PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0004]

Patent Document 1: Japanese Patent Laid-open Publication No. 2010-254808 (CLAIMS)

Patent Document 2: Japanese Patent Laid-open Publication No. 2013-48215 (CLAIMS)

Patent Document 3: Japanese Patent Laid-open Publication No. 2013-241568 (CLAIMS)

SUMMARY

PROBLEMS TO BE SOLVED

[0005]

However, the temporary-bonding adhesive in which de-bonding can be performed only by heating like Patent Document 1 has problems that a solder bump is melted during a heating step for de-bonding, and an adhesive force during a processing step is deteriorated to cause the semiconductor to de-bond off in the middle of the step, or an adhesive force during a processing step is increased to cause the semiconductor not to de-bond off.

[0006]

The temporary-bonding adhesive like Patent Document 2 in which de-bonding off is performed by mechanically applying a

force at room temperature does not have the above-mentioned problems. However, two types of adhesive layers need to be formed, and there is a problem of putting a sizable load on the process. The temporary-bonding adhesive like Patent Document 3 is one in which de-bonding off is performed by mechanically applying a force at room temperature by a single type of adhesive layer. However, a cycloolefin-based material has a problem the material is decomposed in the semiconductor step under high-temperatures.

[0007]

In view of such situations, it is an object of the embodiments disclosed herein to provide a temporary-bonding adhesive which can bond a semiconductor circuit formation substrate and a support substrate to each other by a single type of adhesive, has excellent heat resistance and thereby does not undergo a change in the adhesive force over the course of steps for manufacturing a semiconductor device or the like, and can subsequently be easily de-bonded by applying a mechanical force or dissolving in a rework solvent at room temperature under mild conditions; an adhesive layer; a wafer work piece and a method for manufacturing a semiconductor device using the wafer work piece; a rework solvent; a polyimide copolymer; a polyimide mixed resin; and a resin composition.

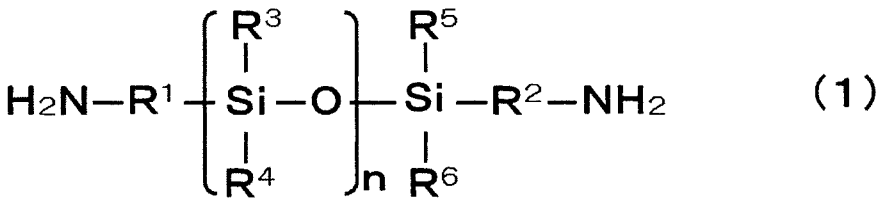
SOLUTIONS TO THE PROBLEMS

[0008]

That is, in a first aspect, there is provided a temporary-bonding adhesive, wherein the temporary-bonding adhesive is a polyimide copolymer having at least an acid dianhydride residue and a diamine residue, the diamine residue includes both of (A1) a polysiloxane-based diamine residue represented by a general formula (1) in which n is a natural number of 1 to 15, and (B1) a polysiloxane-based diamine residue represented by a general formula (1) in which n is a natural number of 16 to 100, and the polyimide copolymer contains 40 to 99.99 mol% of the (A1) residue and 0.01 to 60 mol% of the (B1) residue:

[0009]

[Chemical Formula 1]



(1)

[0010]

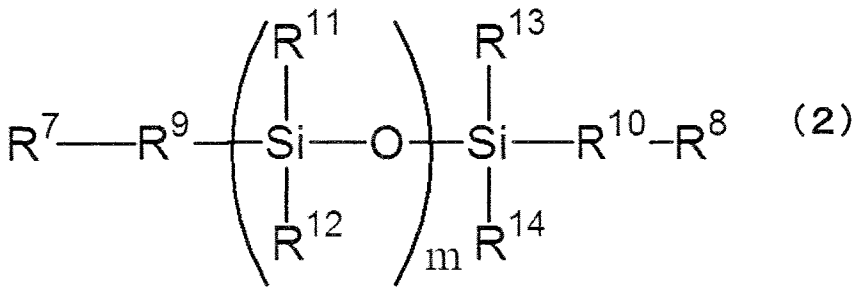
in which n is a natural number, R^1 and R^2 may be the same or different and represent an alkylene group having 1 to 30 carbon atoms or a phenylene group, and R^3 to R^6 may be the same or different and represent an alkyl group having 1 to 30 carbon atoms, a phenyl group, or a phenoxy group.

In another aspect, there is provided a temporary-bonding adhesive, wherein the temporary-bonding adhesive is a polyimide

In another aspect, there is provided a temporary-bonding adhesive, wherein the temporary-bonding adhesive is a resin composition containing (a) a resin (excluding a siloxane polymer represented by a general formula (2)), and at least one of (b-1) a siloxane polymer represented by a general formula (2) and (b-2) a compound represented by a general formula (3):

[0013]

[Chemical Formula 3]



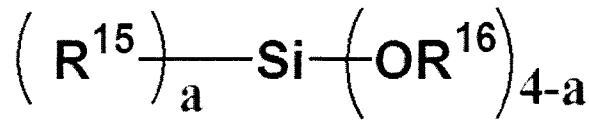
(2)

[0014]

in which m is an integer of 10 to 100, R^7 and R^8 may be the same or different and represent a monovalent organic group having 1 to 30 carbon atoms and 0 to 3 nitrogen atoms, R^9 and R^{10} may be the same or different and represent an alkylene group having 1 to 30 carbon atoms or a phenylene group, and R^{11} to R^{14} may be the same or different and represent an alkyl group having 1 to 30 carbon atoms, an alkylene group having 1 to 30 carbon atoms, an alkoxy group having 1 to 30 carbon atoms, a phenyl group, or a phenoxy group.

[0015]

[Chemical Formula 4]



(3)

[0016]

in which R^{15} represents a monovalent organic group having 2 to 20 carbon atoms and 1 to 3 nitrogen atoms, R^{16} represents hydrogen, an alkyl group having 1 to 20 carbon atoms, or an aromatic group, and a represents an integer of 0 to 4.

In another aspect, there is provided an adhesive layer obtained by forming a coating of the temporary-bonding adhesive as defined above.

[0017]

In another aspect, there is provided a wafer work piece formed by bonding a semiconductor circuit lamination substrate to a support substrate with at least the adhesive layer as defined above interposed therebetween.

[0017a] In another aspect, there is provided a wafer work piece formed by bonding a semiconductor circuit formation substrate to a support substrate with the adhesive layer as defined above interposed therebetween.

[0018]

In another aspect, there is provided a method for manufacturing a semiconductor device

using the wafer work piece as defined above including at least any one of a step of fabricating the semiconductor circuit formation substrate into a thinner one, a step of subjecting the semiconductor circuit formation substrate of the wafer work piece to device processing, a step of de-bonding off the semiconductor circuit formation substrate of the wafer work piece from a support

substrate, and a step of washing, with a solvent, an adhesive layer adhering to the semiconductor circuit formation substrate de-bonded off from the wafer work piece or the support substrate of the wafer work piece.

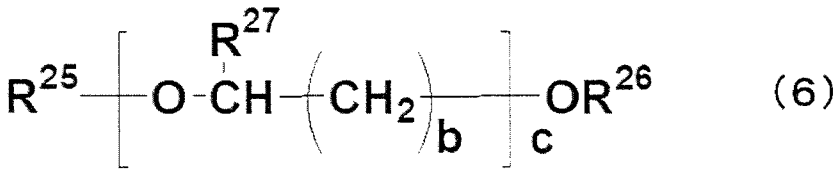
[0018a] In another aspect, there is provided a method for manufacturing a semiconductor device, wherein the step of fabricating the semiconductor circuit formation substrate into a thinner one as defined above comprises a step of fabricating a thickness of the semiconductor circuit formation substrate to at least 1 μm and at most 100 μm.

[0019]

In another aspect, there is provided a rework solvent for cleaning the adhesive layer adhering to the de-bonded semiconductor circuit formation substrate or support substrate, wherein the rework solvent contains at least (A) an amine-based solvent and (B) a solvent represented by the general formula (6):

[0020]

[Chemical Formula 5]



(6)

[0021]

in which R^{25} and R^{26} independently represent hydrogen, alkyl groups having 1 to 12 carbon atoms, an acetyl group, or aromatic

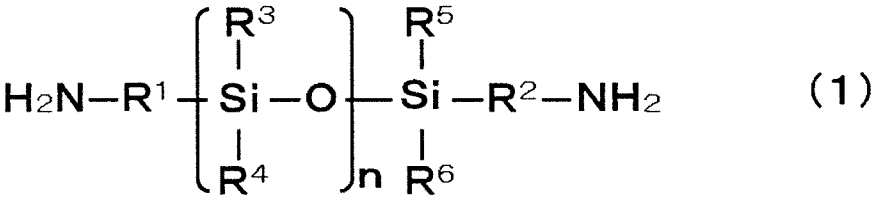
groups, R^{27} represents hydrogen or a methyl group, b is either 0, 1 or 2, and c is an integer of 1 to 3.

In another aspect, there is provided a polyimide copolymer having at least an acid dianhydride residue and a diamine residue, wherein the diamine residue includes both of (A1) a polysiloxane-based diamine residue represented by a general

formula (1) in which n is a natural number of 1 to 15, and (B1) a polysiloxane-based diamine residue represented by a general formula (1) in which n is a natural number of 16 to 100, and the polyimide copolymer contains 40 to 99.99 mol% of the (A1) residue and 0.01 to 60 mol% of the (B1) residue:

[0022]

[Chemical Formula 6]



(1)

[0023]

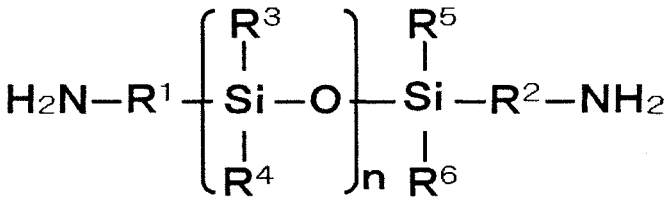
in which n is a natural number, R^1 and R^2 may be the same or different and represent an alkylene group having 1 to 30 carbon atoms or a phenylene group, and R^3 to R^6 may be the same or different and represent an alkyl group having 1 to 30 carbon atoms, a phenyl group, or a phenoxy group.

In another aspect, there is provided a polyimide mixed resin including (A2) a polyimide and/or a precursor thereof having at least an acid dianhydride residue and a diamine residue, containing a polysiloxane-based diamine residue represented by a general formula (1) in which n is a natural number of 1 to 15 and not containing a polysiloxane-based diamine residue represented by a general formula (1) in which n is a natural number of 16 to 100, and (B2) a polyimide and/or a precursor

thereof having at least an acid dianhydride residue and a diamine residue, containing a polysiloxane-based diamine residue represented by a general formula (1) in which n is a natural number of 16 to 100 and not containing a polysiloxane-based diamine residue represented by a general formula (1) in which n is a natural number of 1 to 15, and the polyimide mixed resin contains 40 to 99.99 wt% of the (A2) and 0.01 to 60 wt% of the (B2):

[0024]

[Chemical Formula 7]

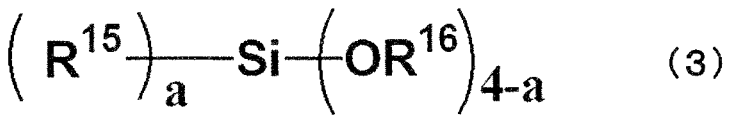


(1)

[0025]

in which n is a natural number, R^1 and R^2 may be the same or different and represent an alkylene group having 1 to 30 carbon atoms or a phenylene group, and R^3 to R^6 may be the same or different and represent an alkyl group having 1 to 30 carbon atoms, a phenyl group, or a phenoxy group.

In another aspect, there is provided a resin composition containing (a) a resin (excluding a siloxane polymer represented by a general formula (2)), and at least one of (b-1) a siloxane polymer represented by a general formula (2) and (b-2) a compound represented by a general formula (3), wherein



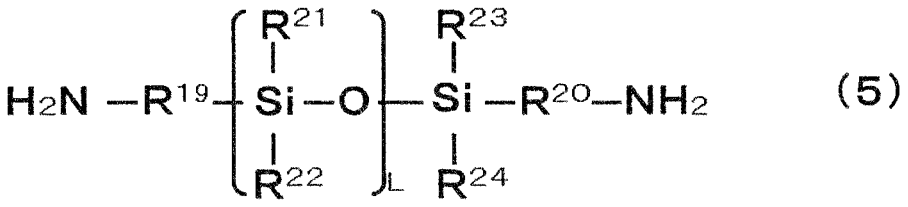
(3)

[0029]

in which R^{15} represents a monovalent organic group having 2 to 20 carbon atoms and 1 to 3 nitrogen atoms, R^{16} represents hydrogen, an alkyl group having 1 to 20 carbon atoms, or an aromatic group, and a represents an integer of 0 to 4.

[0030]

[Chemical Formula 10]



(5)

[0031]

in which L is an integer of 1 to 100, R^{19} and R^{20} may be the same or different and represent an alkylene group having 1 to 30 carbon atoms or a phenylene group, and R^{21} to R^{24} may be the same or different and represent an alkyl group having 1 to 30 carbon atoms, a phenyl group, or a phenoxy group.

EFFECTS

[0032]

According to the present disclosure, it is possible to provide a temporary-bonding adhesive having excellent heat resistance which can bond a semiconductor circuit formation