COMPOSITION, MULTILAYER BODY AND METHOD FOR PRODUCING MULTILAYER BODY

[Technical Field]

[0001] The present invention relates to a composition, a multilayer body, and a method for producing a multilayer body.

[Background Art]

[0002] The further development of integration technologies for elements such as semiconductor chips is required in view of the rising demand for reduction in size and weight and enhanced performance of electronic devices. However, the miniaturization of circuits is insufficient as a solution to meet these demands. Therefore, a technique has been proposed for increasing the level of integration by laminating multiple substrates (wafers) and elements such as semiconductors in a vertical manner to form a multilayer three-dimensional structure.

[0003] As the method for laminating the substrates (wafers) or chips (hereinafter, also referred to as "the substrate or the like"), a method of directly bonding the substrates (fusion bonding) and a method of bonding the substrates with an adhesive have been proposed.

[0004] The details of the method are found, for example, in Japanese Patent Application Laid-Open (JP-A) No. H04-132258, JP-A No. 2010-226060, JP-A No. 2016-47895, A. Bayrashev, B. Ziaie, Sensors and Actuators A 103 (2003) 16-22, and Q. Y. Tong, U. M. Gosele, Advanced Material 11, No. 17 (1999) 1409-1425.

[Summary of the Invention]

[Problem to be Solved by the Invention]

[0005] The method of bonding the substrates with an adhesive is advantageous in that the substrates are bonded at a lower temperature than in the case of fusion bonding, but there are concerns that strain stemming from a difference in the thermal expansion coefficients of an adhesive and a substrate may cause warpage or separation of the substrates. While the thermal expansion coefficient of the adhesive could be lowered by addition of an inorganic filler, the adhesion strength of the adhesive might also be lowered. Therefore, development of a material having both a low thermal expansion coefficient and a higher adhesive strength is desired.

[0006] In view of the foregoing, embodiments of the present invention is to provide a composition that has a low thermal expansion coefficient and exhibits excellent adhesive strength with respect to a substrate; a multilayer body obtained by using the composition; and a method for producing a multilayer body using the composition.

[Means for Solving the Problem]

[0007] The specific means for solving the problem includes the following aspects and embodiments.

According to a first aspect of the present invention, there is provided a composition, including:

a compound (A), having an Si-O bond and a cationic functional group that includes at least one selected from the group consisting of a primary nitrogen atom and a secondary nitrogen atom;

a compound (B), having at least three -C(=O)OX groups, wherein X is a hydrogen atom or an alkyl group with a carbon number of from 1 to 6, and from one to six of the -C(=O)OX groups is a -C(=O)OH group; and

a compound (C), having a cyclic structure and at least one primary nitrogen atom that is directly bonded to the cyclic structure,

the composition having a percentage of the primary nitrogen atom and the secondary nitrogen atom in the compound (A), with respect to a total amount of the primary nitrogen atom and the secondary nitrogen atom in the compound (A) and the primary nitrogen atom in the compound (C), of from 3 mol% to 95 mol%.

In an embodiment of the above composition, the compound (C) has two or more primary nitrogen atoms that are directly bonded to the cyclic structure.

In an embodiment of the above composition, the compound (C) has a weight average molecular weight of from 80 to 600.

In an embodiment of the above composition, the compound (A) has two alkyl groups that are bonded to an oxygen atom in the Si-O bond.

In an embodiment of the above composition, the compound (B) has a weight average molecular weight of from 200 to 600.

An embodiment of the above composition further comprises a polar solvent.

An embodiment of the above composition is used for producing a semiconductor device.

An embodiment of the above composition is used for forming a layer on a substrate or between substrates.

According to a second aspect of the present invention, there is provided a multilayer body including a substrate and a layer, the layer comprising a reaction product of:

a compound (A), having an Si-O bond and a cationic functional group that includes at least one selected from the group consisting of a primary nitrogen atom and a secondary nitrogen atom;

a compound (B), having at least three -C(=O)OX groups, wherein X is a hydrogen atom or an alkyl group with a carbon number of from 1 to 6, and from one to six of the -C(=O)OX groups is a -C(=O)OH group; and

a compound (C), having a cyclic structure and at least one primary nitrogen atom that is directly bonded to the cyclic structure,

the layer having a percentage of the primary nitrogen atom and the secondary nitrogen atom in the compound (A), with respect to a total amount of the primary nitrogen atom and the

secondary nitrogen atom in the compound (A) and the primary nitrogen atom in the compound (C), of from 3 mol% to 95 mol%.

In an embodiment of the above multilayer body, the substrate comprises a first substrate and a second substrate, and the first substrate, the layer comprising the reaction product, and the second substrate are disposed in this order.

According to a third aspect of the present invention, there is provided a method for producing a multilayer body, the method comprising forming a layer on a substrate or between substrates and curing the layer, the layer including:

a compound (A), having an Si-O bond and a cationic functional group that includes at least one selected from the group consisting of a primary nitrogen atom and a secondary nitrogen atom;

a compound (B), having at least three -C(=O)OX groups, wherein X is a hydrogen atom or an alkyl group with a carbon number of from 1 to 6, and from one to six of the -C(=O)OX groups is a -C(=O)OH group; and

a compound (C), having a cyclic structure and at least one primary nitrogen atom that is directly bonded to the cyclic structure,

the layer having a percentage of the primary nitrogen atom and the secondary nitrogen atom in the compound (A), with respect to a total amount of the primary nitrogen atom and the secondary nitrogen atom in the compound (A) and the primary nitrogen atom in the compound (C), of from 3 mol% to 95 mol%.

[Effect of the Invention]

[0008] According to embodiments of the present application, a composition that has a low thermal expansion coefficient and exhibits excellent adhesive strength with respect to a substrate; a multilayer body obtained by using the composition; and a method for producing a multilayer body using the composition are provided.

[Embodiments for Implementing the Invention]

[0009] In the present disclosure, any numerical range described using the expression “from * to” represents a range in which numerical values described before and after the “to” are included in the range as a minimum value and a maximum value, respectively.

In a numerical range described in stages, in the present disclosure, an upper limit value or a lower limit value described in one numerical range may be replaced with an upper limit value or a lower limit value in another numerical range described in stages. Further, in a numerical range described in the present disclosure, the upper limit value or the lower limit value in the numerical range may be replaced with a value shown in the Examples.

[0010] <Composition>