

DESCRIPTION

POLISHING COMPOSITION AND METHOD FOR ADJUSTING
POLISHING SPEED

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CROSS-REFERENCE TO RELATED APPLICATION

[0001]

This application claims priority to Japanese Patent Application No. 2017-250050, the disclosure of which is incorporated herein by reference in its entirety.

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FIELD

[0002]

The present invention relates to a polishing composition and a method for adjusting polishing speed using the polishing composition.

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BACKGROUND

[0003]

In recent years, miniaturization and high integration of printed circuit boards, module boards, package boards or the like have progressed the development of minuter and higher-density wiring. Wires are overlaid into a number of layers to form an irregular profile, which needs to be removed by polishing into a flat profile.

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[0004]

Conventionally, in a printed circuit board or the like, wires formed of copper or a copper alloy are layered on an insulating substrate formed of a resin to form a conductive layer. Known as a polishing composition for polishing copper or the copper alloy is, for example, a polishing composition including abrasive grains such as colloidal silica, a copper complexing agent, alkylbenzenesulfonic acid triethanolamine, and water (Patent Literature 1).

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30

CITATION LIST

Patent Literature

[0005]

Patent Literature 1 JP 2015-090922 A

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SUMMARY

Technical Problem

[0006]

Recently, there has been a demand for polishing the resin
constituting the insulating substrate at the same time as polishing the
copper or the copper alloy. In particular, it has been demanded to
simultaneously polish the copper or the copper alloy and the resin while
adjusting the polishing speed for the copper or the copper alloy relative to the
polishing speed for the resin. However, no consideration has been
previously given on a polishing composition for simultaneously polishing the
copper or the copper alloy and the resin.

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[0007]

The present invention has been conceived in view of such
circumstances, and it is therefore an object of the present invention to
provide a polishing composition capable of adjusting the polishing speed for
copper or a copper alloy relative to the polishing speed for a resin.

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Solution to Problem

[0008]

The present inventors have found that, when a polishing composition
including alumina abrasive grains, glycine, a hydrogen peroxide solution,
and water is used to simultaneously polish copper or a copper alloy and a
resin, the polishing speed for the copper or the copper alloy relative to the
polishing speed for the resin can be adjusted by adjusting the content of the
glycine. The summary of the present invention is provided below.

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[0009]

The polishing composition according to the present invention is a polishing composition for polishing copper or a copper alloy and a resin, and includes alumina abrasive grains, glycine, a hydrogen peroxide solution, and water.

5 [0010]

It is preferable that the polishing composition according to the present invention further include an anionic surfactant.

[0011]

In the polishing composition according to the present invention, the anionic surfactant is preferably an alkylbenzenesulfonic acid.

10 [0012]

The polishing composition according to the present invention preferably has a pH of 7.0 or more and 11.0 or less.

[0013]

15 A method for adjusting a polishing speed according to the present invention uses the polishing composition according to the present invention, and includes adjusting a polishing speed for copper or a copper alloy relative to a polishing speed for a resin by adjusting the content of the glycine.

20 BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a graph showing the polishing speed for polyimide and copper when polished using a polishing composition of each of Examples, and the surface roughness of copper after being polished.

25 Fig. 2 is a graph showing the polishing speed for polyimide and copper when polished using a polishing composition of each of Comparative Examples, and the surface roughness of copper after being polished.

DESCRIPTION OF EMBODIMENTS

30 [0015]

Hereinafter, a polishing composition according to an embodiment of

the present invention will be described.

[0016]

<Polishing composition>

The polishing composition according to the embodiment of the
5 present invention includes alumina abrasive grains, glycine, a hydrogen
peroxide solution, and water.

[0017]

(Alumina abrasive grains)

The polishing composition according to this embodiment includes
10 alumina abrasive grains. The alumina abrasive grains are not particularly
limited, and may be appropriately selected from various known kinds of
alumina particles for use. Examples of such known kinds of alumina
particles include α -alumina, γ -alumina, δ -alumina, θ -alumina, η -alumina,
 κ -alumina, and χ -alumina. The examples of the known kinds of alumina
15 particles further include alumina called fumed alumina (typically alumina
fine particles produced when alumina salt is calcined at a high temperature),
and alumina called colloidal alumina or alumina sol (for example an alumina
hydrate such as boehmite), based on classification according to production
methods. These kinds of alumina particles may be individually used, or two
20 or more of them may be used in combination.

[0018]

The content of the alumina abrasive grains in the polishing
composition is preferably 0.3 mass % or more, and preferably 5.0 mass % or
less. When the content of the alumina abrasive grains falls within the
25 above range, it is possible to suppress a decrease in storage stability while
maintaining a high polishing capability. The content of the alumina
abrasive grains is more preferably 1.0 mass % or more, and more preferably
3.0 mass % or less. In the case where two or more kinds of the alumina
abrasive grains are included, the content of the alumina abrasive grains
30 shall be the total content of the two or more kinds of the alumina abrasive
grains.

[0019]

(Glycine)

The polishing composition according to this embodiment includes glycine. The polishing composition including a hydrogen peroxide solution,
5 which will be described later, can adjust the polishing speed for copper or a copper alloy relative to the polishing speed for a resin by adjusting the content of the glycine. The glycine can reduce the surface roughness of copper or a copper alloy after being polished.

[0020]

10 The content of the glycine in the polishing composition is preferably 0.3 mass % or more, and preferably 15.0 mass % or less. When the content of the glycine falls within the above range, the surface roughness of the copper or the copper alloy after being polished can be further reduced. The content of the glycine is more preferably 0.4 mass % or more, and more
15 preferably 5.0 mass % or less.

[0021]

(Hydrogen peroxide solution)

The polishing composition according to this embodiment includes a hydrogen peroxide solution. The content of the hydrogen peroxide solution
20 in the polishing composition is preferably 0.1 mass % or more and preferably 3.0 mass % or less, in terms of precisely adjusting the polishing speed for copper or a copper alloy relative to the polishing speed for a resin.

[0022]

(Anionic surfactant)

25 The polishing composition according to this embodiment may include an anionic surfactant as required. Examples of the anionic surfactant include a polyacrylic acid, an alkylbenzenesulfonic acid, an alkanesulfonic acid, and an α -olefinsulfonic acid, and salts thereof. Among these, the alkylbenzenesulfonic acid or the salt thereof is preferable. These anionic
30 surfactants may be individually used, or two or more kinds of them may be used in combination.

[0023]

Examples of the alkylbenzenesulfonic acid include alkylbenzenesulfonic acids from C6 to C20, specifically a decylbenzenesulfonic acid, a undecylbenzenesulfonic acid, a
5 dodecylbenzenesulfonic acid, a tridecylbenzenesulfonic acid, and a tetradecylbenzenesulfonic acid. Among these, the dodecylbenzenesulfonic acid is preferable in terms of the absorption speed on the surface of copper or a copper alloy and in terms of the ease of polishing. Further, examples of alkylbenzenesulfonate include sodium alkylbenzenesulfonate and
10 alkylbenzenesulfonic acid triethanolamine.

[0024]

The polishing composition according to this embodiment, which includes the glycine, may increase the polishing speed for copper or a copper alloy relative to the polishing speed for a resin. However, the polishing
15 composition according to this embodiment including an anionic surfactant causes the anionic surfactant to be absorbed on the surface of the copper or the copper alloy at the time of polishing to protect the copper or the copper alloy. As a result, an increase of the polishing speed for the copper or the copper alloy relative to the polishing speed for the resin can be suppressed.
20 Further, in the polishing composition, the anionic surfactant forms clusters by being absorbed on the surfaces of the alumina abrasive grains, to thereby improve dispersibility of the alumina abrasive grains. This can prevent the alumina abrasive grains from precipitating, and thus allows the polishing composition to be uniformly supplied on a polishing pad. The particle size
25 of the clusters formed is larger than the particle size of the alumina. This configuration enables an increased polishing speed for the resin.

[0025]

In the polishing composition, the content of the anionic surfactant is preferably 0.3 mass % or more, and preferably 3.0 mass % or less. When the
30 content of the anionic surfactant falls within the above range, an increase of the polishing speed for copper or a copper alloy relative to the polishing

speed for a resin can be further suppressed. The content of the anionic surfactant is more preferably 0.5 mass % or more, and more preferably 1.5 mass % or less. In the case where two or more kinds of the anionic surfactants are included, the content of the anionic surfactants shall be the total content of the two or more kinds of the anionic surfactants.

[0026]

(Water)

In the polishing composition according to this embodiment, the alumina abrasive grains, the glycine and the surfactant are dissolved or suspended in water. It is preferable that the water including few impurities, such as ion exchange water, be used so as not to inhibit various actions of the alumina abrasive grains, the glycine and the surfactant.

[0027]

(Defoamer)

The polishing composition according to this embodiment may include a defoamer as required. This configuration allows foaming of the polishing composition to be suppressed and allows copper or a copper alloy and a resin to be more uniformly polished. Examples of the defoamer include a silicone emulsion and a nonionic surfactant. In the polishing composition, the content of the defoamer is preferably 0.05 mass % or more, and preferably 0.3 mass % or less.

[0028]

(pH adjuster)

It is preferable that the polishing composition according to this embodiment have a pH of 7.0 or more and 11.0 or less. This configuration can improve the mechanical polishing power for a resin and increase the polishing speed for the resin. With regard to copper or a copper alloy, on the other hand, this configuration allows the anionic surfactant to be absorbed on the surface of the copper or the copper alloy to thereby suppress an increase of the polishing speed for the copper or the copper alloy. In order to adjust the pH within the above range, the polishing composition according to

this embodiment may include a pH adjuster as required. Examples of the pH adjuster include: an acid such as an organic acid or an inorganic acid; an inorganic base such as ammonia or KOH; and an organic base such as tetramethylammonium hydroxide (TMAH).

5 [0029]

The polishing composition according to the present invention is not limited to the abovementioned embodiment. Further, the polishing composition according to the present invention is not limited to the abovementioned operational effects, either. Various modifications can be made to the polishing composition according to the present invention without departing from the gist of the present invention.

[0030]

<Polishing object>

The polishing composition according to this embodiment is for polishing copper or a copper alloy and a resin. Examples of the copper or the copper alloy include copper, a tin-copper alloy, and a nickel-copper alloy. Examples of the resin include an epoxy resin, a phenol resin, and a polyimide resin.

[0031]

20 Examples of the polishing object to be polished with the polishing composition according to this embodiment include a printed circuit board, a module board, and a package board, which include the copper or the copper alloy and the resin.

[0032]

25 <Method for adjusting polishing speed>

A method for adjusting polishing speed according to this embodiment uses the aforementioned polishing composition, and includes adjusting the polishing speed for copper or a copper alloy relative to the polishing speed for a resin, by adjusting the content of the glycine. Such a configuration enables the polishing speed for the copper or the copper alloy relative to the polishing speed for the resin to be easily adjusted.

Examples

[0033]

Hereinafter, examples of the present invention will be described.

5 However, the present invention is not limited to the following examples.

[0034]

<Preparation of polishing composition>

The polishing compositions A to I (Examples) having the respective compositions shown in Table 1 and the polishing compositions a to e (Comparative Examples) having the respective compositions shown in Table 2 were prepared. The polishing compositions a to e having the respective compositions shown in Table 1 are respectively the same as the polishing compositions A to E having the respective compositions shown in Table 1, except that the polishing compositions a to e do not include any hydrogen peroxide solution but instead have an increased volume of water contained therein. Details of each component are shown below:

Alumina abrasive grains: A9225 (manufactured by Saint-Gobain K.K.)

Glycine: manufactured by FUSO CHEMICAL CO., LTD.

20 LAS: Triethanolamine dodecylbenzenesulfonate (manufactured by TOHO Chemical Industry Co., Ltd.)

Silicone-based defoamer : Silicone emulsion (manufactured by SENKA corporation)

KOH: manufactured by TOAGOSEI CO., LTD.

25 Hydrogen peroxide solution: manufactured by KANTO CHEMICAL CO., INC.

Water: ion-exchanged water

[0035]

<Measurement of pH>

30 The pH of each of the polishing compositions was measured using a pH meter.

[0036]

<Measurement of polishing speed>

Using each of the polishing compositions, a polishing object was polished under the following conditions to obtain the polishing speed. The results are shown in Tables 1 and 2, and Figs. 1 and 2.

Polishing object: Polyimide (deposited on silicon wafers), copper (plated on silicon wafers)

Polisher: FREX (manufactured by EBARA CORPORATION)

Polishing pressure: 3 psi

Slurry flow rate: 300 mL/min

Platen rotation speed / carrier rotation speed: 103 rpm / 97 rpm

Polishing time: 1 minute

Polishing pad: IC1000 (Nitta Haas Incorporated)

[0037]

<Measurement of surface roughness>

Copper was polished using each of the polishing compositions, and thereafter the surface roughness Ra of the copper was measured using a contactless surface roughness measuring instrument (Wyko NT9300 manufactured by Veeco). The measurement results are shown in Tables 1 and 2, and Figs. 1 and 2.

[0038]

<Evaluation of dispersion stability>

100 ml of each of the polishing compositions was put in a plastic container having a transparent or translucent side wall and was sufficiently stirred therein, followed by being allowed to stand at room temperature for 10 minutes to obtain a slurry of each polishing composition. Then, the slurry was visually observed to evaluate its dispersion stability. The evaluation criteria are as follows. The evaluated results are shown in Table 1.

○: It is not observed that the abrasive grains are precipitated in the lower part of the container.

×: It is observed that the abrasive grains are being precipitated in the lower part of the container.

[0039]

Table 1

Polishing composition		A	B	C	D	E	F	G	H	I
Composition (mass %)	Alumina abrasive grains	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	Glycine	0.1	0.2	0.3	0.4	0.5	0.3	0.3	0.3	0.3
	Anionic surfactant	0.5	0.5	0.5	0.5	0.5	1.0	1.5	–	–
	Defoamer	0.1	0.1	0.1	0.1	0.1	0.1	0.1	–	0.1
	pH adjuster	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Hydrogen peroxide solution	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	Water	Balance	Balance	Balance	Balance	Balance	Balance	Balance	Balance	Balance
	pH	9.3	9.1	9.1	8.8	8.7	8.9	8.9	9.4	9.4
	Polishing speed of polyimide (nm/min)	492	480	501	506	545	522	514	304	241
	Polishing speed of copper (nm/min)	161	324	397	453	608	365	392	508	488
Copper surface roughness Ra (nm)		1.3	0.9	0.5	0.7	0.6	1.0	0.7	1.1	1.0
Dispersion stability		○	○	○	○	○	○	○	×	×

[0040]

Table 2

Polishing composition		a	b	c	d	e
Composition (mass %)	Alumina abrasive grains	2.0	2.0	2.0	2.0	2.0
	Glycine	0.1	0.2	0.3	0.4	0.5
	Anionic surfactant	0.5	0.5	0.5	0.5	0.5
	Defoamer	0.1	0.1	0.1	0.1	0.1
	pH adjuster	0.1	0.1	0.1	0.1	0.1
Water		Balance	Balance	Balance	Balance	Balance
pH		9.8	9.3	9.2	9.0	8.9
Polishing speed of polyimide (nm/min)		527	493	523	500	506
Polishing speed of copper (nm/min)		58	57	53	57	56
Copper surface roughness Ra (nm)		26.8	19.5	2.3	1.6	1.9
Dispersion stability		○	○	○	○	○

5 [0041]

As shown in Table 1, the polishing compositions A to E, which meet all the requirements of the present invention, can adjust the polishing speed for the copper relative to the polishing speed for the polyimide resin, depending on the content of the glycine. The polishing compositions of C, F, G, H, and I, which meet all the requirements of the present invention, include LAS and can thereby suppress an increase of the polishing speed of

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the copper relative to the polishing speed of the polyimide resin.

[0042]

On the other hand, as shown in Table 2, the polishing compositions a to e, which do not include the hydrogen peroxide solution, cannot adjust the polishing speed for the copper relative to the polishing speed for the polyimide resin even if the content of the glycine is changed.

CLAIMS

1. A polishing composition for polishing copper or a copper alloy and a resin, the polishing composition comprising:
 - 5 alumina abrasive grains;
 - glycine;
 - a hydrogen peroxide solution; and
 - water, wherein
 - the content of the alumina abrasive grains is 3.0 mass % or less,
 - 10 the polishing composition further comprises an anionic surfactant,
 - and
 - the content of the anionic surfactant is 0.5 mass % or more.
2. The polishing composition according to claim 1, wherein the anionic
15 surfactant is an alkylbenzenesulfonic acid.
3. The polishing composition according to claim 1 or 2, having a pH of 7.0 or more and 11.0 or less.
- 20 4. A method for adjusting a polishing speed using the polishing composition according to any one of claims 1 to 3, the method comprising:
 - adjusting to increase or decrease a polishing speed for copper or a copper alloy relative to a polishing speed for a resin by accordingly adjusting to increase or decrease the content of the glycine.