

POLISHING COMPOSITION

TECHNICAL FIELD

[0001] The present invention relates to a polishing composition.

BACKGROUND ART

[0002] During polishing of a semiconductor wafer by CMP, multi-stage polishing such as three-stage or four-stage polishing is performed to achieve high-precision smoothing and planarization. The main purpose of the final-polishing step at the last stage is to reduce minute defects or surface haze (hereinafter “haze”).

[0003] A polishing composition used at the final-polishing step for a semiconductor wafer typically contains a water-soluble polymer such as hydroxyethyl cellulose (HEC). The role of the water-soluble polymer is to hydrophilize the surface of the semiconductor wafer to prevent adhering of abrasives to the surface, excessive chemical etching and/or aggregation of abrasives, for example, to reduce related damage to the semiconductor wafer. It is known that this reduces minute defects and/or haze.

[0004] A raw material for HEC is cellulose, which is a natural material, and thus HEC may contain water-insoluble impurities derived from cellulose. As such, a polishing composition containing HEC may cause minute defects due to such impurities. Another problem is associated with the fact that HECs that are typically used have molecular weights of several hundreds of thousands to several millions; the higher the molecular weight, the more likely the filter is to be clogged, and filters with smaller apertures do not allow the liquid to easily pass through. As such, when a water-soluble polymer with a large molecular weight is to be used, it is difficult to remove coarse particles. Further, such abrasives can easily aggregate, raising concerns about the long-term stability of the polishing composition.

[0005] JP 2012-216723 A discloses a polishing composition containing at least one water-soluble polymer selected from vinyl alcohol-based resins having a 1,2-diol structural unit. Since the polishing composition contains a vinyl alcohol-based resin having a 1,2-diol structural unit, the semiconductor wafer after polishing has fewer minute defects and lower surface roughness. This is presumably because introducing a modifying group with steric hindrance (i.e., 1,2-diol structure) prevents crystallization

of polyvinyl alcohol.

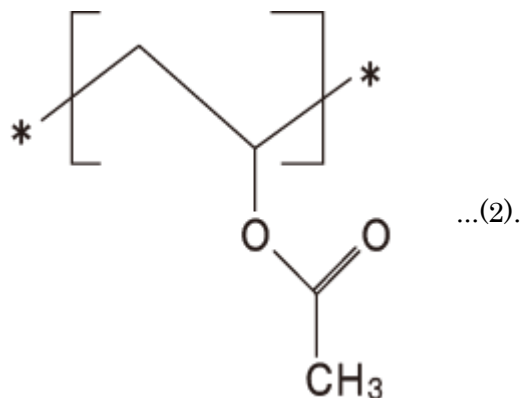
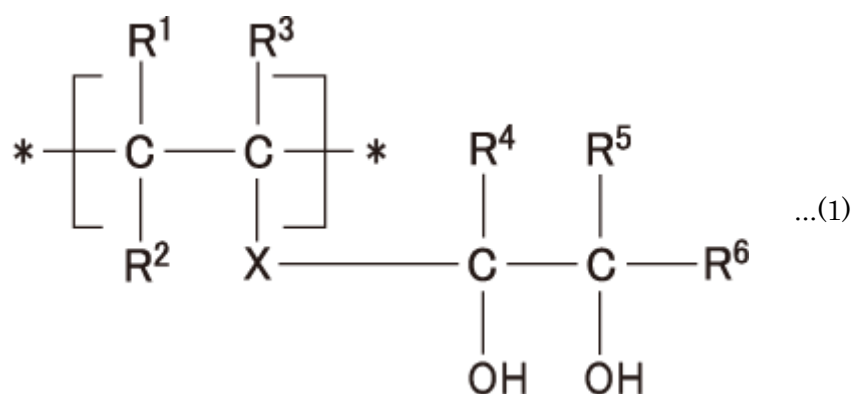
DISCLOSURE OF THE INVENTION

[0006] In recent years, design rules for semiconductor devices have become more and more miniaturization-oriented and, as a result, requirements for stricter controls of minute defects and haze on the surface of the semiconductor wafer have been presented.

[0007] An object of the present invention is to provide a polishing composition that can further reduce minute defects and haze on a semiconductor wafer after polishing.

[0008] A polishing composition according to an embodiment of the present invention contains: abrasives; a basic compound; and a vinyl alcohol-based resin having a 1,2-diol structural unit represented by the general formula (1) provided below, the vinyl alcohol-based resin containing a structural unit represented by the following general formula, (2), in a molar concentration of 2 mol% or higher relative to a total of all structural units:

[Chem. 1]



Here, each of R¹, R² and R³ independently indicates a hydrogen atom or an organic group, X indicates a single bond or a joining chain, and each of R⁴, R⁵ and R⁶ independently indicates a hydrogen atom or an organic group. [0009] The present invention will reduce minute defects and haze on a semiconductor wafer after polishing compared with conventional art.

EMBODIMENTS FOR CARRYING OUT THE INVENTION

[0010] To solve the above-stated problems, the present inventors conducted various investigations, and they obtained the following findings.

[0011] As discussed above, a water-soluble polymer is added to hydrophilize the surface of a semiconductor wafer. In this respect, it is assumed that the greater the number of hydroxyl groups, which are hydrophilic groups, the better; accordingly, the vinyl alcohol-based resin added to the polishing composition is typically a completely saponified resin (with a saponification of 98 mol% or higher).

[0012] However, the investigations by the present inventors demonstrated that, in the case of a vinyl alcohol-based resin having a 1,2-diol structural unit, using a partially saponified resin reduces minute defects and haze more significantly than using a completely saponified resin.

[0013] Although the mechanism is unclear, one factor may be that using a partially saponified resin reduces hydrogen bonding among the hydroxyl groups, which weakens the bonding between the molecules such that polymers can dissolve in water more easily, thus reducing production of undissolved matters or gelatinous foreign bodies. Another factor may be that the increased content of vinyl acetate groups, which are hydrophobic groups, strengthens hydrophobic interaction with respect to the semiconductor wafer, which increases the ability to protect the semiconductor wafer.

[0014] The present invention was made based on all these findings. A polishing composition according to an embodiment of the present invention will be described in detail below.

[0015] The polishing composition according to an embodiment of the present invention contains: abrasives; a basic compound; and a vinyl alcohol-based resin having a 1,2-diol structural unit (hereinafter referred to as “modified PVA”).

[0016] The abrasives used may be those commonly used in this field, such as

colloidal silica, fumed silica, colloidal alumina, fumed alumina and ceria, where it is particularly suitable to use colloidal silica or fumed silica. While the particle size of the abrasives is not limited to any particular value, abrasives with a secondary average particle size of 30 to 100 nm may be used, for example.

[0017] While the content of abrasives is not limited to any particular value, the content may be, for example, 0.10 to 20 mass % of the entire polishing composition. Prior to use, the polishing composition is diluted 10 to 40 times for polishing. The polishing composition according to the present embodiment is preferably diluted, prior to use, such that the concentration of abrasives is 100 to 5000 ppm (ppm by mass; the same applies hereinafter). There is a tendency that the higher the concentration of abrasives, the fewer minute defects and the less haze. The lower limit for the concentration of abrasives after dilution is preferably 1000 ppm, and more preferably 2000 ppm. The upper limit for the concentration of abrasives after dilution is preferably 4000 ppm, and more preferably 3000 ppm.

[0018] The basic compound etches the surface of the semiconductor wafer to achieve chemical polishing. The basic compound may be, for example, an amine compound or an inorganic alkali compound.

[0019] The amine compound may be, for example, a primary amine, a secondary amine, a tertiary amine, a quaternary ammonium and a hydroxide thereof, or a heterocyclic amine. Specific examples include ammonia, tetramethylammonium hydroxide (TMAH), tetraethylammonium hydroxide (TEAH), tetrabutylammonium hydroxide (TBAH), methylamine, dimethylamine, trimethylamine, ethylamine, diethylamine, triethylamine, hexylamine, cyclohexylamine, ethylenediamine, hexamethylenediamine, diethylenetriamine (DETA), triethylenetetramine, tetraethylenepentamine, pentaethylenehexamine, monoethanolamine, diethanolamine, triethanolamine, N-(β -aminoethyl)ethanolamine, anhydrous piperazine, piperazine hexahydrate, 1-(2-aminoethyl)piperazine, N-methylpiperazine, piperazine hydrochloride, guanidine carbonate, etc.

[0020] Examples of the inorganic alkali compound include alkali metal hydroxides, alkali metal salts, alkaline earth metal hydroxides, and alkaline earth metal salts. Specific examples of the inorganic alkali compound include potassium hydroxide, sodium hydroxide, potassium hydrogencarbonate, potassium carbonate, sodium hydrogencarbonate, and

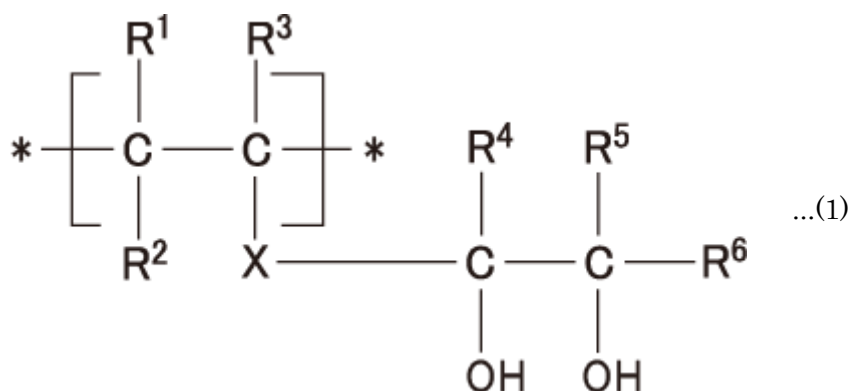
sodium carbonate.

[0021] One of these basic compounds may be used alone, or two or more thereof may be mixed for use. The particularly suitable ones of these basic compounds are alkali metal hydroxides, alkali metal salts, ammonia, amines, ammonium salts, and quaternary ammonium hydroxides.

[0022] The content of the basic compound (if two or more basic compounds are contained, their total amount) is not limited to any particular value; for example, the mass ratio of the basic compound(s) to the abrasives is 1:0.001 to 1:0.10. The polishing composition according to the present embodiment is preferably diluted, prior to use, such that the concentration of the basic compound(s) is 5 to 200 ppm.

[0023] The modified PVA is a vinyl alcohol-based resin having a 1,2-diol structural unit represented by the following general formula, (1):

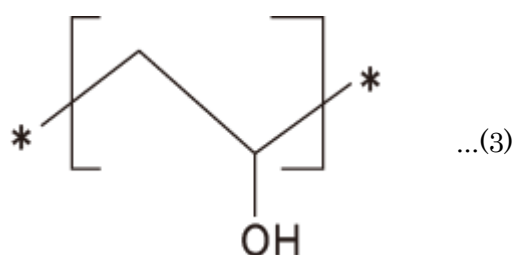
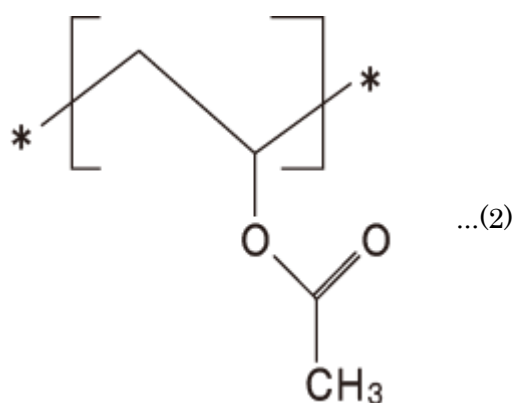
[Chem. 2]



Here, each of R¹, R² and R³ independently indicates a hydrogen atom or an organic group, X indicates a single bond or a joining chain, and each of R⁴, R⁵ and R⁶ independently indicates a hydrogen atom or an organic group.

[0024] “Vinyl alcohol-based resin” means a water-soluble polymer containing structural units represented by the following formulas, (2) and (3):

[0025] [Chem. 3]



[0026] The modified PVA has, in addition to structural units represented by formulas (2) and (3), a 1,2-diol structural unit represented by formula (1). This prevents crystallization of polyvinyl alcohol, thereby further reducing minute defects and haze on the semiconductor wafer after polishing. The amount of modification of the 1,2-diol structural unit in the polymer is not limited to any particular value, and may be 1 to 20 mol%, for example.

[0027] The most suitable modified PVAs are ones in which all of R¹ to R³ and R⁴ to R⁶ in the 1,2-diol structural unit represented by general formula (1) are hydrogen atoms and X is a single bond.

[0028] The average degree of polymerization of the modified PVA is not limited to any particular value, and may be 200 to 3000, for example. The average degree of polymerization of the modified PVA may be measured in accordance with JIS K 6726.

[0029] The content of the modified PVA (if two or more modified PVAs are contained, their total amount) is not limited to any particular value; for example, the mass ratio of the modified PVA(s) to the abrasives is 1:0.001 to 1:0.40. The lower limit for the mass ratio of the modified PVA(s) to the abrasives is preferably 0.0050, and more preferably 0.0070.

[0030] The polishing composition according to the present embodiment is preferably diluted, prior to use, such that the concentration of the modified PVA(s) is 10 to 200 ppm. There is a tendency that the higher the

[0031] The modified PVA may be manufactured by, for example, saponifying a copolymer of a vinylester-based monomer and a compound represented by the following general formula, (4).

$$\begin{array}{c} \text{R}^1 \quad \quad \text{R}^3 \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{R}^2 \quad \quad \text{X} - \text{C} - \text{C} - \text{R}^6 \\ \quad \quad \quad | \quad \quad | \\ \quad \quad \quad \text{OR}^7 \quad \text{OR}^8 \end{array} \quad \dots(4)$$

[0033] In the polishing composition according to the present embodiment, the modified PVA contains a structural unit represented by the following general formula, (2), in a molar concentration of 2 mol% or higher relative to the total of all structural units:

CC(=O)OCC(*)CC(*) ... (2)

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limit for the molar concentration of the structural unit represented by formula (2) in the modified PVA is preferably 5 mol%, and more preferably 10 mol%. On the other hand, the higher the molar concentration of the structural unit represented by formula (2) in the modified PVA, the weaker the power to hydrophilize the semiconductor wafer. The upper limit for the molar concentration of the structural unit represented by formula (2) in the modified PVA is preferably 30 mol%, and more preferably 20 mol%.

[0035] The molar concentration (mol%) of the structural unit represented by formula (2) in the modified PVA can be deemed equal to the value obtained by subtracting the degree of saponification (mol%) of the modified PVA from 100 mol%. The degree of saponification of the modified PVA is measured in accordance with JIS K 6726, similar to PVA.

[0036] The polishing composition according to the present embodiment may further contain a non-ionic surfactant. Including a non-ionic surfactant further reduces minute defects and haze.

[0037] Non-ionic surfactants suitable for the polishing composition according to the present embodiment include, for example, ethylenediaminetetrapolyoxyethylenepolyoxypropylene (poloxamine), poloxamer, polyoxyalkylene alkylether, polyoxyalkylene fatty acid ester, polyoxyalkylene alkylamine, polyoxyalkylene methylglucoside, etc.

[0038] Examples of the polyoxyalkylene alkylether include polyoxyethylene laurylether, polyoxyethylene cetylether, and polyoxyethylene stearylether. Examples of the polyoxyalkylene fatty acid ester include polyoxyethylene monolaurate and polyoxyethylene monostearate. Examples of the polyoxyalkylene alkylamine include polyoxyethylene laurylamine and polyoxyethylene oleylamine. Examples of the polyoxyalkylene methylglucoside include polyoxyethylene methylglucoside and polyoxypropylene methylglucoside.

[0039] The content of the non-ionic surfactant (if two or more such surfactants are contained, their total amount) is not limited to any particular value; for example, the mass ratio of the non-ionic surfactant(s) to the abrasives is 1:0.0001 to 1:0.015. The polishing composition according to the present embodiment is preferably diluted, prior to use, such that the content of the non-ionic surfactant(s) is 0.5 to 30 ppm.

[0040] The polishing composition according to the present embodiment may further contain a pH conditioner. The pH of the polishing composition

according to the present embodiment is preferably 8.0 to 12.0.

[0041] The polishing composition according to the present embodiment may additionally contain any ingredients that are generally known in the field of polishing compositions.

[0042] The polishing composition according to the present embodiment may be manufactured by mixing the abrasives, basic compound, modified PVA and other ingredients as appropriate, and then adding water. Alternatively, the polishing composition according to the present embodiment may be manufactured by successively mixing the abrasives, basic compound, modified PVA and other ingredients with water. These ingredients may be mixed by a means that is typically used in the technical field of polishing compositions, such as a homogenizer or ultrasonics.

[0043] The polishing composition described above is diluted with water to be in an appropriate concentration before being used to polish a semiconductor wafer.

[0044] The polishing composition according to the present embodiment is particularly suitable for final polishing of a silicon wafer.

EXAMPLES

[0045] Now, the present invention will be described more specifically using examples. The present invention is not limited to these examples.

[0046] [Polish Test 1]

Polishing compositions labeled Inventive Examples 1 to 10 and Comparative Examples 1 to 4 listed in Table 1 were prepared.

	Abrasives		Basic compound			Water-soluble polymer				Defects	Haze
	Part. size (nm)	Content (ppm)	Type	Content (ppm)	Ratio to abrasives	Type	Deg. of polymerization	*1 (mol%)	Content (ppm)	Ratio to abrasives	
Inv. Ex. 1	65	2300	NH ₄ OH	20	0.0087	mod. PVA A	450	7.0	20	0.0087	138
Inv. Ex. 2	65	2300	NH ₄ OH	20	0.0087	mod. PVA B	450	14.0	20	0.0087	137
Inv. Ex. 3	65	1100	NH ₄ OH	20	0.0182	mod. PVA B	450	14.0	20	0.0182	139
Inv. Ex. 4	65	2300	NH ₄ OH	20	0.0087	mod. PVA B	450	14.0	50	0.0217	137
Inv. Ex. 5	65	2300	NH ₄ OH	50	0.0217	mod. PVA B	450	14.0	50	0.0217	144
Inv. Ex. 6	65	2300	NH ₄ OH	80	0.0348	mod. PVA B	450	14.0	50	0.0217	151
Inv. Ex. 7	65	2300	NH ₄ OH	20	0.0087	mod. PVA C	300	11.0	20	0.0087	138
Inv. Ex. 8	65	1100	NH ₄ OH	20	0.0182	mod. PVA C	300	11.0	20	0.0182	137
Inv. Ex. 9	65	2300	NH ₄ OH	20	0.0087	mod. PVA C	300	11.0	50	0.0217	139
Inv. Ex. 10	65	2300	NH ₄ OH	20	0.0087	mod. PVA C	300	11.0	100	0.0435	139
Comp. Ex. 1	65	2300	NH ₄ OH	20	0.0087	mod. PVA D	450	<1.0	20	0.0087	144
Comp. Ex. 2	65	1100	NH ₄ OH	20	0.0182	mod. PVA D	450	<1.0	20	0.0182	145
Comp. Ex. 3	65	1100	NH ₄ OH	20	0.0182	PVA A	500	12.3	20	0.0182	160
Comp. Ex. 4	65	1100	NH ₄ OH	20	0.0182	PVA B	500	1.5	20	0.0182	154

*1: Molar concentration of structural unit represented by formula (2)

[0048] All the values of the contents shown in Table 1 are those after dilution. The abrasives used were colloidal silica. "Part. size" in Table 1 represents the average secondary particle size of the abrasives. "NH₄OH" means aqueous solution of ammonia. Modified PVAs A to D mean butenediol vinyl alcohol polymers with different degrees of polymerization and different degrees of saponification. PVA A and B mean polyvinyl alcohols with different degrees of saponification.

[0049] The polishing compositions of these Inventive and Comparative Examples were used to polish silicon wafers of 12 inches. The silicon wafers used had p-type conductivity, and had resistivities not lower than 0.1 $\Omega\cdot\text{cm}$ and lower than 100 $\Omega\cdot\text{cm}$. The plane polished was <100> plane. The polishing equipment used was SPP800S single-face polishing equipment from Okamoto Machine Tool Works, LTD. The polishing pad used was a suede pad. The polishing composition was diluted 31 times and supplied at a supply rate of 1 liter/min. Polishing was performed for two minutes, where the rotation speed of the surface plate was 40 rpm, the rotation speed of the carrier was 39 rpm, and the polishing load was 100 gf/cm². Before polishing with the polishing compositions of the inventive and comparative examples, polishing slurry NP7050S (from Nitta Haas Incorporated) was used to perform pre-polishing for three minutes.

[0050] Minute defects and haze on each silicon wafer as polished were measured. Minute defects were measured by a wafer surface tester MAGICS M5640 (from Lasertec Corporation). Haze was measured by a wafer surface tester LS 6600 (from Hitachi Engineering Co., Ltd.). The results are shown in the columns labeled "Defects" and "Haze" in Table 1 provided above.

[0051] A comparison between Inventive Example 1 and Comparative Example 1 and a comparison between Inventive Example 3 and Comparative Example 2 demonstrate a tendency that the higher the molar concentration of the structural unit represented by formula (2), the fewer minute defects and the less haze, provided that the other conditions are the same.

[0052] A comparison between Inventive Examples 2 and 4 and a comparison between Inventive Examples 7, 9 and 10 demonstrate a tendency that the higher the concentration of the modified PVA, the fewer minute defects, provided that the other conditions are the same.

[0053] A comparison between Inventive Examples 2 and 3 and a comparison

between Inventive Examples 7 and 8 demonstrate a tendency that the higher the concentration of abrasives, the fewer minute defects, provided that the other conditions are the same.

[0054] A comparison between Inventive Examples 4 to 6 demonstrates a tendency that the lower the concentration of the basic compound, the fewer minute defects and the less haze, provided that the other conditions are the same.

[0055] A comparison between Comparative Examples 3 and 4 demonstrates that, with normal PVA, increased molar concentration of the structural unit represented by formula (2) increases minute defects and haze, unlike with the modified PVA.

[0056] [Polish Test 2]

Polishing compositions labeled Inventive Examples 11 to 26 and Comparative Examples 5 to 8 shown in Tables 2 and 3 were prepared.

[0057] [Table 2]

	Abrasives		Basic compound			Water-soluble polymer					Surfactant			Defects	Haze
	Part. size (nm)	Content (ppm)	Type	Content (ppm)	Ratio to abrasives	Type	Deg. of polymerization	*1 (mol%)	Content (ppm)	Ratio to abrasives	Type	Content (ppm)	Ratio to abrasives		
Inv. Ex. 11	65	2300	NH ₄ OH	20	0.0087	mod. PVA A	450	7.0	20	0.0087	poloxamine	2.2	0.0010	131	125
Inv. Ex. 12	65	2300	NH ₄ OH	20	0.0087	mod. PVA B	450	14.0	20	0.0087	polyalcohol A	2.4	0.0010	95	124
Inv. Ex. 13	65	2300	NH ₄ OH	20	0.0087	mod. PVA C	300	11.0	20	0.0087	poloxamine	2.2	0.0010	71	123
Inv. Ex. 14	70	2300	NH ₄ OH	20	0.0087	mod. PVA C	300	11.0	20	0.0087	polyalcohol A	2.4	0.0010	88	127
Inv. Ex. 15	65	2300	NH ₄ OH	30	0.0130	mod. PVA C	300	11.0	20	0.0087	poloxamine	2.2	0.0010	71	122
Inv. Ex. 16	89	2300	NH ₄ OH	20	0.0087	mod. PVA C	300	11.0	20	0.0087	polyalcohol A	2.4	0.0010	81	125
Inv. Ex. 17	65	2300	NH ₄ OH	20	0.0087	mod. PVA C	300	11.0	20	0.0087	poloxamine	2.9	0.0013	76	123
Inv. Ex. 18	65	1700	NH ₄ OH	20	0.0118	mod. PVA C	300	11.0	20	0.0118	polyalcohol A	2.4	0.0017	76	124
Inv. Ex. 19	65	1100	NH ₄ OH	20	0.0182	mod. PVA C	300	11.0	20	0.0182	poloxamine	2.9	0.0026	88	123
Inv. Ex. 20	65	600	NH ₄ OH	20	0.0333	mod. PVA C	300	11.0	20	0.0333	polyalcohol A	2.4	0.0048	71	124
Inv. Ex. 21	65	1100	NH ₄ OH	20	0.0182	mod. PVA C	300	11.0	20	0.0182	poloxamine	2.9	0.0026	82	121
											polyalcohol B	2.4	0.0022		

*1: Molar concentration of structural unit represented by formula (2)

[0058] [Table 3]

	Abrasives		Basic compound		Water-soluble polymer					Surfactant			Defects	Haze	
	Part. size (nm)	Content (ppm)	Type	Content (ppm)	Ratio to abrasives	Type	Deg. of polymerization	*1 (mol%)	Content (ppm)	Ratio to abrasives	Type	Content (ppm)			Ratio to abrasives
Inv. Ex. 22	89	1100	NH ₄ OH	20	0.0182	mod. PVA C	300	11.0	20	0.0182	poloxamine	2.9	0.0026	80	122
											polyalcohol B	2.4	0.0022		
Inv. Ex. 23	65	1100	NH ₄ OH	20	0.0182	mod. PVA C	300	11.0	30	0.0273	poloxamine	2.9	0.0026	107	121
											polyalcohol B	2.4	0.0022		
Inv. Ex. 24	65	1100	NH ₄ OH	30	0.0273	mod. PVA C	300	11.0	20	0.0182	poloxamine	2.9	0.0026	75	122
											polyalcohol B	2.4	0.0022		
Inv. Ex. 25	65	1100	NH ₄ OH	20	0.0182	mod. PVA C	300	11.0	20	0.0182	polyalcohol B	2.4	0.0022	61	125
Inv. Ex. 26	65	1100	NH ₄ OH	20	0.0182	mod. PVA C	300	11.0	20	0.0182	polyalcohol A	2.4	0.0022	71	122
											polyalcohol B	2.4	0.0022		
Comp. Ex. 5	65	2300	NH ₄ OH	20	0.0087	mod. PVA D	450	<1.0	20	0.0087	poloxamine	2.2	0.0010	232	127
											polyalcohol A	2.4	0.0010		
Comp. Ex. 6	65	2300	NH ₄ OH	20	0.0087	mod. PVA E	2500	<2.0	20	0.0087	poloxamine	2.2	0.0010	711	128
											polyalcohol A	2.4	0.0010		
Comp. Ex. 7	65	0	NH ₄ OH	20	–	mod. PVA C	300	11.0	20	–	poloxamine	2.9	–	13653	159
											polyalcohol A	2.4	–		
Comp. Ex. 8	65	1100	NH ₄ OH	20	0.0182	PVA A	500	12.3	20	0.0182	poloxamine	2.9	0.0026	98	132
											polyalcohol A	2.4	0.0022		

*1: Molar concentration of structural unit represented by formula (2)

[0059] All the values of the contents shown in Tables 2 and 3 are those after dilution. “Poloxamine” means

ethylenediaminetetrapolyoxyethylenepolyoxypropylene with a weight-average molecular weight of 7240, “polyalcohol A” means polyoxypropylene methylglucoside with a weight-average molecular weight of 775, and “polyalcohol B” means polyoxyethylene methylglucoside with a weight-average molecular weight of 1075. The other ingredients were the same as in Table 1.

[0060] The polishing compositions labeled Inventive Examples 11 to 26 and Comparative Examples 5 to 8 were used to polish silicon wafers and minute defects and haze were measured in the same manner as in Polish Test 1.

[0061] A comparison between Inventive Examples 11 and 12 and Comparative Example 5 demonstrates a tendency that the higher the molar concentration of the structural unit represented by formula (2), the fewer minute defects and the less haze, provided that the other conditions are the same.

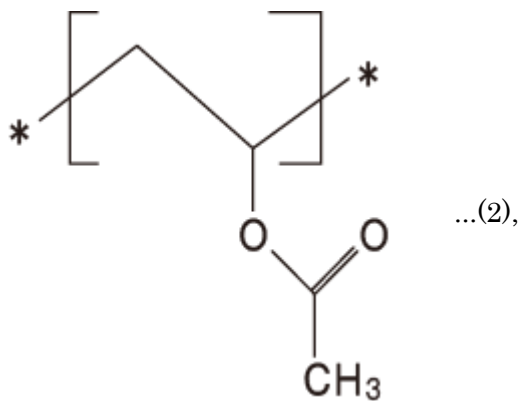
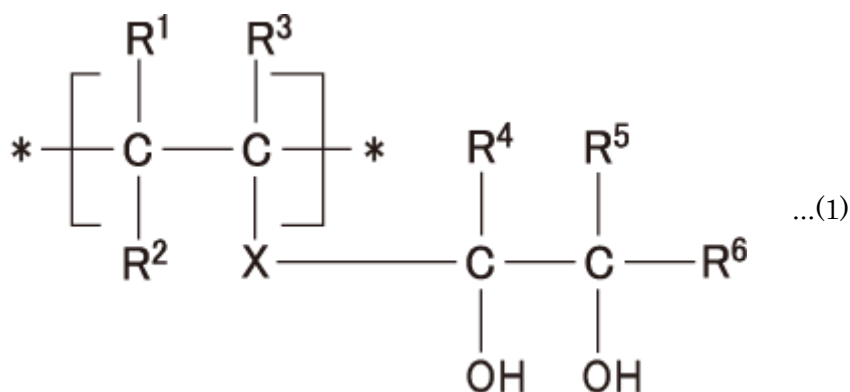
[0062] A comparison between Inventive Examples 1 to 10 and 11 to 26 demonstrates that including a non-ionic surfactant significantly reduces minute defects and haze.

[0063] Embodiments of the present invention have been described. The above-described embodiments are exemplary only, intended to allow the present invention to be carried out. Accordingly, the present invention is not limited to the above-described embodiments, and the above-described embodiments, when carried out, may be modified as appropriate without departing from the spirit of the invention.

CLAIMS

1. A polishing composition comprising:
 abrasives;
 a basic compound; and
 a vinyl alcohol-based resin having a 1,2-diol structural unit
 represented by the general formula (1) provided below,
 the vinyl alcohol-based resin containing a structural unit
 represented by the following general formula, (2), in a molar concentration of
 2 mol% or higher relative to a total of all structural units:

[Chem. 1]



where each of R¹, R² and R³ independently indicates a hydrogen atom or an organic group, X indicates a single bond or a joining chain, and each of R⁴, R⁵ and R⁶ independently indicates a hydrogen atom or an organic group.

2. The polishing composition according to claim 1, further comprising a non-ionic surfactant.

3. The polishing composition according to claim 1 or 2, wherein the basic compound is one or more selected from the group consisting of an alkali metal oxide, an alkali metal salt, ammonia, an amine, an ammonium salt, and a quaternary ammonium hydroxide.