

~~WHAT IS CLAIMED is:~~ CLAIMS

1. A substrate processing method comprising:

a processing liquid supplying step of supplying a processing liquid having a solute and a solvent to a surface of a substrate (W);

a processing film forming step of solidifying or curing the processing liquid supplied to the surface of the substrate (W) to form, on the surface of the substrate (W), a processing film (100) that holds a removal object (103) present on the surface of the substrate (W);

a peeling step of supplying a peeling liquid forming liquid to the surface of the substrate (W) to put the peeling liquid forming liquid in contact with the processing film (100) and form a peeling liquid and peeling the processing film (100), in the state of holding the removal object (103), from the surface of the substrate (W) by the peeling liquid; and

a removing step of continuing the supply of the peeling liquid forming liquid, after the peeling of the processing film (100), to wash away and remove the processing film (100) from the surface of the substrate (W) in the state where the removal object (103) is held by the processing film (100).

~~2. The substrate processing method according to Claim 1,~~

wherein the solute has a peeling liquid forming substance,

the processing film forming step includes a step of forming the processing film (100) having the peeling liquid forming substance (112) in a solid state, and

the peeling step includes a step of dissolving the peeling liquid forming substance (112) that is in the solid state inside the processing film (100) in the peeling liquid forming liquid supplied to the surface of the substrate (W) to form the peeling liquid.

32. The substrate processing method according to Claim ~~1 or~~ 2, wherein the peeling liquid is an alkaline liquid.

43. The substrate processing method according to ~~any one of~~ Claims ~~1 to 3~~ 1 to 3 or 2, wherein the peeling liquid forming liquid is pure water.

4. A substrate processing method comprising:
a processing liquid supplying step of supplying a processing liquid having a solute and a solvent to a surface of a substrate (W);
a processing film forming step of solidifying or curing the processing liquid supplied to the surface of the substrate (W) to form, on the surface of the substrate (W), a processing film (100) that holds a removal object (103) present on the surface of the substrate (W);

a peeling step of supplying a peeling liquid forming liquid to the surface of the substrate (W) to put the peeling liquid forming liquid in contact with the processing film (100) and form a peeling liquid and peeling the processing film (100), in the state of holding the removal object (103), from the surface of the substrate (W) by the peeling liquid; and

a removing step of continuing the supply of the peeling liquid forming liquid, after the peeling of the processing film (100), to wash away and remove the processing film (100) from the surface of the substrate (W) in the state where the removal object (103) is held by the processing film (100),

wherein the peeling liquid forming liquid is pure water.

5. The substrate processing method according to any one of Claims 1 to 4, wherein the peeling step includes a penetrating hole forming step of supplying the peeling liquid forming liquid to the surface of the substrate (W) to dissolve the processing film (100) partially and form a penetrating hole (102) in the processing film (100).

~~6. The substrate processing method according to Claim 5,~~
~~wherein~~ A substrate processing method comprising:

a processing liquid supplying step of supplying a processing liquid having a solute and a solvent to a surface of a substrate (W);

a processing film forming step of solidifying or curing the processing liquid supplied to the surface of the substrate (W) to form, on the surface of the substrate (W), a processing film (100) that holds a removal object (103) present on the surface of the substrate (W);

a peeling step of supplying a peeling liquid forming liquid to the surface of the substrate (W) to put the peeling liquid forming liquid in contact with the processing film (100) and form a peeling liquid and peeling the processing film (100), in the state of holding the removal object (103), from the surface of the substrate (W) by the peeling liquid; and

a removing step of continuing the supply of the peeling liquid forming liquid, after the peeling of the processing film (100), to wash away and remove the processing film (100) from the surface of the substrate (W) in the state where the removal object (103) is held by the processing film (100),

wherein the peeling step includes a penetrating hole forming step of supplying the peeling liquid forming liquid to the surface of the substrate (W) to dissolve the processing film (100) partially and form a penetrating hole (102) in the processing film (100),

the solute has a high solubility substance and a low solubility substance that is lower in solubility in the peeling liquid than the high solubility substance,

the processing film forming step includes a step of

forming the processing film (100) having the high solubility substance (110) and the low solubility substance (111) in solid states, and

the penetrating hole forming step includes a step of dissolving the high solubility substance (110) that is in the solid state inside the processing film (100) in the peeling liquid formed on the substrate (W) to form the penetrating hole (102) in the processing film (100).

7. The substrate processing method according to Claim 6, wherein a solubility of the low solubility substance in the peeling liquid forming liquid is lower than a solubility of the high solubility substance in the peeling liquid forming liquid, and

the penetrating hole forming step includes a step of dissolving the high solubility substance (110) that is in the solid state inside the processing film (100) in the peeling liquid forming liquid supplied to the surface of the substrate (W) to form the penetrating hole (102) in the processing film (100).

8. ~~The substrate processing method according to Claim 5,~~
wherein A substrate processing method comprising:

a processing liquid supplying step of supplying a processing liquid having a solute and a solvent to a surface of a substrate (W);

a processing film forming step of solidifying or curing the processing liquid supplied to the surface of the substrate (W) to form, on the surface of the substrate (W), a processing film (100) that holds a removal object (103) present on the surface of the substrate (W);

a peeling step of supplying a peeling liquid forming liquid to the surface of the substrate (W) to put the peeling liquid forming liquid in contact with the processing film (100) and form a peeling liquid and peeling the processing film (100), in the state of holding the removal object (103), from the surface of the substrate (W) by the peeling liquid; and

a removing step of continuing the supply of the peeling liquid forming liquid, after the peeling of the processing film (100), to wash away and remove the processing film (100) from the surface of the substrate (W) in the state where the removal object (103) is held by the processing film (100),

wherein the peeling step includes a penetrating hole forming step of supplying the peeling liquid forming liquid to the surface of the substrate (W) to dissolve the processing film (100) partially and form a penetrating hole (102) in the processing film (100),

the solute has a high solubility substance and a low

solubility substance that is lower in solubility in the peeling liquid forming liquid than the high solubility substance,

the processing film forming step includes a step of forming the processing film (100) having the high solubility substance (110) and the low solubility substance (111) in solid states, and

the penetrating hole forming step includes a step of dissolving the high solubility substance (110) that is in the solid state inside the processing film (100) in the peeling liquid forming liquid supplied to the surface of the substrate (W) to form the penetrating hole (102) in the processing film (100).

9. A substrate processing method comprising:

a processing liquid supplying step of supplying a processing liquid having a solute that contains an alkaline component and a solvent toward a surface of a substrate (W);

a processing film forming step of solidifying or curing the processing liquid supplied to the surface of the substrate (W) to form, on the surface of the substrate (W), a processing film (100) that contains the alkaline component and holds a removal object (103) present on the surface of the substrate (W);

a peeling step of supplying pure water to the surface of the substrate (W) to put the pure water in contact with the

processing film (100) to elute the alkaline component from the processing film (100) into the pure water and form an alkaline aqueous solution, and peeling the processing film (100), in the state of holding the removal object (103), from the surface of the substrate (W) by the alkaline aqueous solution; and

a removing step of continuing the supply of the pure water, after the peeling of the processing film (100), to wash away and remove the processing film (100) from the surface of the substrate (W) in the state where the removal object (103) is held by the processing film (100).

10. A substrate processing apparatus (1, 1P) comprising:

a processing liquid supplying unit (9) that supplies a processing liquid having a solute and a solvent to a surface of a substrate (W);

a solid forming unit (23, 11, 12) that solidifies or cures the processing liquid;

a peeling liquid forming liquid supplying unit (10) that supplies a peeling liquid forming liquid to the surface of the substrate; and

a controller (3) that controls the processing liquid supplying unit (9), the solid forming unit (23, 11, 12), and the peeling liquid forming liquid supplying unit (10),

wherein the controller (3) is programmed to execute a processing liquid supplying step of supplying the processing

liquid from the processing liquid supplying unit (9) to the surface of the substrate (W), a processing film forming step of making the solid forming unit (23, 11, 12) solidify or cure the processing liquid supplied to the surface of the substrate (W) to form, on the surface of the substrate (W), a processing film (100) that holds a removal object (103) present on the surface of the substrate (W), a peeling step of supplying the peeling liquid forming liquid from the peeling liquid forming liquid supplying unit (10) to the surface of the substrate (W) to put the peeling liquid forming liquid in contact with the processing film (100) and form a peeling liquid, and peeling the processing film (100), in the state of holding the removal object (103), from the surface of the substrate (W) by the peeling liquid, and a removing step of continuing the supply of the peeling liquid forming liquid from the peeling liquid forming liquid supplying unit (10), after the peeling of the processing film (100), to remove the processing film (100) from the surface of the substrate (W) in the state where the removal object (103) is held by the processing film (100).

~~11. The substrate processing apparatus (1, 1P) according to Claim 10, wherein~~

the solute has a peeling liquid forming substance,

the processing film (100) having the peeling liquid forming substance (112) in a solid state is formed in the

processing film forming step, and

in the peeling step, the peeling liquid forming liquid supplied to the surface of the substrate (W) dissolves the peeling liquid forming substance (112) in the solid state inside the processing film (100) to form the peeling liquid.

1211. The substrate processing apparatus (1, 1P) according to Claim ~~10 or 11~~, wherein the peeling liquid is an alkaline liquid.

1312. The substrate processing apparatus (1, 1P) according to ~~any one of Claims 10 to 12~~or 11, wherein the peeling liquid forming liquid supplying unit (10) supplies pure water as the peeling liquid forming liquid to the surface of the substrate (W).

13. A substrate processing apparatus (1, 1P) comprising:
a processing liquid supplying unit (9) that supplies a processing liquid having a solute and a solvent to a surface of a substrate (W);
a solid forming unit (23, 11, 12) that solidifies or cures the processing liquid;
a peeling liquid forming liquid supplying unit (10) that supplies a peeling liquid forming liquid to the surface of the substrate; and

a controller (3) that controls the processing liquid supplying unit (9), the solid forming unit (23, 11, 12), and the peeling liquid forming liquid supplying unit (10),

wherein the controller (3) is programmed to execute a processing liquid supplying step of supplying the processing liquid from the processing liquid supplying unit (9) to the surface of the substrate (W), a processing film forming step of making the solid forming unit (23, 11, 12) solidify or cure the processing liquid supplied to the surface of the substrate (W) to form, on the surface of the substrate (W), a processing film (100) that holds a removal object (103) present on the surface of the substrate (W), a peeling step of supplying the peeling liquid forming liquid from the peeling liquid forming liquid supplying unit (10) to the surface of the substrate (W) to put the peeling liquid forming liquid in contact with the processing film (100) and form a peeling liquid, and peeling the processing film (100), in the state of holding the removal object (103), from the surface of the substrate (W) by the peeling liquid, and a removing step of continuing the supply of the peeling liquid forming liquid from the peeling liquid forming liquid supplying unit (10), after the peeling of the processing film (100), to remove the processing film (100) from the surface of the substrate (W) in the state where the removal object (103) is held by the processing film (100), and

the peeling liquid forming liquid supplying unit (10)

supplies pure water as the peeling liquid forming liquid to the surface of the substrate (W).

14. The substrate processing apparatus (1, 1P) according to any one of Claims 10 to 13, wherein, in the peeling step, the peeling liquid forming liquid is supplied to the surface of the substrate (W) to dissolve the processing film (100) partially and form a penetrating hole (102) in the processing film (100).

~~15. The substrate processing apparatus (1, 1P) according to Claim 14, wherein~~ A substrate processing apparatus (1, 1P) comprising:

a processing liquid supplying unit (9) that supplies a processing liquid having a solute and a solvent to a surface of a substrate (W);

a solid forming unit (23, 11, 12) that solidifies or cures the processing liquid;

a peeling liquid forming liquid supplying unit (10) that supplies a peeling liquid forming liquid to the surface of the substrate; and

a controller (3) that controls the processing liquid supplying unit (9), the solid forming unit (23, 11, 12), and the peeling liquid forming liquid supplying unit (10),

wherein the controller (3) is programmed to execute a

processing liquid supplying step of supplying the processing liquid from the processing liquid supplying unit (9) to the surface of the substrate (W), a processing film forming step of making the solid forming unit (23, 11, 12) solidify or cure the processing liquid supplied to the surface of the substrate (W) to form, on the surface of the substrate (W), a processing film (100) that holds a removal object (103) present on the surface of the substrate (W), a peeling step of supplying the peeling liquid forming liquid from the peeling liquid forming liquid supplying unit (10) to the surface of the substrate (W) to put the peeling liquid forming liquid in contact with the processing film (100) and form a peeling liquid, and peeling the processing film (100), in the state of holding the removal object (103), from the surface of the substrate (W) by the peeling liquid, and a removing step of continuing the supply of the peeling liquid forming liquid from the peeling liquid forming liquid supplying unit (10), after the peeling of the processing film (100), to remove the processing film (100) from the surface of the substrate (W) in the state where the removal object (103) is held by the processing film (100),

in the peeling step, the peeling liquid forming liquid is supplied to the surface of the substrate (W) to dissolve the processing film (100) partially and form a penetrating hole (102) in the processing film (100),

the solute has a high solubility substance and a low

solubility substance that is lower in solubility in the peeling liquid than the high solubility substance,

the processing film (100) having the high solubility substance (110) and the low solubility substance (111) in solid states is formed in the processing film forming step, and

in the peeling step, the peeling liquid formed on the substrate (W) dissolves the high solubility substance (110) in the solid state inside the processing film (100) to form the penetrating hole (102) in the processing film (100).

16. The substrate processing apparatus (1, 1P) according to Claim 15, wherein a solubility of the low solubility substance in the peeling liquid forming liquid is lower than a solubility of the high solubility substance in the peeling liquid forming liquid, and,

in the processing film forming step, the peeling liquid forming liquid, supplied to the surface of the substrate (W), dissolves the high solubility substance (110) in the solid state inside the processing film (100) to form the penetrating hole (102) in the processing film (100).

17. ~~The substrate processing apparatus (1, 1P) according to Claim 14, wherein~~ A substrate processing apparatus (1, 1P) comprising:

a processing liquid supplying unit (9) that supplies a

processing liquid having a solute and a solvent to a surface of a substrate (W);

a solid forming unit (23, 11, 12) that solidifies or cures the processing liquid;

a peeling liquid forming liquid supplying unit (10) that supplies a peeling liquid forming liquid to the surface of the substrate; and

a controller (3) that controls the processing liquid supplying unit (9), the solid forming unit (23, 11, 12), and the peeling liquid forming liquid supplying unit (10),

wherein the controller (3) is programmed to execute a processing liquid supplying step of supplying the processing liquid from the processing liquid supplying unit (9) to the surface of the substrate (W), a processing film forming step of making the solid forming unit (23, 11, 12) solidify or cure the processing liquid supplied to the surface of the substrate (W) to form, on the surface of the substrate (W), a processing film (100) that holds a removal object (103) present on the surface of the substrate (W), a peeling step of supplying the peeling liquid forming liquid from the peeling liquid forming liquid supplying unit (10) to the surface of the substrate (W) to put the peeling liquid forming liquid in contact with the processing film (100) and form a peeling liquid, and peeling the processing film (100), in the state of holding the removal object (103), from the surface of the substrate (W) by the

peeling liquid, and a removing step of continuing the supply of the peeling liquid forming liquid from the peeling liquid forming liquid supplying unit (10), after the peeling of the processing film (100), to remove the processing film (100) from the surface of the substrate (W) in the state where the removal object (103) is held by the processing film (100),

in the peeling step, the peeling liquid forming liquid is supplied to the surface of the substrate (W) to dissolve the processing film (100) partially and form a penetrating hole (102) in the processing film (100),

the solute has a high solubility substance and a low solubility substance that is lower in solubility in the peeling liquid forming liquid than the high solubility substance,

the processing film having the high solubility substance (110) and the low solubility substance (111) in solid states is formed in the processing film forming step, and

in the peeling step, the peeling liquid forming liquid supplied to the surface of the substrate (W) dissolves the high solubility substance (110) in the solid state inside the processing film (100) to form the penetrating hole (102) in the processing film (100).

18. A substrate processing apparatus (1, 1P) comprising:
a processing liquid supplying unit (9) that supplies a processing liquid having a solute that contains an alkaline

component and a solvent to a surface of a substrate (W);

a solid forming unit (23, 11, 12) that solidifies or cures the processing liquid;

a pure water supplying unit (10) that supplies pure water to the surface of the substrate (W); and

a controller (3) that controls the processing liquid supplying unit (9), the solid forming unit (23, 11, 12), and the pure water supplying unit (10),

wherein the controller (3) is programmed to execute a processing liquid supplying step of supplying the processing liquid from the processing liquid supplying unit (9) to the surface of the substrate (W), a processing film forming step of making the solid forming unit (23, 11, 12) solidify or cure the processing liquid supplied to the surface of the substrate (W) to form, on the surface of the substrate (W), a processing film (100) that contains the alkaline component and holds a removal object (103) present on the surface of the substrate (W), a peeling step of supplying the pure water from the pure water supplying unit (10) to the surface of the substrate (W) to put the pure water in contact with the processing film (100) to elute the alkaline component from the processing film (100) into the pure water and form an alkaline aqueous solution, and peeling the processing film (100), in the state of holding the removal object (103), from the surface of the substrate (W) by the alkaline aqueous solution, and a removing step of

continuing the supply of the pure water from the pure water supplying unit (10), after the peeling of the processing film (100), to remove the processing film (100) from the surface of the substrate (W) in the state where the removal object (103) is held by the processing film (100).