LAMINATE, METHOD FOR MANUFACTURING LAMINATE, HOLLOW STRUCTURE, AND ELECTRONIC COMPONENT

TECHNICAL FIELD

[0001]

The present invention relates to a laminate, a method for manufacturing a laminate, a hollow structure, and an electronic component.

BACKGROUND ART

[0002]

For high speed, high quality communication by electronic devices, electronic components such as MEMS (micro electro mechanical systems) are essential technologies. As recent electronic devices become smaller, wiring designs of electronic components have become more intricate and complex.

[0003]

To realize increased design freedom of wiring designs, devices using insulating materials such as polyimide at wiring intersections have been disclosed. (Patent Documents 1-4)

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0004]

Patent document 1: Japanese Unexamined Patent Publication (Kokai) No. 2004-282707
Patent document 2: Japanese Unexamined Patent Publication (Kokai) No. HEI 5-167387
Patent document 3: Japanese Unexamined Patent Publication (Kokai) No. HEI 7-30362
Patent document 4: International Publication WO 2011/050351

SUMMARY OF INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005]

However, there have been problems with laminates using conventional insulating materials because they are highly corrosive to metal wiring under high temperature and high humidity conditions.

MEANS OF SOLVING THE PROBLEMS

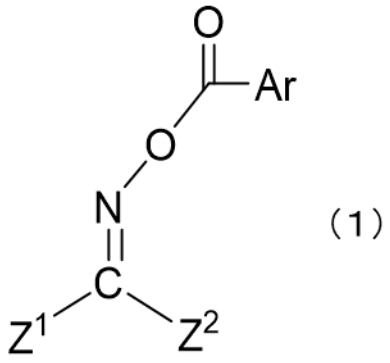
[0006]

According to a first aspect of the present invention, there is provided a laminate including:
a metal wire (M1) with a thickness of 0.1 to 5 μm,
a relief pattern of an organic insulating film (P1) with a thickness of 0.5 to 4 μm, and
a metal wire (M2) with a thickness of 0.1 to 5 μm
which are disposed in this order on a piezoelectric substrate: wherein:
the organic insulating film (P1) includes a cured product obtainable by curing a photosensitive resin composition containing an alkali soluble resin (A) and a naphthoquinone diazide compound (E),
the naphthoquinone diazide compound (E) accounting for 5 to 25 parts by mass relative to

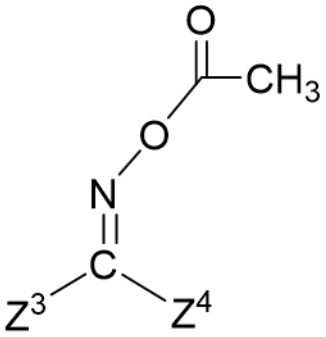
100 parts by mass of the alkali soluble resin (A), and
the ion elution quantity from the organic insulating film (P1) being 2,000 ppm or less as determined by the ion elution quantity measurement method described below:
(ion elution quantity measurement method)
the organic film is immersed in pure water with a mass ten times that of the film and then subjected to hot water extraction at 121°C for 20 hours, followed by collecting the supernatant of the extract to provide a test liquid, and the test liquid and standard solutions of the target ions are introduced into an ion chromatograph, and the concentrations of the formate ion, acetate ion, propionate ion, and sulfate ion in the test liquid are measured by the working curve based measurement method and converted to the mass of the eluted ions relative to the mass of the organic film to determine the ion elution quantity.

According to a second aspect of the present invention, there is provided a laminate including:
a metal wire (M1) with a thickness of 0.1 to 5 μm,
a relief pattern of an organic insulating film (P1) with a thickness of 0.5 to 4 μm, and
a metal wire (M2) with a thickness of 0.1 to 5 μm
which are disposed in this order on a piezoelectric substrate, wherein:
the organic insulating film (P1) includes a cured product obtainable by curing a photosensitive resin composition containing an alkali soluble resin (A), an oxime based photopolymerization initiator (B), and a radical polymerizable compound (C),
the oxime based photopolymerization initiator (B) accounting for 1 to 20 parts by mass relative to 100 parts by mass of the alkali soluble resin (A),
the oxime based photopolymerization initiator (B) containing a compound as represented by the formula (1) and a compound as represented by the formula (2),
the ratio in mass between the compound represented by the formula (1) and the compound represented by the formula (2) being 1:1 to 20:1, and
the ion elution quantity from the organic insulating film (P1) being 2,000 ppm or less as determined by the ion elution quantity measurement method described below:
(ion elution quantity measurement method)
the organic film is immersed in pure water with a mass ten times that of the film and then subjected to hot water extraction at 121°C for 20 hours, followed by collecting the supernatant of the extract to provide a test liquid, and the test liquid and standard solutions of the target ions are introduced into an ion chromatograph, and the concentrations of the formate ion, acetate ion, propionate ion, and sulfate ion in the test liquid are measured by the working curve based measurement method and converted to the mass of the eluted ions relative to the mass of the organic film to determine the ion elution quantity.

[0007]
[Chemical compound 1]

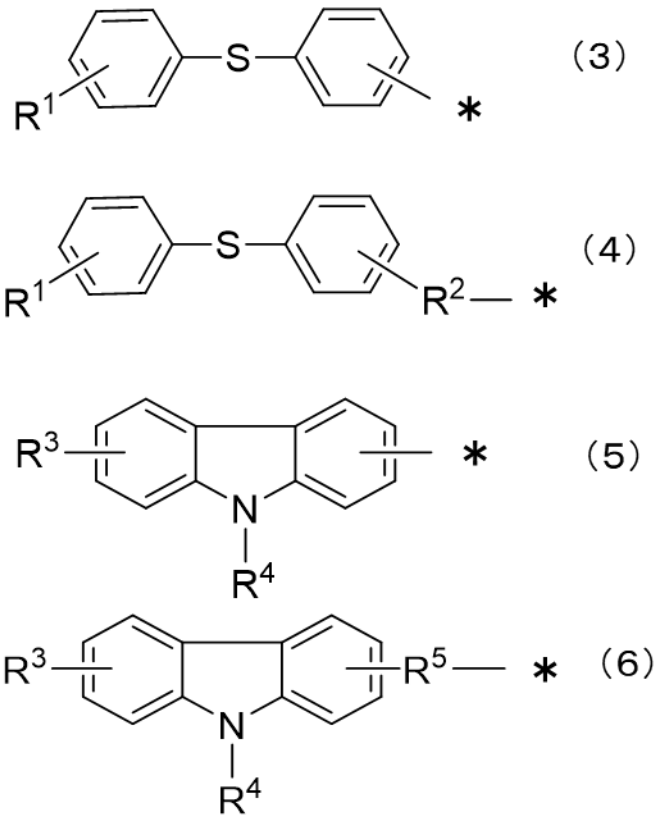


（1）



（2）

[0008]
(In the formula (1), Ar is an aryl group having 6 to 20 carbon atoms; Z^1 is an organic group as represented by any of formulas (3) to (6); and Z^2 is a hydrogen atom or a monovalent organic group having 1 to 20 carbon atoms. In the formula (2), Z^3 is an organic group as represented by any of the formulas (3) to (6), and Z^4 is a hydrogen atom or a monovalent organic group having 1 to 20 carbon atoms.)
[0009]
[Chemical compound 2]



[0010]
(In the formulas (3) to (6), R^1 and R^3 each denote a hydrogen atom or a monovalent organic group having 1 to 20 carbon atoms; R^2 and R^5 each denote a divalent organic group having 1 to 20 carbon atoms; and R^4 denotes a monovalent organic group having 1 to 20 carbon atoms.)

In an embodiment of the above aspects, the test liquid of the organic insulating film (P1) prepared above in the procedure for ion elution quantity measurement method has a conductivity of 500 μS/cm or less.

In an embodiment of the above aspects, the plane where the piezoelectric substrate is in contact with the metal wire (M1) makes an angle of 20° to 60° with the plane where the relief pattern of the organic insulating film (P1) is in contact with the metal wire (M2).

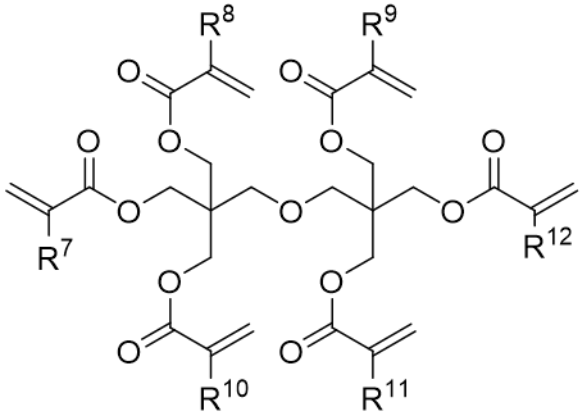
In an embodiment of the above aspects, the alkali soluble resin (A) includes at least one selected from the group consisting of polyimide, polybenzoxazole, polyamide, precursors thereof, and copolymers thereof.

In an embodiment of the second aspect, the ratio in mass between the compound represented by the formula (1) and the compound represented by the formula (2) is 4:1 to 20:1.

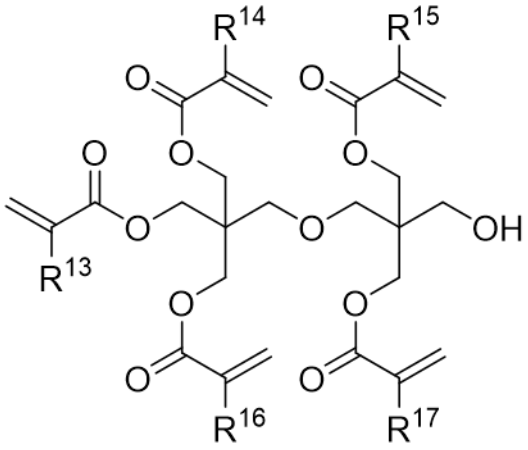
In an embodiment of the second aspect, the radical polymerizable compound (C) further includes a compound as represented by the formula (7) and a compound as represented by the formula (8), the ratio in mass between the compound represented by the formula (7) and the compound represented by the formula (8) being 1:9 to 5:5:

[0011]

[Chemical compound 3]



(7)



(8)

[0012]

wherein in the formulas (7) and (8), R^7 to R^{17} are each independently a hydrogen atom or a methyl group.

In an embodiment of the above aspects, the photosensitive resin composition contains a thermally crosslinkable compound (D), the thermally crosslinkable compound (D) including a polyfunctional epoxy group-containing compound (D-1) and a polyfunctional alkoxymethyl group-containing compound (D-2), the polyfunctional epoxy group-containing compound (D-1) accounting for 5 to 30 parts by mass relative to 100 parts by mass of the alkali soluble resin (A), and the polyfunctional alkoxymethyl group-containing compound (D-2) accounting

for 1 to 10 parts by mass relative thereto.

According to a third aspect of the present invention, there is provided a method for manufacturing a laminate including the following steps in that order:
a step (1) for forming a metal wire (M1) on a piezoelectric substrate,
a step (2) for applying a photosensitive resin composition over the piezoelectric substrate and the metal wire (M1) and drying it by heating at 80°C to 130°C to form a photosensitive resin film on the substrate,
a step (3) for exposing the photosensitive resin film to light through a mask to an exposure dose of 150 to 2,000 mJ/cm^2,
a step (4) for heating the light-exposed photosensitive resin film at 80°C to 130°C,
a step (5) for removing the unexposed regions with an alkaline aqueous solution to develop the photosensitive resin film,
a step (6) for heat-treating the developed photosensitive resin film at 200°C to 280 to form a relief pattern of an organic insulating film (P1), and
a step (7) for forming a metal wire (M2) on the piezoelectric substrate and the organic insulating film (P1).

In an embodiment of the above aspect, the thickness of the light-exposed region of the photosensitive resin film after developing for 80 seconds and that after developing for 140 seconds in the step (5) differ by 0.20 μm or less.

An embodiment of the above aspect further comprises a step (5-1) between the step (5) and the step (6) for heating the developed photosensitive resin film from a temperature of 100°C or less to a temperature of 150°C to 200°C at a heating rate of 10°C/min or more.

An embodiment of the above aspect further comprises a step (5-2) between the step (5) and the step (6) for exposing the developed photosensitive resin film to light to an exposure dose of 1,000 to 3,000 mJ/cm^2.

According to a fourth aspect of the present invention, there is provided a hollow structure comprising the laminate according to the first or second aspect, a hollow structure support member (P2), and a hollow structure roof member (P3).

In an embodiment of the above aspect, the hollow structure support member (P2) and the hollow structure roof member (P3) are organic films containing at least one alkali soluble resin (A) selected from the group consisting of polyimide, polybenzoxazole, polyamide, precursors thereof, and copolymers thereof.

In an embodiment of the above aspect, the total ion elution quantity of the organic insulating film (P1) with a thickness of 0.5 to 4 μm, the hollow structure support member (P2), and the hollow structure roof member (P3) is 2,000 ppm or less, wherein the organic insulating film (P1) with a thickness of 0.5 to 4 μm, the hollow structure support member (P2), and the hollow structure roof member (P3) are examined separately by the ion elution quantity measurement method.

[16] An electronic component comprising the hollow structure according to any one of [13] to [15].

ADVANTAGEOUS EFFECTS OF THE INVENTION

[0013]

Embodiments of the present invention serve to suppress corrosion of metal wires during storage under high temperature and high humidity conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

[Fig. 1] This is a diagram showing a laminate according to the present invention.

[Fig. 2] This is a diagram showing a cross section of a laminate according to the present invention.

[Fig. 3] This is a diagram showing a cross section of a hollow structure that contains a laminate according to the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0015]

The present invention provides a laminate comprising:
a metal wire (M1) with a thickness of 0.1 to 5 μm,
a relief pattern of an organic insulating film (P1) with a thickness of 0.5 to 4 μm, and
a metal wire (M2) with a thickness of 0.1 to 5 μm
which are disposed in this order on a piezoelectric substrate,
wherein the organic insulating film (P1) includes a cured product obtainable by curing a photosensitive resin composition containing an alkali soluble resin (A) and a naphthoquinone diazide compound (E),
the naphthoquinone diazide compound (E) accounting for 5 to 25 parts by mass relative to 100 parts by mass of the alkali soluble resin (A), and
the ion elution quantity of the organic insulating film (P1) measured by the ion elution quantity measurement method described below being 2,000 ppm or less.

[0016]

(Ion elution quantity measurement method)
The organic film is immersed in pure water with a mass ten times that of the film and then subjected to hot water extraction at 121°C for 20 hours, followed by collecting the supernatant of the extract to provide a test liquid. The test liquid and standard solutions of the target ions are introduced into an ion chromatograph, and the concentrations of the formate ion, acetate ion, propionate ion, and sulfate ion in the test liquid are measured by the working curve based measurement method and converted to the mass of each eluted ion relative to the mass of the organic film to determine the ion elution quantity.

[0017]

In cases related to measurement of the laminate according to the present invention by the ion elution quantity measurement method, the organic film refers to the organic insulating film (P1).

[0018]