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(54) ASSEMBLY SYSTEM FOR STATIONING SEMICONDUCTOR WAFER SUITABLE FOR PROCESSING AND PROCESS FOR MANUFACTURING SEMICONDUCTOR WAFER

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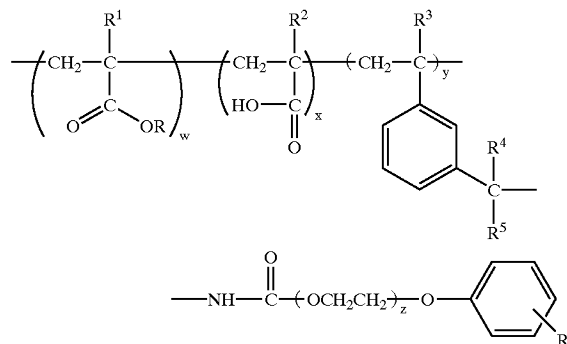
(57) **ABSTRACT**

Disclosed is an assembly system for stationing a semiconductor wafer suitable for processing said wafer, said system comprising: (a) a holding block; (b) a semiconductor wafer; and (c) an aqueous adhesive composition interposed between said ceramic block and said semiconductor wafer, said adhesive composition comprising water; at least one release agent selected from the group consisting of polyethylene glycols, fluorine-free ethoxylated surfactants, fluorosurfacants, and silicone polymers; and at least one resin selected from the group consisting of (meth)acrylic acid or (meth)acrylate based polymers, vinyl acetate polymers, rosin-modified maleic resins, novolak resins, and polymers represented by the formula



wherein each R^1, R^2, and R^3 independently is hydrogen or methyl; R is a hydrocarbyl group of 1 to 4 carbon atoms; each R^4 and R^5 independently is hydrogen or a hydrocarbyl group of 1 to 4 carbon atoms; R^6 is hydrocarbyl group of 1 to 20 carbon atoms; w, x, y, and z independently are a number from 1 to 100; wherein said adhesive composition adheres more strongly to said holding block than to said semiconductor wafer. Also disclosed is a process for manufacturing a semiconductor wafer, comprising the steps of: (a) providing a holding block; (b) providing a semiconductor wafer; (c) coating said holding block or one side of said semiconductor wafer with the foregoing aqueous adhesive composition; (d) contacting one side of said semiconductor wafer to said coated holding block or said coated side of said semiconductor wafer to said holding block, such that said semiconductor wafer adheres to said coated holding block; (e) polishing the other side of said semiconductor wafer; and (f) removing the semiconductor wafer from the coated ceramic holding block.

ASSEMBLY SYSTEM FOR STATIONING SEMICONDUCTOR WAFER SUITABLE FOR PROCESSING AND PROCESS FOR MANUFACTURING SEMICONDUCTOR WAFER

FIELD OF THE INVENTION

[0001] The present invention provides an assembly system for stationing a semiconductor wafer suitable for the processing of said wafer and also provides a process for manufacturing a semiconductor wafer.

BACKGROUND OF THE INVENTION

[0002] The ubiquitous integrated chips utilized in the making of modern electronic devices are constructed from small, fragile silicon wafers. It is imperative that these wafers possess flat, blemish-free, mirror-like surfaces, since surface imperfections can adversely affect the electrical properties of the final integrated chips.

[0003] Typically, substrate wafers are cut by diamond-sawing single crystal silicon rods. In order to ensure integrated chips of sound structural integrity, it is first necessary to remove the toughened portion of the crystal surface which was produced during the sawing procedure.

[0004] The first operation for obtaining a blemish-free surface is called "lapping". The lapping operation employs a coarse abrasive such as coarse alumina or silicon carbide abrasive particles. Lapping removes coarse surface imperfections from the sawing operation. Lapping also provides flatness and parallelism to the surface.

[0005] After the lapping operation, a series of polishing steps are employed to eliminate the remaining surface imperfections. During the polishing operation, a number of silicon wafers are typically mounted or "fixtured" onto a nonceramic (such as metal) or ceramic carrier or polishing head by a template assembly or by an adhesive material, in order to eliminate the need for manually polishing each individual wafer. The template assembly consists of impregnated polyurethane and plastic retaining rings to hold the silicon wafers in place. Adhesive materials may be a wax or a resin dissolved in a suitable solvent.

[0006] However, it is desirable to utilize water-based adhesive materials to avoid the problems associated with volatile organic solvents. Furthermore, since the adhesive materials used are derived from natural products (such as rosin), there are inconsistencies associated with batch to batch variations which makes it difficult for one to maintain a tight control on product variation. The batch to batch variation can in turn lead to adhesion problems of the semiconductor wafer to the nonceramic or ceramic carrier or polishing head, leading to wafer defects. Therefore, in order to avoid problems stemming from batch to batch variations, it is also desirable to use adhesive compositions comprising synthetic components or products. The present invention avoids the aforementioned problems in that it provides water-based adhesive compositions and utilizes synthetic components.

[0007] U.S. Pat. No. 5,942,445 discloses a method of manufacturing a semiconductor wafer comprising the steps of flattening a thin disc-shaped wafer obtained right after slicing by surface grinding, and polishing the flattened wafer on both sides simultaneously. This patent discloses the presence of a wax or like adhesive between wafer and a base plate.

[0008] U.S. Pat. No. 5,534,053 discloses a method for reducing or eliminating static charges on fixturing adhesive films and silicon wafers so treated by adding an antistatic agent to the fixturing adhesive.

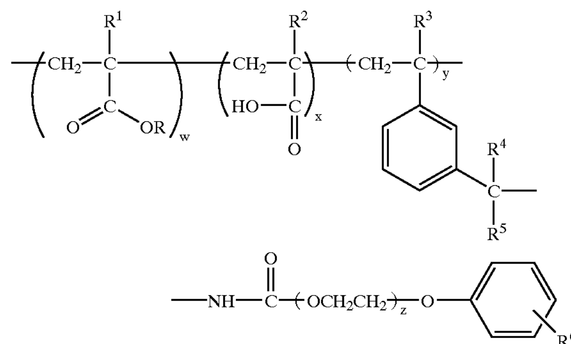
SUMMARY OF THE INVENTION

[0009] The present invention provides an assembly system for stationing a semiconductor wafer suitable for processing said wafer, said system comprising:

[0010] (a) a holding block;

[0011] (b) a semiconductor wafer; and

[0012] (c) an aqueous adhesive composition interposed between said ceramic block and said semiconductor wafer, said adhesive composition comprising water; at least one release agent selected from the group consisting of polyethylene glycols, fluorine-free ethoxylated surfactants, fluorosurfactants, and silicone polymers; and at least one resin selected from the group consisting of (meth)acrylic acid or (meth)acrylate based polymers, vinyl acetate polymers, rosin-modified maleic resins, novolak resins, and polymers represented by the formula



[0013] wherein each R^1, R^2, and R^3 independently is hydrogen or methyl; R is a hydrocarbyl group of 1 to 4 carbon atoms; each R^4 and R^5 independently is hydrogen or a hydrocarbyl group of 1 to 4 carbon atoms; R^6 is hydrocarbyl group of 1 to 20 carbon atoms; w, x, y, and z independently are a number from 1 to 100; wherein said adhesive composition adheres more strongly to said holding block than to said semiconductor wafer.

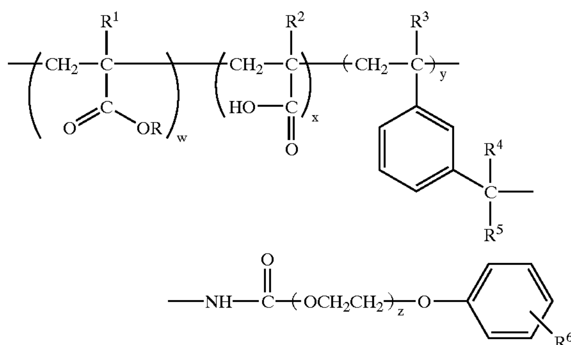
[0014] The present invention also provides a process for manufacturing a semiconductor wafer, comprising the steps of:

[0015] (a) providing a holding block;

[0016] (b) providing a semiconductor wafer;

[0017] (c) coating said holding block or one side of said semiconductor wafer with an aqueous adhesive composition comprising water; at least one release agent selected from the group consisting of polyeth-

ylene glycols, fluorine-free ethoxylated surfactants, fluorosurfacants, and silicone polymers; and at least one resin selected from the group consisting of (meth)acrylic acid or (meth)acrylate based polymers, vinyl acetate polymers, rosin-modified maleic resins, novolak resins, and polymers represented by the formula



[0018] wherein each R^1, R^2, and R^3 independently is hydrogen or methyl; R is a hydrocarbyl group of 1 to 4 carbon atoms; each R^4 and R^5 independently is hydrogen or a hydrocarbyl group of 1 to 4 carbon atoms; R^6 is hydrocarbyl group of 1 to 12 carbon atoms; w, x, y, and z independently are a number from 1 to 100;

[0019] (d) contacting one side of said semiconductor wafer (neither side of which is previously coated) to said coated holding block, or said coated side of said semiconductor wafer to said holding block (uncoated) such that said semiconductor wafer adheres to said coated holding block;

[0020] (e) polishing the other side of said semiconductor wafer; and

[0021] (f) removing the semiconductor wafer from the coated ceramic holding block.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] In one aspect, the present invention provides an assembly system for stationing a semiconductor wafer suitable for processing said wafer, said system comprising: (a) a holding block; (b) a semiconductor wafer and (c) an adhesive composition interposed between the holding block and the semiconductor wafer, wherein the adhesive composition adheres more strongly to the holding block than to the semiconductor wafer.

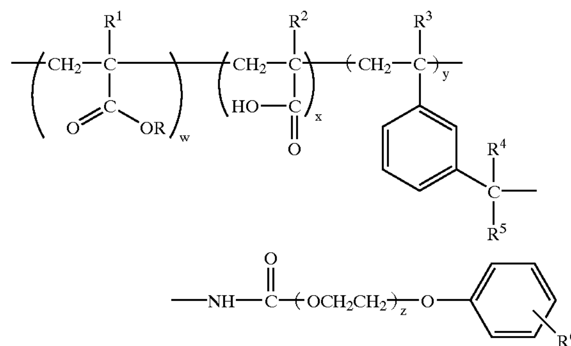
[0023] Holding Block

[0024] The holding block of the present assembly system should preferably be flat, should not warp under temperature change of 0° C. and 100° C. and should be amenable to rapid heating. In one embodiment, the holding block is made of a ceramic material, such as silicon carbide, zinc oxide, aluminum oxide, or titanium dioxide material.

[0025] Suitable examples of nonceramic materials that can be used for the holding block include metal and various polymer derived materials such as high temperature thermoset resins, Bakelite, high temperature polyimides, and highly crosslinked polyurethanes.

[0026] The Adhesive Composition

[0027] The adhesive composition of the present invention comprises water; at least one release agent selected from the group consisting of polyethylene glycols, fluorine-free ethoxylated surfactants, fluorosurfacants, and silicone polymers; and at least one resin selected from the group consisting of (meth)acrylic acid or (meth)acrylate based polymers, vinyl acetate polymers, rosin-modified maleic resins, novolak resins, and polymers represented by the formula



[0028] wherein each R^1, R^2, and R^3 independently is hydrogen or methyl; R is a hydrocarbyl group of 1 to 4 carbon atoms; each R^4 and R^5 independently is hydrogen or a hydrocarbyl group of 1 to 4 carbon atoms; R^6 is hydrocarbyl group of 1 to 20 carbon atoms, and in one embodiment 5 to 15 carbon atoms; w, x, y, and z independently are a number from 1 to 100, and in one embodiment, from 1 to 50 carbon atoms; wherein said adhesive composition adheres more strongly to said holding block than to said semiconductor wafer.

[0029] As used herein, "release agent" denotes an additive that migrates to the interface between the semiconductor wafer and adhesive composition to facilitate removal of the wafer with a minimum of adhesive transfer to the wafer.

[0030] As used herein, the term "hydrocarbyl substituent" or "hydrocarbyl group" is used in its ordinary sense, which is well known to those skilled in the art. Specifically, it refers to a group having a carbon atom directly attached to the remainder of the molecule and having predominantly hydrocarbon character. Examples of hydrocarbyl groups include:

[0031] (1) hydrocarbon substituents, that is, aliphatic (e.g., alkyl or alkenyl), alicyclic (e.g., cycloalkyl, cycloalkenyl) substituents, and aromatic-, aliphatic-, and alicyclic-substituted aromatic substituents, as well as cyclic substituents wherein the ring is completed through another portion of the molecule (e.g., two substituents together form an alicyclic radical);

[0032] (2) substituted hydrocarbon substituents, that is, substituents containing non-hydrocarbon groups which, in the context of this invention, do not alter the predominantly hydrocarbon substituent (e.g.,

halo (especially chloro and fluoro), hydroxy, alkoxy, mercapto, alkylmercapto, nitro, nitroso, and sulfoxy);

[**0033**] (3) hetero substituents, that is, substituents which, while having a predominantly hydrocarbon character, in the context of this invention, contain other than carbon in a ring or chain otherwise composed of carbon atoms. Heteroatoms include sulfur, oxygen, nitrogen, and encompass substituents as pyridyl, furyl, thienyl and imidazolyl. In general, no more than two, preferably no more than one, non-hydrocarbon substituent will be present for every ten carbon atoms in the hydrocarbyl group; typically, there will be no non-hydrocarbon substituents in the hydrocarbyl group.

[**0034**] In one embodiment, the release agent in the present aqueous adhesive composition is present at a level of from 0.05% to 20%, and in one embodiment, from 0.1 to 15%, and in one embodiment, from 0.5% to 10% by weight of the adhesive composition.

[**0035**] In one embodiment, the water present in the present aqueous adhesive composition is present at a level of 5% to 95%, and in one embodiment, from 30% to 90%, and in one embodiment, from 60% to 80% by weight of the adhesive composition.

[**0036**] In one embodiment, the resin is present at a level of 5 to 40%, and in one embodiment 10% to 30%, and in one embodiment at 15% to 25% by weight of the adhesive composition.

[**0037**] The polyethylene glycol of the present invention preferably has a weight average molecular weight (M_w) ranging from 100 to 50,000, in one embodiment from 100 to 5000, in one embodiment from 5,000 to 30,000, and in one embodiment from 100 to 500. They are available commercially, for example under the name "CRISANOL™ Polyethylene glycol" from Clariant Corporation. In one embodiment, the polyethylene glycol is present at a level of 1-15%, and in one embodiment 4-10% by weight of the adhesive composition.

[**0038**] The fluorine-free ethoxylated surfactant is not particularly limited. Some common examples include those commercially available under the name "NEODOL™" and "TERGITOL™".

[**0039**] The fluorosurfactant includes both ionic and nonionic surfactants, and include compounds having perfluoroalkyl groups. In one embodiment, the compound having the prefluoroalkyl group is represented is represented by the formula $C_nF_{2n+1}X$ wherein X is SO_2 or $(CH_2)_2OH$ and n is 4-14. Suitable nonlimiting examples include those fluorosurfactants available from Dupont under the name "ZONYL®", those available from Dainippon Ink & Chemicals, Inc., under the name "MEGAFACE™", and those available from 3M under the name "FLUORAD".

[**0040**] The silicone polymers include without limitation polydimethylsiloxane (PDMS) materials, including silicone-urethane copolymers. While not wishing to be bound by theory, it is believed that the silicone polymers migrate to the surface and act as release coats due to their low surface tension. Both "reactive" modified and "nonreactive" modified PDMS polymers can be used.

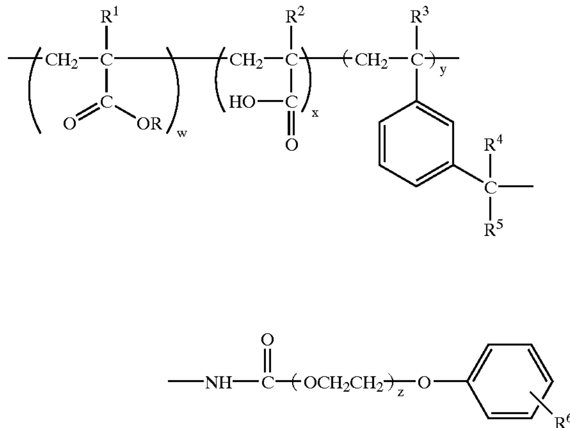
[**0041**] While not wishing to be bound by theory, it is believed that "reactive" modified PDMS materials can be chemically bonded to the adhesive matrix to provide less different adhesive properties in the bulk and at both the upper and lower bonding interfaces. "Nonreactive" modified PDMS materials include alkoxylate-modified PDMS that have limited water solubility for use in aqueous systems.

[**0042**] While not wishing to be bound by theory, it is believed that silicone—urethane copolymers (polyurethane copolymers made with dimethylsiloxane segments) give the properties of a film forming urethane with their high temperature stability combined with ultra high release properties of silicones without phase separation. Such copolymers are commercially available from Dinichiseika Color and Chemicals MFG Co. Ltd. (DNS), and from Polyurethane Specialties Co. Inc.

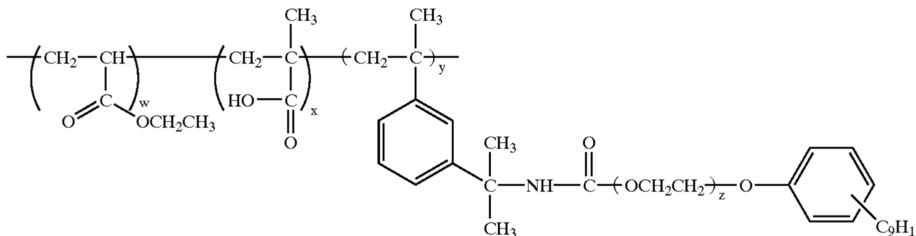
[**0043**] The (meth)acrylic acid or (meth)acrylate polymer can be any polymer comprising acrylic acid, methacrylic acid, an acrylate or a methacrylate repeating unit. In one embodiment, the (meth)acrylic acid or (meth)acrylate polymer is a styrene-acrylic acid copolymer. This copolymer preferably has a weight average molecular weight (M_w) ranging from 500 to 300,000 and in one embodiment from 500 to 2500, and in one embodiment from 500 to 50,000. They may be available commercially, for example, under the name "JONCRYL®" from S. C. Johnson Polymer. These JONCRYL® materials are usually aqueous solutions containing water, ammonium hydroxide and styrene-acrylic acid copolymers. In one embodiment, the styrene acrylic acid copolymer is present in the adhesive composition at a level of about 5 to 40% by weight of the adhesive composition.

[**0044**] The polyvinyl acetate is not limited in any way. In one embodiment, it is available as an aqueous emulsion from National Starch Chemical Corporation. In one embodiment, the vinyl acetate is a dextrin-modified polyvinyl acetate. In one embodiment, vinyl acetate polymer comprises a vinyl alcohol-vinyl acetate copolymer. These copolymers can be made by partial hydrolysis of starting polyvinyl acetate with methanol, in the presence of a suitable catalyst such as sodium hydroxide. The vinyl alcohol-vinyl acetate copolymer preferably has a weight average molecular weight (M_w) ranging from 5000 to 250,000 and in one embodiment from 10,000 to 100,000 and in one embodiment from 5,000 to 50,000. These copolymers are available commercially, for example, under the name "MOWIOL®" available from Clariant Corporation. Some preferred Mowiol copolymers include Mowiol 3-83, Mowiol 8-88, Mowiol 5-72 and Mowiol 15-20. The first number in this nomenclature relates to molecular weight and viscosity, while the second number relates to the degree of hydrolysis. For example Mowiol 3-83 is 83% hydrolyzed polyvinyl acetate, and has a P_w (weight average degree of polymerization) of 350, while Mowiol 8-88 has P_w of 1000 and is 88% hydrolyzed polyvinyl acetate.

[0045] The polymer represented by the formula



[0046] preferably is an adduct of an ethoxylated nonylphenol with poly(ethyl acrylate-co-methyacrylic acid-co-3-(1-isocyanato-1-methylethyl)-alpha-methylstyrene), said adduct being represented by the formula



[0047] wherein w, x, y, and z represent respectively the number of repeating units of ethyl acrylate, acrylic acid, 3-(1-isocyanato-1-methylethyl)-alpha-methylstyrene/ethoxylated nonylphenol adduct, as shown, and ethylene oxide. The parameters w, x, and y can be varied by one skilled in the art to obtain appropriate molecular weights of these polymers and the appropriate ratios of the various repeat units. A 25 wt % solution in water of copolymer is available from Aldrich (product number 45,815-5; viscosity 10-100 cps; bp 73° C.).

[0048] The rosin-modified maleic resin of this invention has no limitations on the kind thereof, and its commercially available products include those available under the names "MALKYD™" and "HIPARAC™", such as Malkyd No. 31 and Malkyd No. 32 (by Arakawa Chemicals Co., Ltd.), Hiparac C and Hiparac PR (by Nippon Shellac Co., Ltd.), Harimac 145P and Harimac R-120AH (by Harima Chemical Industry Co., Ltd.), etc.

[0049] The novolak resin of the present invention is not limited in any way. Preferred novolak resins include those made from ortho- and para-cresol, and in one embodiment, in order to provide enhanced aqueous base solubilities, the novolak resins are preferentially polyhydroxy-based phenolic resins.

[0050] The adhesive composition adheres more strongly to the holding block than to the semiconductor wafer. This means that the adhesive force between the holding block and the adhesive composition is stronger than that between the semiconductor wafer and the adhesive composition.

[0051] The aqueous adhesive composition of the present invention can also contain optional ingredients. Some preferred ingredients include alcohols having 2 to 5 carbon atoms, aqueous ammonium hydroxide solution and biocide compositions. Examples of suitable alcohols include ethanol, 1-propanol, 2-propanol (isopropanol), 1- and 2-butanols, and 1-, 2-, and 3-pentanols, with isopropanol being the most preferred. In one embodiment, the ammonium hydroxide is a 0.5% to 60wt % dilute solution. Examples of biocide compositions include compounds such as dimethyloxazolidine (such as 4,4-dimethyloxazolidine) and 3,44-trimethyloxalidine. In one embodiment, the biocide composition is present at a level of 0.05% to 1% by weight of the aqueous adhesive composition.

[0052] The present invention also provides a process for manufacturing a semiconductor wafer, comprising the steps of:

[0053] (a) providing a holding block;

[0054] (b) providing a semiconductor wafer;

[0055] (c) coating said holding block or one side of said semiconductor wafer with the foregoing aqueous adhesive composition;

[0056] (d) contacting the coated side of said semiconductor wafer to said holding block (uncoated) or said coated holding block to one side of the semiconductor wafer (neither side of which is previously coated), such that said semiconductor wafer adheres to said coated holding block;

[0057] (e) polishing the other uncoated side of said semiconductor wafer; and

[0058] (f) removing the semiconductor wafer from the coated ceramic holding block.

[0059] In one embodiment, prior to step (d), the coated holding block or the coated semiconductor wafer is heated at a temperature of 80-95° C., and in one embodiment, 90-95° C.

[0060] The following specific examples will provide detailed illustrations of the methods of producing and utilizing compositions of the present invention. These examples are not intended, however, to limit or restrict the scope of the invention in any way and should not be construed as providing conditions, parameters or values which must be utilized exclusively in order to practice the present invention. Unless otherwise specified, all parts and percents are by weight.

EXAMPLES

Example 1

[0061] The following adhesive compositions illustrate some typical formulations. All weights are in grams. Tables 1 and 2 below illustrate some formulations with vinyl alcohol-vinyl acetate copolymer resins.

TABLE 3

Sample No.	Joncryl Eco 84[7]	PEG 200[2]	Flourad FC-430[8]	Water
19	41.86	6.98	—	51.16
20	41.69	6.95	0.40	50.95
21	41.41	6.91	1.06	50.62
		PEG-1000		
22	42	14		44
23	42	9.3		48.7
24	42	4.7		53.3

TABLE 1

Sample No.	Mowiol[1] 8-88	Mowiol[1] 3-88	Mowiol[1] 3-83	PEG[2] 200	PEG[2] 300	PEG[2] 10K	Water	NH_4OH	Isopropyl Alcohol	Bio-Ban-CS-1135[3]
1	—	—	18.10	9.05	—	—	72.74	—		0.10
2	1.75	—	—	—	—	2.30	95.95	—		—
3	0.93	—	—	—	6.66	6.60	59.2	—	26.66	
4		19.00		5.00			76.00			
5			19.50	2.50			78.00			
6			19.75	5.00			75.25			
7			20.00				80.00			
8			18.81	4.34			75.26		1.58	
9			26.40	8.80				47.38 (1% NH_4OH)	3.31	
10			19.80	1.00			79.20			
11			19.60	2.00			78.40			
12			18.18	9.09			72.73			
13			18.10	9.00			72.40		0.50	
14			19.49	1.99			77.97		0.55	
15			19.30	1.97			77.21		1.52	
16			18.10	9.05			72.75			0.10
	Mowiol 5-72 (18.10%)	Mowiol 15-20								
17	14.89		7.72				77.72			
18		60.00	8.67				31.33			

[0062]

TABLE 2

Sample No.	Mowiol 3-83[1]	Megaface R-08[4]	F242T[5]	Tergitol NP-4[6]	Water
38	99.90	0.100	—	—	—
39	99.75	0.25	—	—	—
40	80.00	4.00	—	—	16.00
41	99.75	—	0.25	—	—
42	99.50	—	0.50	—	—
43	80.00	—	4.00	—	16.00
44	99.90	—	—	0.10	—
45	99.75	—	—	0.25	—
46	80.00	—	—	4.00	16.00

[0063] Tables 3 and 4 below illustrate some formulations with styrene-acrylic acid copolymer resins.

[0064]

TABLE 4

Sample No.	Joncryl Eco 84[7]	Megaface R-08[4]	Water
29	49.98	0.050	49.98
30	49.94	0.12	49.94
31	44.44	2.22	53.33
		F-242T[5]	
32	49.94	0.12	49.94
33	49.88	0.25	49.88
34	44.44	2.22	53.33
		Tergitol NP-4[6]	
35	49.98	0.05	49.98
36	49.94	0.12	49.94
37	44.44	2.22	53.33

[0065] Table 5 below illustrates some formulations with adduct of ethoxylated nonylphenol with poly(ethyl acrylate-

co-methyacrylic acid-co-3-(1-isocyanato-1-methylethyl)-alpha-methylstyrene).

TABLE 5

Sample No.	Poly Ac Co[9]	PEG 10K[2]	PEG 300[2]	Water	Isopropanol
25	3.80	9.60	—	48.10	38.50
26	2.20	5.40	43.50	27.30	21.70
27	6.25	6.25	12.50	25.00	50.00
28	48.90	—	—	—	32.52

*Also contains 2.45% Aquanol P-1 (an aqueous vinyl alcohol-vinyl acetate copolymer) and 0.22% aqueous NH_4OH.
[1]Vinyl acetate-vinyl alcohol copolymer from Clariant Corporation;
[2]polyethylene glycols; molecular weight as indicated (200, 300, 10,000);
[3]biocide composition from Angus Chemical Co.; contains 4,4-dimethyloxazolidine; 3,4,4-trimethyloxazolidine; 2-amino-2-methyl-1-propanol;
[4]flurosurfactant containing a perfluroalkyl group; from Dai Nippon International Corporation
[5]silicone polyethoxylate from Shin-Etsu
[6]nonylphenol polyethoxylate from Union Carbide; (alternatively, "Surfynol 440", a linear ethoxylate from Union Carbide can be used).
[7]aqueous solution of styrene-acrylic acid copolymer and ammonium hydroxide solution; from S.C. Johnson Polymer;
[8]flurosurfactant containing a perfluroalkyl group; from 3M;
[9]adduct of ethoxylated nonylphenol with poly[ethyl acrylate-co-methyacrylicacid-co-3-(1-isocyanato-1-methylethyl)-alpha-methylstyrene]; from Aldrich (Cat. No. 45,815-5)

Example 2

[0066] Basic Process for Applying Adhesive Composition to Holding Block and Ceramic Wafer

[0067] The adhesive composition is applied to the holding block by spin coating using spray, puddle coating or other solvent based dispense methods. The coated holding block is dried by heating (90-95° C.) the block by hot plate, infrared heaters or forced hot air dryers. Unpolished wafers are adhered to the adhesive by pressing the warm coated block onto the wafer. Adhesion is assisted by applying pressure to the assembly or pulling vacuum on the system while allowing the wafer/adhesive/holding block "sandwich" to cool.

[0068] The cooled wafer is polished by means of aqueous slurries containing polishing abrasives known to those skilled in the art. These may include, but are not limited to, quartz, pumice, silicon carbide etc. or mixtures thereof. The wafer is polished in a series of finer polishes until the desired surface polish is achieved.

[0069] The polished wafer/adhesive/holding block array is then rinsed with cold water and air dried with spinning. The polished wafer is finally removed by separating the wafer from the adhesive which essentially remains attached to the holding block. The separation can be accomplished by application of a blade or several blades to the interface between the wafer and the adhesive and exerting enough force to make a clean separation without deforming or breaking the wafer. Any adhesive that remains adhered to the unpolished side of the wafer can be removed/cleaned with a suitable cleaning solution.

[0070] Each of the documents referred to above is incorporated herein by reference. Except in the Examples, or where otherwise explicitly indicated, all numerical quantities in this description specifying amounts of materials, reaction conditions, molecular weights, number of carbon atoms, and the like, are to be understood as modified by the word "about."

[0071] While the invention has been explained in relation to its preferred embodiments, it is to be understood that various modifications thereof will become apparent to those skilled in the art upon reading the specification. Therefore, it is to be understood that the invention disclosed herein is intended to cover such modifications as fall within the scope of the appended claims.

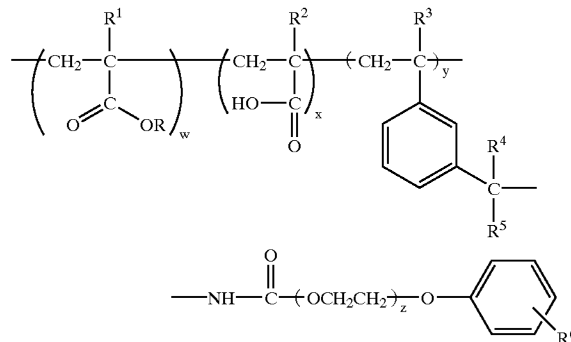
What is claimed is:

1. An assembly system for stationing a semiconductor wafer suitable for processing said wafer, said system comprising:

(b) a holding block

(b) a semiconductor wafer; and

(c) an aqueous adhesive composition interposed between said ceramic block and said semiconductor wafer, said adhesive composition comprising water; at least one release agent selected from the group consisting of polyethylene glycols, fluorine-free ethoxylated surfactants, fluorosurfacants, and silicone polymers; and at least one resin selected from the group consisting of (meth)acrylic acid or (meth)acrylate based polymers, vinyl acetate polymers, rosin-modified maleic resins, novolak resins, and polymers represented by the formula



wherein each R^1, R^2, and R^3 independently is hydrogen or methyl; R is a hydrocarbyl group of 1 to 4 carbon atoms; each R^4 and R^5 independently is hydrogen or a hydrocarbyl group of 1 to 4 carbon atoms; R^6 is hydrocarbyl group of 1 to 20 carbon atoms; w, x, y, and z independently are a number from 1 to 100; wherein said adhesive composition adheres more strongly to said holding block than to said semiconductor wafer.

2. The assembly system of claim 1, wherein the release agent is present at a level of about 0.05% to about 20% by weight of the adhesive composition.

3. The assembly system of claim 1, wherein the resin is present at a level of about 5% to about 40% by weight of the adhesive composition.

4. The assembly system of claim 1, wherein water is present at a level of about 5% to about 95% by weight of the adhesive composition.

5. The assembly system of claim 1, wherein the fluorosurfactant is a compound having a perfluoroalkyl group, said compound being represented by the formula $C_nF_{2n+1}X$ wherein X is SO_2 or $(CH_2)_2OH$; and n is about 4-14.

6. The assembly system of claim 1, wherein the (meth) acrylic acid or (meth)acrylate based polymer is a styrene-acrylic acid copolymer.

7. The assembly system of claim 1, wherein the vinyl acetate polymer is a vinyl alcohol-vinyl acetate copolymer.

8. The assembly system of claim 7, wherein the vinyl alcohol-vinyl acetate copolymer has a weight average molecular weight (M_w) of about 5,000 to about 250,000.

9. The assembly system of claim 1, wherein the adhesive composition further comprises at least one of the following components: an alcohol having about 2 to 5 carbon atoms, an aqueous ammonium hydroxide solution, and a biocide composition.

10. The assembly system of claim 9, wherein the alcohol is isopropanol.

11. The assembly system of claim 9, wherein the biocide composition comprises at least one compound selected from the group consisting of dimethyloxazolidine and 3,4,4-trimethyloxazolidine.

12. The assembly system of claim 1, wherein the release agent is polyethylene glycol and the resin is a (meth)acrylic acid or (meth)acrylate based polymer.

13. The assembly system of claim 12, wherein the (meth) acrylic acid or (meth)acrylate based polymer is a styrene-acrylic acid copolymer.

14. The assembly system of claim 1, wherein the release agent is polyethylene glycol and the resin is a vinyl acetate polymer.

15. The assembly system of claim 14, wherein the vinyl acetate polymer is a vinyl acetate-vinyl alcohol copolymer.

16. The assembly system of claim 1, wherein the adhesive composition comprises, by weight, about 5% to about 95% water, about 0.05% to about 20% of polyethylene glycol having a weight average molecular weight (M_w) of about 100 to 5000, and about 5% to about 40% of styrene-acrylic acid copolymer having a weight average molecular weight (M_w) of about 500 to about 50,000.

17. The assembly system of claim 16, wherein the styrene-acrylic acid copolymer has a weight average molecular weight (M_w) of about 500 to about 2500.

18. The assembly system of claim 1, wherein the adhesive composition comprises, by weight, about 5% to about 95% water, about 0.05% to about 20% of polyethylene glycol having a weight average molecular weight (M_w) of about 100 to 5000, about 5% to about 40% of vinyl alcohol-vinyl acetate copolymer having a weight average molecular weight (M_w) of about 5000 to 50,000, and 0.05% to 1% of a biocide composition comprising dimethyloxazolidine and 3,4,4-trimethyloxazolidine.

19. The assembly system of claim 1, wherein the holding block is a ceramic holding block.

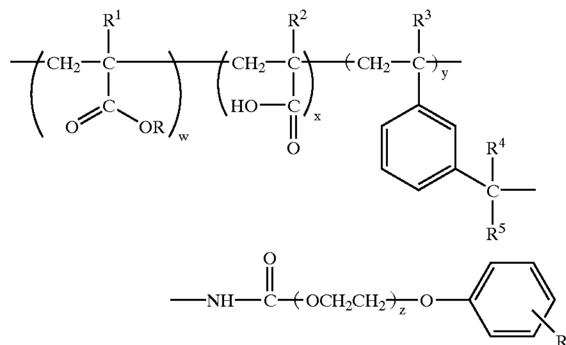
20. The assembly system of claim 19, wherein the ceramic holding block comprises a silicon carbide, zinc oxide, aluminum oxide, or titanium dioxide material.

21. A process for manufacturing a semiconductor wafer, comprising the steps of:

(a) providing a holding block;

(b) providing a semiconductor wafer;

(c) coating said holding block with an aqueous adhesive composition comprising water; at least one release agent selected from the group consisting of polyethylene glycols, fluorine-free ethoxylated surfactants, fluorosurfacants, and silicone polymers; and at least one resin selected from the group consisting of (meth) acrylic acid or (meth)acrylate based polymers, vinyl acetate polymers, rosin-modified maleic resins, novolak resins, and polymers represented by the formula



wherein each R^1, R^2, and R^3 independently is hydrogen or methyl; R is a hydrocarbyl group of 1 to 4 carbon atoms; each R^4 and R^5 independently is hydrogen or a hydrocarbyl group of 1 to 4 carbon atoms; R^6 is hydrocarbyl group of 1 to 20 carbon atoms; w, x, y, and z independently are a number from 1 to 100;

(d) contacting one side of said semiconductor wafer to said coated holding block, such that said semiconductor wafer adheres to said coated holding block;

(e) polishing the other side of said semiconductor wafer; and

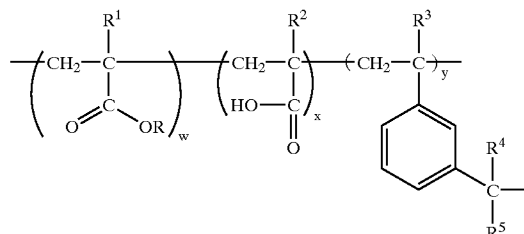
(f) removing the semiconductor wafer from the coated ceramic holding block.

22. A process for manufacturing a semiconductor wafer, comprising the steps of:

(a) providing a holding block;

(b) providing a semiconductor wafer;

(c) coating one side of said semiconductor wafer with an aqueous adhesive composition comprising water; at least one release agent selected from the group consisting of polyethylene glycols, fluorine-free ethoxylated surfactants, fluorosurfacants, and silicone polymers; and at least one resin selected from the group consisting of (meth)acrylic acid or (meth)acrylate based polymers, vinyl acetate polymers, rosin-modified maleic resins, novolak resins, and polymers represented by the formula



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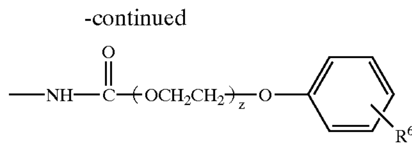

wherein each R^1, R^2, and R^3 independently is hydrogen or methyl; R is a hydrocarbyl group of 1 to 4 carbon atoms; each R^4 and R^5 independently is hydrogen or a hydrocarbyl group of 1 to 4 carbon atoms; R^6 is hydrocarbyl group of 1 to 20 carbon atoms; w, x, y, and z independently are a number from 1 to 100;

(d) contacting said coated side of said semiconductor wafer in step (c) to said holding block such that said semiconductor wafer adheres to said coated holding block;

(e) polishing the other uncoated side of said semiconductor wafer; and

(f) removing the semiconductor wafer from the coated ceramic holding block.

23. The process of claim 21, wherein prior to step (d), the coated holding block of step (c) is heated to a temperature of about 80-95° C.

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