due to minute foreign matters generated when a chip is diced being sandwiched in a bonding interface, and conduction failure of an electrode or deteriorated reliability of a resulting laminate.

SOLUTIONS TO THE PROBLEMS

[0006]

Embodiments of the present invention are described below.

According to a first aspect of the present invention, there is provided a laminate in which

a first substrate including an exposed (A-1) metal electrode and an exposed (B-1) resin layer provided on the same face of a substrate body, and

a second substrate including an exposed (A-2) metal electrode and an exposed (B-2) resin layer, or an exposed (A-2) metal electrode and an exposed (C) inorganic insulating layer, provided on the same face of a substrate body

are laminated together such that

the (A-2) metal electrode and at least a part of the (A-1) metal electrode, and the (B-2) resin layer and at least a part of the (B-1) resin layer, or

the (A-2) metal electrode and at least a part of the (A-1) metal electrode, and the (C) inorganic insulating layer and at least a part of the (B-1) resin

layer

are directly bonded, respectively,

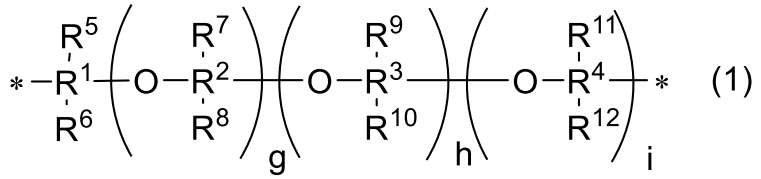
wherein at least one of the (B-1) resin layer and the (B-2) resin layer contains a resin having one or more selected from the group consisting of a carbonyl group, a hydroxy group, alkylene oxide groups, groups having a siloxane linkage, and nitrogen-containing heterocyclic rings.

In an embodiment of the above laminate, the second substrate includes the exposed (A-2) metal electrode and the exposed (B-2) resin layer provided on the same face of a substrate body.

In an embodiment of the above laminate, the alkylene oxide group is a group represented by formula (1):

[0007]

[Chem. 1]



(1)

[0008]

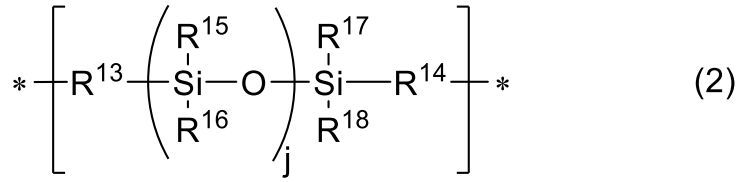
in the formula (1), R^1 to R^4 each independently represent an alkylene group having 1 to 6 carbon atoms; R^5 to R^{12} each independently represent a hydrogen atom, a fluorine atom, or an alkyl group having 1 to 6 carbon atoms; parenthesized structures are different from each other; g, h, and i each independently represent an integer

of 0 to 35, and g + h + i > 0; sign * represents a bonding site.

In an embodiment of the above laminate, the group having a siloxane linkage is a group represented by formula (2):

[0009]

[Chem. 2]



(2)

[0010]

in the formula (2), j is a natural number of 1 to 50; R^{13} and R^{14} each independently represent an alkylene group having 1 to 30 carbon atoms, an alkenylene group having 2 to 10 carbon atoms, an alkynylene group having 2 to 10 carbon atoms, or a phenylene group having 6 to 20 carbon atoms; R^{15} to R^{18} each independently represent an alkyl group having 1 to 30 carbon atoms, a phenyl group, or a phenoxy group; sign * represents a bonding site.

In an embodiment of the above laminate,

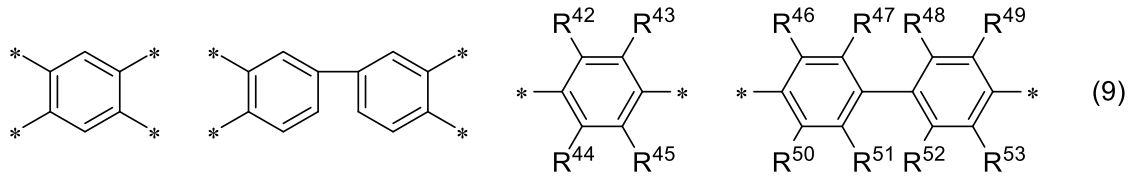
at least one of the (B-1) resin layer and the (B-2) resin layer contains one or more resins which are selected from the group consisting of polyimides, polyimide precursors, polybenzoxazoles, polybenzoxazole precursors, polyamides excluding the polyimide precursors and the polybenzoxazole precursors, and copolymers thereof and which have a group represented by the formula (1) or the

formula (2).

In an embodiment of the above laminate the resin contained in at least one of the (B-1) resin layer and the (B-2) resin layer contains two or more types of structures represented by formula (9):

[0011]

[Chem. 3]



(9)

[0012]

wherein sign * represents a bonding site; R^{42} to R^{53} each independently represent a hydrogen atom, a fluorine atom, a hydroxy group, or a hydrocarbon group having 1 to 6 carbon atoms, which may be partially or fully substituted with one or more among a fluorine atom, a hydroxy group, and a carboxyl group.

In an embodiment of the above laminate, a coefficient of thermal expansion of at least one of the (B-1) resin layer and the (B-2) resin layer in a temperature range of 50°C to 150°C is 10 ppm/K or more and 40 ppm/K or less.

In an embodiment of the above laminate, at least one of the (B-1) resin layer and the (B-2) resin layer further contains an antioxidant.

In an embodiment of the above laminate, at least one

of the (B-1) resin layer and the (B-2) resin layer forms a crosslinked structure.

In an embodiment of the above laminate, at least one of the (B-1) resin layer and the (B-2) resin layer has an elastic modulus of 1.5 GPa or more and 7 GPa or less.

In an embodiment of the above laminate, a plurality of singulated pieces of the first substrate is directly bonded onto the same face of the second substrate.

In an embodiment of the above laminate, a bonding strength between the first substrate and the second substrate as measured in a die shear test is 10 MPa or more.

In an embodiment of the above laminate, at least one of the substrate bodies of the first substrate and the second substrate contains one or more selected from the group consisting of silicon, niobium lithate, tantalum lithate, gallium nitride, silicon carbide, gallium arsenide, and indium phosphide.

According to a second aspect of the present invention, there is provided a semiconductor element including the above laminate.

According to a third aspect of the present invention, there is provided a MEMS element including the above laminate.

EFFECTS OF THE INVENTION

[0013]

The laminate according to embodiments of the present invention has high bonding strength and few voids in the boding surface, and thus has high reliability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a sectional view of a laminate produced by W2W.

Fig. 2 is a sectional view of a laminate produced by C2W.

Fig. 3 is a process diagram of the production of a laminate by W2W.

Fig. 4 is a process diagram of the production of a laminate by C2W.

EMBODIMENTS OF THE INVENTION

[0015]

The laminate of the present invention is obtained by laminating