CLAIMS

[Claim 1] A cleaning agent for a silicon wafer having a finely uneven pattern at its surface, comprising:

a water-based cleaning liquid having a water content of 50 mass % or more; and

a water-repellent cleaning liquid for providing at least a recessed portion of the uneven pattern with water repellency during a cleaning process,

the water-repellent cleaning liquid comprising a mixture of a water-repellent compound and an organic solvent, the water-repellent compound having a hydrophobic group and a reactive moiety chemically bondable to Si element in the silicon wafer, the organic solvent containing at least an alcoholic solvent.

[Claim 2] The cleaning agent for a silicon wafer according to claim 1, wherein the alcoholic solvent is at least one selected from the group consisting of alcohols with a carbon number of not greater than 10.

[Claim 3] The cleaning agent for a silicon wafer according to claim 1 or 2, wherein the water-repellent compound comprises at least one selected from the group consisting of the following general formulas [1] and [2].

$(R^1)_aSi(CH_3)_bH_cX_{4-a-b-c}$ [1]

$[R^2Si(CH_3)_{2-d}H_d]_eNH_{3-e}$ [2]

where, R^1 mutually independently represents one of a monovalent organic group having hydrocarbon group with a carbon number of from 1 to 18 and a monovalent organic group having fluoroalkyl chain with a carbon number of from 1 to 8; R^2 mutually independently represents one of a monovalent organic group having hydrocarbon group with a carbon number of from 1 to 18 and a monovalent organic group having fluoroalkyl chain with a carbon number of from 1 to 8; X mutually independently represents at least one group selected from the group consisting of halogen group, alkoxy group, acetoxy group, trifluoroacetoxy group, $-OC(CH_3)=CHCOCH_3$, $-OC(CH_3)=N-Si(CH_3)_3$, $-OC(CF_3)=N-Si(CH_3)_3$, $-CO-NH-Si(CH_3)_3$, alkylsulfonate group,

perfluoroalkylsulfonate group, nitrile group and a monovalent organic group whose element to be bonded to Si element is nitrogen; a is an integer of from 1 to 3; each of b and c is an integer of from 0 to 2; the total of a, b and c is from 1 to 3; d is an integer of from 0 to 2; e is an integer of from 1 to 3.

[Claim 4] The cleaning agent for a silicon wafer according to claim 1 or 2, wherein the organic solvent comprises the alcoholic solvent and an aprotic solvent.

[Claim 5] The cleaning agent for a silicon wafer according to claim 1 or 2, wherein the organic solvent comprises the alcoholic solvent and a halogen element-containing uninflammable solvent.

[Claim 6] The cleaning agent for a silicon wafer according to claim 1 or 2, wherein a surface of the recessed portion of the silicon wafer which surface is provided with water repellency by the water-repellent cleaning liquid has a capillary force of not larger than 2.1 MN/m^2 on the assumption that water is retained in the recessed portion of the surface of the silicon wafer.

[Claim 7] A water-repellent cleaning liquid for providing water repellency, during a cleaning process for a silicon wafer having at its surface a finely uneven pattern, at least to a recessed portion of the uneven pattern, comprising:
a water-repellent compound having a reactive moiety chemically bondable to Si element in the silicon wafer, and a hydrophobic group; and
an organic solvent containing at least an alcoholic solvent and mixed with the water-repellent compound,
wherein the water-repellent compound and the organic solvent are mixed.

[Claim 8] A cleaning method for a surface of a silicon wafer which method uses a cleaning agent for a silicon wafer according to claim 1, comprising:

a step of removing the cleaning agent from the surface of the silicon wafer, after removing the cleaning liquid from the surface of the silicon wafer.

[Claim 9] The cleaning method for a surface of a silicon wafer according to claim 8, comprising:

a step of conducting at least one treatment selected from the group consisting of irradiating the surface of the silicon wafer with light, heating the silicon wafer, and exposing the silicon wafer to ozone, after removing the cleaning liquid from the surface of the silicon wafer.

CLAIMS

[Claim 1] A cleaning agent for a silicon wafer having a finely uneven pattern at its surface, comprising:

a water-based cleaning liquid; and

a water-repellent cleaning liquid for providing at least a recessed portion of the uneven pattern with water repellency during a cleaning process, the water-repellent cleaning liquid comprising a mixture of a water-repellent compound and an organic solvent, the water-repellent compound having a hydrophobic group and a reactive moiety chemically bondable to Si element in the silicon wafer, the organic solvent containing at least an alcoholic solvent.

[Claim 2] A cleaning agent for a silicon wafer, as claimed in Claim 1, wherein the alcoholic solvent is at least one selected from the group consisting of alcohols with a carbon number of not greater than 10.

[Claim 3] A cleaning agent for a silicon wafer, as claimed in Claim 1 or Claim 2, wherein the water-repellent compound comprises at least one selected from the group consisting of the following general formulas [1] and [2].

$(R^1)_aSi(CH_3)_bH_cX_{4-a-b-c}$ [1]

$[R^2Si(CH_3)_{2-d}H_d]_eNH_{3-e}$ [2]

where: R^1 mutually independently represents one of a monovalent organic group having hydrocarbon group with a carbon number of from 1 to 18 and a monovalent organic group having fluoroalkyl chain with a carbon number of from 1 to 8; R^2 mutually independently represents one of a monovalent organic group having hydrocarbon group with a carbon number of from 1 to 18 and a monovalent organic group having fluoroalkyl chain with a carbon number of from 1 to 8; X mutually independently represents at least one group selected from the group consisting of halogen group, alkoxy group,

acetoxy group, trifluoroacetoxy group, $-OC(CH_3)=CHCOCH_3$, $-OC(CH_3)=N-Si(CH_3)_3$, $-OC(CF_3)=N-Si(CH_3)_3$, $-CO-NH-Si(CH_3)_3$, alkylsulfonate group, perfluoroalkylsulfonate group, nitrile group and a monovalent organic group whose element to be bonded to Si element is nitrogen; a is an integer of from 1 to 3; each of b and c is an integer of from 0 to 2; the total of a, b and c is from 1 to 3; d is an integer of from 0 to 2; e is an integer of from 1 to 3.

[Claim 4] A cleaning agent for a silicon wafer, as claimed in any one of Claims 1 to 3, wherein the organic solvent comprises the alcoholic solvent and an aprotic solvent.

[Claim 5] A cleaning agent for a silicon wafer, as claimed in any one of Claims 1 to 4, wherein the organic solvent comprises the alcoholic solvent and a halogen element-containing uninflammable solvent.

[Claim 6] A cleaning agent for a silicon wafer, as claimed in any one of Claims 1 to 5, wherein a surface of the recessed portion of the silicon wafer which surface is provided with water repellency by the water-repellent cleaning liquid has a capillary force of not larger than 2.1 MN/m^2 on the assumption that water is retained in the recessed portion of the surface of the silicon wafer.

[Claim 7] A water-repellent cleaning liquid for providing water repellency, during a cleaning process for a silicon wafer having at its surface a finely uneven pattern, at least to a recessed portion of the uneven pattern, comprising:

a water-repellent compound having a reactive moiety chemically bondable to Si element in the silicon wafer, and a hydrophobic group; and

an organic solvent containing at least an alcoholic solvent and mixed with the water-repellent compound,

wherein the water-repellent compound and the organic solvent are mixed.

[Claim 8] A cleaning method for a surface of a silicon wafer which method uses a cleaning agent for a silicon wafer as claimed in Claim 1, comprising:

a step of removing the cleaning agent from the surface of the silicon wafer, after removing the cleaning liquid from the surface of the silicon wafer.

[Claim 9] A cleaning method for a surface of a silicon wafer, as claimed in Claim 8, comprising:

a step of conducting at least one treatment selected from the group consisting of irradiating the surface of the silicon wafer with light, heating the silicon wafer, and exposing the silicon wafer to ozone, after removing the cleaning liquid from the surface of the silicon wafer.