Claims

[Claim 1] A substrate cleaning system comprising:

a heater configured to heat pure water;

a chemical-liquid diluting module configured to mix chemical liquid and the pure water heated by the heater at a predetermined volume ratio; and

a cleaning module configured to clean a substrate,

wherein the cleaning module comprises:

a substrate holding device configured to hold the substrate;

a cleaning member configured to contact the substrate and scrub the substrate;

a chemical-liquid supply nozzle configured to supply chemical liquid having a determined temperature to the substrate; and

a pure-water supply nozzle configured to supply the heated pure water to the substrate,

wherein a temperature of the diluted chemical liquid mixed by the chemical-liquid diluting module is determined to be higher than a normal temperature thereof and lower than a glass transition point of the cleaning member, and

the cleaning member is configured to scrub the substrate while the diluted chemical liquid having the determined temperature is supplied to the substrate.

[Claim 2] The substrate cleaning system according to claim 1, further comprising:

a chemical-liquid supply line to which the chemical-liquid supply nozzle is coupled; and

a pure-water supply line to which the pure-water supply nozzle is coupled,

wherein the heater is coupled to the pure-water supply line and arranged upstream of a coupling member in a flow direction of the pure water, the coupling member being configured to couple the chemical-liquid supply line to the pure-water supply line.

[Claim 3] The substrate cleaning system according to claim 1 or 2, wherein a temperature of the pure water supplied from the pure-water supply nozzle is higher than the temperature of the diluted chemical liquid supplied from the chemical-liquid supply nozzle.

[Claim 4] The substrate cleaning system according to any one of claims 1 to 3, wherein the cleaning module comprises:

a first filter arranged adjacent to the chemical-liquid supply nozzle and configured to capture foreign matter flowing through the chemical-liquid supply line; and

a second filter arranged adjacent to the pure-water supply nozzle and configured to capture foreign matter flowing through the pure-water supply line.

[Claim 5] The substrate cleaning system according to any one of claims 1 to 4, wherein the chemical-liquid supply nozzle comprises a radial nozzle configured to supply the diluted chemical liquid to a region from a center of the substrate to a periphery of the substrate held by the substrate holding device.

[Claim 6] The substrate cleaning system according to any one of claims 1 to 5, wherein the chemical-liquid supply nozzle comprises:

a first chemical-liquid supply nozzle configured to supply the diluted chemical liquid to a center of the substrate held by the substrate holding device; and

a second chemical-liquid supply nozzle configured to supply the diluted chemical liquid to a periphery of the substrate held by the substrate holding device.

[Claim 7] The substrate cleaning system according to any one of claims 1 to 6, wherein the chemical-liquid supply nozzle comprises:

a front-surface-side chemical-liquid supply nozzle configured to supply the diluted chemical liquid to a front surface of the substrate held by the substrate holding

device; and

a back-surface-side chemical-liquid supply nozzle configured to supply the diluted chemical liquid to a back surface of the substrate held by the substrate holding device.

[Claim 8] The substrate cleaning system according to any one of claims 1 to 7, wherein

the cleaning module includes a heating device arranged adjacent to a periphery of the substrate held by the substrate holding device, and

the heating device is arranged to heat the diluted chemical liquid present on the periphery of the substrate.

[Claim 9] A substrate cleaning system comprising:

a chemical-liquid diluting module configured to mix chemical liquid and pure water at a predetermined volume ratio;

a cleaning module configured to clean a substrate using a cleaning member configured to contact the substrate and using diluted chemical liquid supplied by the chemical-liquid diluting module;

a flow-rate regulator configured to regulate flow rate of the diluted chemical liquid;

a heater configured to heat at least one of the chemical liquid, the pure water, and the diluted chemical liquid; and

a controller configured to control the heater and the flow-rate regulator such that a temperature of the diluted chemical liquid is higher than a normal temperature and lower than a glass transition point of the cleaning member when the diluted chemical liquid is supplied to the cleaning module.

[Claim 10] A substrate cleaning method comprising:

heating pure water by a heater;

mixing chemical liquid and the pure water heated by the heater at a predetermined volume ratio;

determining a temperature of the mixed diluted-chemical-liquid to be higher than a normal temperature and lower than a glass transition point of a cleaning member which is configured to scrub a substrate;

supplying the diluted chemical liquid having the determined temperature through a chemical-liquid supply nozzle to the substrate held by a substrate holding device;

supplying the pure water, heated by the heater, through a pure-water supply nozzle to the substrate held by the substrate holding device; and

scrubbing the substrate by the cleaning member while the diluted chemical liquid having the determined temperature is supplied to the substrate.

[Claim 11] The substrate cleaning method according to claim 10, further comprising:

heating pure water flowing through a pure-water supply line coupled to the pure-water supply nozzle with the use of the heater; and

mixing the pure water with the chemical liquid flowing through a chemical-liquid supply line, which is coupled to the pure-water supply line at a position downstream of the heater in a flow direction of the pure water.

[Claim 12] The substrate cleaning method according to claim 10 or 11, wherein a temperature of the pure water supplied from the pure-water supply nozzle is higher than the temperature of the diluted chemical liquid supplied from the chemical-liquid supply nozzle.

[Claim 13] The substrate cleaning method according to any one of claims 10 to 12, further comprising:

capturing foreign matter flowing through the chemical-liquid supply line with the use of a first filter arranged adjacent to the chemical-liquid supply nozzle; and

capturing foreign matter flowing through the pure-water supply line with the use of a second filter arranged adjacent to the pure-water supply nozzle.

[Claim 14] The substrate cleaning method according to any one of claims 10 to 13, further comprising:

supplying the diluted chemical liquid to the substrate held by the substrate holding device with the use of the chemical-liquid supply nozzle configured to supply the diluted chemical liquid,

wherein the chemical supply nozzle comprises a radial nozzle, and

wherein the diluted chemical liquid is supplied to a region from a center of the substrate to a periphery of the substrate held by the substrate holding device.

[Claim 15] The substrate cleaning method according to any one of claims 10 to 14, further comprising:

supplying the diluted chemical liquid to the substrate held by the substrate holding device with the use of the chemical-liquid supply nozzle,

wherein the chemical-liquid supply nozzle comprises a first chemical-liquid supply nozzle configured to supply the diluted chemical liquid to a center of the substrate held by the substrate holding device and a second chemical-liquid supply nozzle configured to supply the diluted chemical liquid to a periphery of the substrate held by the substrate holding device.

[Claim 16] The substrate cleaning method according to any one of claims 10 to 15, further comprising:

supplying the diluted chemical liquid to the substrate held by the substrate holding device with the use of the chemical-liquid supply nozzle,

wherein the chemical-liquid supply nozzle comprises a front-surface-side chemical-liquid supply nozzle configured to supply the diluted chemical liquid to a front

surface of the substrate held by the substrate holding device and a back-surface-side chemical-liquid supply nozzle configured to supply the diluted chemical liquid to a back surface of the substrate held by the substrate holding device.

[Claim 17] The substrate cleaning method according to any one of claims 10 to 16, further comprising:

heating the diluted chemical liquid present on a periphery of the substrate with the use of a heating device arranged adjacent to the periphery of the substrate held by the substrate holding device.

[Claim 18] A substrate cleaning system comprising:

a heater configured to heat pure water to produce heated pure water;

a chemical-liquid diluting module configured to mix chemical liquid and the heated pure water to produce heated chemical liquid; and

a cleaning module configured to clean a substrate,

wherein the cleaning module comprises:

a substrate holding device configured to hold the substrate;

a cleaning member configured to contact the substrate and scrub the substrate;

a chemical-liquid supply nozzle configured to supply the heated chemical liquid to the substrate;

a pure-water supply nozzle configured to supply pure water to the substrate; and

an internal pipe coupled to the cleaning member and configured to directly supply heated fluid, which is the heated pure water or the heated chemical liquid, to an inside of the cleaning member, the internal pipe communicating with at least one of the heater and the chemical-liquid diluting module and having at least one aperture facing the cleaning member.

[Claim 19] The substrate cleaning system according to claim 18, wherein the internal pipe is arranged inside the cleaning member and extends in a longitudinal direction of the cleaning member.

[Claim 20] The substrate cleaning system according to claim 18 or 19, further comprising:

a chemical-liquid supply line to which the chemical-liquid supply nozzle is coupled;

a pure-water supply line to which the pure-water supply nozzle is coupled; and

a heated-fluid delivery line coupled to the internal pipe,

wherein the heater is coupled to the pure-water supply line, and

the heated-fluid delivery line is coupled to at least one of the pure-water supply line and the chemical-liquid supply line.

[Claim 21] The substrate cleaning system according to any one of claims 18 to 20, wherein the cleaning member is a roll cleaning member having a cylindrical shape, and a longitudinal length of the cleaning member is longer than a diameter of the substrate.

[Claim 22] The substrate cleaning system according to any one of claims 18 to 20, wherein

the cleaning member is a pencil cleaning member having a pencil shape, and

the internal pipe is coupled to an upper part of the pencil cleaning member.

[Claim 23] The substrate cleaning system according to any one of claims 18 to 22, wherein

a temperature of the heated chemical liquid is determined to be higher than a

normal temperature and lower than a glass transition point of the cleaning member, and

the cleaning member is configured to scrub the substrate while the heated chemical liquid having the determined temperature is supplied to the substrate.

[Claim 24] A substrate cleaning system comprising:

a heater configured to heat chemical liquid to produce heated chemical liquid; and

a cleaning module configured to clean a substrate,

wherein the cleaning module comprises:

a substrate holding device configured to hold the substrate;

a cleaning member configured to contact the substrate and scrub the substrate;

a chemical-liquid supply nozzle configured to supply the heated chemical liquid to the substrate;

a pure-water supply nozzle configured to supply pure water to the substrate; and

an internal pipe coupled to the cleaning member and configured to directly supply the heated chemical liquid to an inside of the cleaning member, the internal pipe communicating with the heater and having at least one aperture facing the cleaning member.

[Claim 25] The substrate cleaning system according to claim 24, wherein the internal pipe is arranged inside the cleaning member and extends in a longitudinal direction of the cleaning member.

[Claim 26] The substrate cleaning system according to claim 24 or 25, further comprising:

a chemical-liquid supply line to which the chemical-liquid supply nozzle is coupled;

a pure-water supply line to which the pure-water supply nozzle is coupled; and

a heated-fluid delivery line coupled to the internal pipe,

the heater is coupled to the chemical-liquid supply line, and

the heated-fluid delivery line is coupled to the chemical-liquid supply line.

[Claim 27] The substrate cleaning system according to any one of claims 24 to 26, wherein the cleaning member is a roll cleaning member having a cylindrical shape, and a longitudinal length of the cleaning member is longer than a diameter of the substrate.

[Claim 28] The substrate cleaning system according to any one of claims 24 to 26, wherein

the cleaning member is a pencil cleaning member having a pencil shape, and

the internal pipe is coupled to an upper part of the pencil cleaning member.

[Claim 29] The substrate cleaning system according to any one of claims 24 to 28, wherein

a temperature of the heated chemical liquid is determined to be higher than a normal temperature and lower than a glass transition point of the cleaning member, and

the cleaning member is configured to scrub the substrate while the heated chemical liquid having the determined temperature is supplied to the substrate and the cleaning member.

[Claim 30] A substrate cleaning method comprising:

heating pure water by a heater to produce heated pure water;

mixing chemical liquid and the heated pure water to produce heated chemical liquid;

directly supplying heated fluid, which is the heated pure water or the heated

chemical liquid, to an inside of a cleaning member through an internal pipe coupled to the cleaning member; and

scrubbing a substrate by the cleaning member with the heated fluid supplied through the internal pipe to the cleaning member, while supplying the heated chemical liquid from a chemical-liquid supply nozzle to the substrate,

wherein the internal pipe has at least one aperture facing the cleaning member.

[Claim 31] The substrate cleaning method according to claim 30, wherein in the scrubbing of the substrate, the cleaning member with the heated fluid permeating through the cleaning member is in contact with a center and a periphery of the substrate to supply the heated fluid to the center and the periphery of the substrate through the cleaning member.

[Claim 32] The substrate cleaning method according to claim 30 or 31, further comprising supplying pure water from a pure-water supply nozzle to the substrate after the scrubbing of the substrate.

[Claim 33] The substrate cleaning method according to any one of claims 30 to 32, further comprising determining a temperature of the heated chemical liquid to be higher than a normal temperature and lower than a glass transition point of the cleaning member, wherein

scrubbing the substrate by the cleaning member comprises scrubbing the substrate by the cleaning member with the heated fluid and supplied through the internal pipe to the cleaning member, while supplying the heated chemical liquid having the determined temperature from a chemical-liquid supply nozzle to the substrate.

[Claim 34] A substrate cleaning method comprising:

heating chemical liquid by a heater to produce heated chemical liquid;

directly supplying the heated chemical liquid to an inside of a cleaning member

through an internal pipe coupled to the cleaning member; and

scrubbing a substrate by the cleaning member with the heated chemical liquid supplied through the internal pipe to the cleaning member, while supplying the heated chemical liquid from a chemical-liquid supply nozzle to the substrate,

wherein the internal pipe has at least one aperture facing the cleaning member.

[Claim 35] The substrate cleaning method according to claim 34, further comprising:

while in the scrubbing of the substrate,

contacting the cleaning member with a center and a periphery of the substrate, the heated chemical liquid permeating through the cleaning member, and

supplying the heated chemical liquid to the center and the periphery of the substrate through the cleaning member.

[Claim 36] The substrate cleaning method according to claim 33 or 35, further comprising supplying pure water from a pure-water supply nozzle to the substrate after the scrubbing of the substrate.

[Claim 37] The substrate cleaning method according to any one of claims 34 to 36, further comprising determining a temperature of the heated chemical liquid to be higher than a normal temperature and lower than a glass transition point of the cleaning member, wherein

scrubbing the substrate by the cleaning member comprises scrubbing the substrate by the cleaning member with the heated chemical liquid having the determined temperature and supplied through the internal pipe to the cleaning member, while supplying the heated chemical liquid having the determined temperature from a chemical-liquid supply nozzle to the substrate.