said imaginary lines;

a connection step for establishing the electrical connection among said element parts and the corresponding through holes;

a molding step for introducing molding resin into the entire surface of said substrate material to mold said element parts; and

a cutting step for cutting said substrate material, said molding resin and said through holes along said imaginary lines after said molding resin has been hardened.

31. A method of manufacturing electronic parts according to claim 30 further comprising a dam forming step for forming dams in the periphery of said substrate material to prevent discharge of said introduced molding resin prior to performing said molding step.

32. A method of manufacturing electronic parts according to claim 30 or 31, wherein a jig for horizontally holding said substrate material is used, and said molding resin is hardened in a state where said substrate material is held horizontally by said jig.

33. A method of manufacturing electronic parts according to claim 32, wherein said molding resin to be introduced is controlled by weight.

34. A method of manufacturing electronic parts according to any of claims 30 to 33 further comprising an injection step for



injecting conductive paste into each of said through holes prior to performing said molding step.

35. A method of manufacturing electronic parts according to claim 34, wherein said injection step is performed such that said conductive paste is injected into each of said through holes, and then said conductive paste is heated and hardened.

36. A method of manufacturing electronic parts according to any of claims 30 to 33 further comprising an injecting step for injecting metal material having solderbility into each of said through holes prior to performing said molding step.

37. A method of manufacturing electronic parts according to claim 36, wherein said metal material is solder, and said injecting step is performed such that soldering paste is injected into each of said through holes, and then said soldering paste is heated and melted.

38. A method of manufacturing electronic parts according to claim 36, wherein said metal material is solder, and said injecting step is performed such that opening portions of said through holes are brought into contact with said solder which has been melted and caused to wave.

39. A method of manufacturing electronic parts according to claim 36, wherein said metal material is solder, and said injecting step is performed such that portions of said substrate material except opening portions of said through holes are masked, and then said substrate material is immersed in molten solder.

40. A method of manufacturing electronic parts according to



claim 36, wherein said injecting step is performed such that thick plating is applied to said through holes.

41. A method of manufacturing electronic parts according to any of claims 30 to 33 further comprising:

a closing step for, by using a closing member, closing an opening portion of each of said through holes opened in the reverse surface of said substrate material prior to performing said molding step; and

an opening step for removing said closing member after said molding resin has been hardened.

42. A method of manufacturing electronic parts according to claim 41, wherein said closing member is a non-adhesive flat member that is capable of covering the entire surface of the reverse side of said substrate material, and said closing step is performed such that said flat members is pressed against the reverse side of said substrate material.

43. A method of manufacturing electronic parts according to claim 42, wherein said flat member is made of silicon rubber.

44. A method of manufacturing electronic parts according to claim 41, wherein said closing member is an adhesive sheet that is capable of covering the entire surface of the reverse side of said substrate material, and said closing step is performed by applying and bonding said adhesive sheet to the reverse side of said substrate material.

45. A method of manufacturing electronic parts according to claim 44, wherein said sheet is a ultraviolet hardening sheet, the adhesiveness of which deteriorates when irradiated with ultraviolet rays, and said ultraviolet hardening sheet is



irradiated with ultraviolet rays between said closing step and said opening step.

46. A method of manufacturing electronic parts according to claim 44, wherein said sheet is a thermosetting sheet, the adhesiveness of which deteriorates when heated, and said thermosetting sheet is heated between said closing step and said opening step.

47. A method of manufacturing electronic parts according to claim 41, wherein said closing member is made of soluble resin that is dissolved in an alkali water solution, said closing step is performed such that said soluble resin is introduced into and hardened in each of said through holes, and said opening step is performed such that said soluble resin is washed off with an alkali water solution.

48. A method of manufacturing electronic parts according to any of claims 30 to 33 further comprising a covering step for attaching, to the surface of said substrate material, a covering material for closing the opening portion of each of said through holes prior to performing said molding step.

49. A method of manufacturing electronic parts according to claim 48, wherein said covering material is an adhesive sheet, and said covering step is performed such that said adhesive sheet is applied and bonded to the surface of said substrate material.

50. A method of manufacturing electronic parts according to claim 48, wherein said covering member is a dry film, and said covering step is performed such that said dry film is applied and bonded to the surface of said substrate material.



51. A method of manufacturing electronic parts according to claim 48, wherein said covering member is a glass epoxy molded plate, and said covering step is performed such that said molded plate is bonded to the surface of said substrate material.

52. A method of manufacturing electronic parts according to claim 48, wherein said covering member is made of glass epoxy prepreg, and said covering step is performed such that said prepreg is, with heat, forcibly applied to the surface of said substrate material.

53. A method of manufacturing electronic parts according to claim 48, wherein said covering member is a ceramic molded plate, and said covering step is performed such that said molded plate is bonded to the surface of said substrate material.

54. A method of manufacturing electronic parts according to claim 48, wherein said covering member is a ceramic green sheet, and said covering step is performed such that said green sheet is, with heat, forcibly applied to the surface of said substrate material.

55. A method of manufacturing electronic parts according to any of claims 30 to 54 further comprising the steps of:

attaching, to said substrate material, flatness-maintaining means for maintaining the flatness of said substrate material prior to performing said molding step; and

removing said flatness-maintaining means prior to performing said cutting step and as well as after said molding resin has been hardened.

56. A method of manufacturing electronic parts according to



claim 55, wherein said substrate material is heated and then gradually cooled prior to removing said flatness-maintaining means and as well as after said molding resin has been hardened.

57. A method of manufacturing electronic parts according to any of claims 30 to 54 further comprising the steps of:

attaching, to said substrate material, flatness-maintaining means for maintaining the flatness of said substrate material prior to performing said cutting step and as well as after said molding resin has been hardened;

heating and gradually cooling said substrate material; and removing said flatness-maintaining means.

58. A method of manufacturing electronic parts according to any of claims 55 to 57, wherein said flatness-maintaining means comprises a flatness maintaining plate that is placed on the reverse side of said substrate material, and a holding member for holding both said flatness maintaining plate and said substrate material.

59. A method of manufacturing electronic parts according to any of claims 30 to 58, wherein said through holes and plating leads connected to the corresponding through holes are integrally formed on said substrate material in said substrate manufacturing step.

60. A method of manufacturing electronic parts according to claim 59 further comprising:

a semi-cutting step for semi-cutting said substrate material and said molding resin to separate said plating leads from said through holes prior to performing said cutting step; and

an inspection step for electrically inspecting said element parts.



61. A method of manufacturing electronic parts according to claim 60, wherein said semi-cutting in said semi-cutting step is performed along said imaginary lines.

62. A method of manufacturing electronic parts according to any of claims 30 to 61 further comprising the step of:

applying and bonding an adhesive sheet to the entire surface of either side of said substrate material prior to performing said cutting step, wherein

said cutting step is performed such that said sheet is not completely cut.