CLAIMS

[Claim 1]

A cleaning method for a film-forming apparatus, including a film-forming raw material gas supply source, a film-forming reaction gas supply source, a first cleaning gas supply source, a second cleaning gas supply source, a stage that is provided in a processing chamber and is configured to receive a substrate and to be elevatable, and a cap member that is provided in the processing chamber and faces the stage to form a processing space, the cleaning method comprising:

forming a film over the substrate by supplying, to the processing space, a film-forming raw material gas from the film-forming raw material gas supply source and a film-forming reaction gas from the film-forming reaction gas supply source; and

cleaning an interior of the processing space by transferring the substrate out after the formation of the film, and supplying, to the processing space, a first cleaning gas from the first cleaning gas supply source and a second cleaning gas from the second cleaning gas supply source, in an alternating manner.

[Claim 2]

The cleaning method according to claim 1, wherein

the film is formed over the substrate by supplying, to the processing space, the film-forming raw material gas from the film-forming raw material gas supply source and the film-forming reaction gas from the film-forming reaction gas supply source, in an alternating manner.

[Claim 3]

The cleaning method according to claim 1, wherein

the film-forming apparatus includes a first buffer tank disposed in a first cleaning gas line connecting the processing chamber and the first cleaning gas supply source, and a second buffer tank disposed in a second cleaning gas line connecting the processing chamber and the second cleaning gas supply source, and

the first cleaning gas temporarily stored in the first buffer tank and the second cleaning gas temporarily stored in the second buffer tank are supplied to the processing space in an alternating manner.

[Claim 4]

The cleaning method according to any one of claims 1 to 3, wherein

the stage during the cleaning of the interior of the processing space is raised, and a gap between the stage and the cap member during the cleaning of the interior of the processing space is caused to be narrower than a gap between the stage and the cap member in the formation of the film over the substrate.

[Claim 5]

The cleaning method according to any one of claims 1 to 3, wherein

the film-forming apparatus includes a shower head including a body and the cap member, and

the first cleaning gas and the second cleaning gas are supplied, in an alternating manner, from a gas hole formed in the cap member and a gas hole formed in the body, to the processing space and a processing space-enclosing region located outside the processing space, thereby cleaning the interior of the processing space and the processing space-enclosing region.

[Claim 6]

The cleaning method according to any one of claims 1 to 3, wherein

in a case in which the film formed over the substrate is a high-k film and the high-k film is an oxide film, the first cleaning gas is a gas including fluorine.

[Claim 7]

The cleaning method according to claim 6, wherein

in a case in which the film formed over the substrate is alumina, a combination of the first cleaning gas and the second cleaning gas is that:

the first cleaning gas is an HF gas, and the second cleaning gas is a TMA gas, a DMAC gas, an $Sn(acac)_2$ gas, a gas mixture of a TMA gas and a DMAC gas, or a gas mixture of a TMA gas, a DMAC gas, an $Sn(acac)_2$ gas, and an $SiCl_4$ gas;

the first cleaning gas is a CHF_3 gas, and the second cleaning gas is a TMA gas; or

the first cleaning gas is a gas mixture of an HF gas and an SF_4 gas, and the second cleaning gas is an $Sn(acac)_2$ gas.

[Claim 8]

The cleaning method according to claim 6, wherein

in a case in which the film formed over the substrate is a hafnium oxide, a combination of the first cleaning gas and the second cleaning gas is that:

the first cleaning gas is an HF gas, and the second cleaning gas is a DMAC gas or a gas mixture of a DMAC gas and a $TiCl_4$ gas; or

the first cleaning gas is a gas mixture of an HF gas, an XeF_2 gas, and an SF_4 gas, and the second cleaning gas is a gas mixture of a DMAC gas and a $TiCl_4$ gas.

[Claim 9]

The cleaning method according to claim 6, wherein

in a case in which the film formed over the substrate is a zirconium oxide, a combination of the first cleaning gas and the second cleaning gas is that:

the first cleaning gas is an HF gas, and the second cleaning gas is a DMAC gas, a gas mixture of a DMAC gas and a $TiCl_4$ gas, or a gas mixture of a DMAC gas, a TMA gas, an $Sn(acac)_2$ gas, and an $SiCl_4$ gas; or

the first cleaning gas is a WF_6 gas, and the second cleaning gas is a DMAC gas.

[Claim 10]

The cleaning method according to claim 6, wherein

in a case in which the film formed over the substrate is an IGZO, a combination of the first cleaning gas and the second cleaning gas is that:

the first cleaning gas is an HF gas, and the second cleaning gas is a DMAC gas.

[Claim 11]

The cleaning method according to any one of claims 1 to 3, wherein

the film formed over the substrate is a metal film, and

the first cleaning gas is a gas including oxygen or a gas including chlorine.

[Claim 12]

The cleaning method according to claim 11, wherein

in a case in which the film formed over the substrate is Co,

the first cleaning gas is a Cl_2 gas and the second cleaning gas is a gas mixture of an Hhfac gas and an Hacac gas, or the first cleaning gas is an O_2 gas and the second cleaning gas is an Hfac gas.

[Claim 13]

The cleaning method according to claim 11, wherein

in a case in which the film formed over the substrate is Cu,

the first cleaning gas is an O_3 gas, and the second cleaning gas is an Hfac gas.

[Claim 14]

The cleaning method according to claim 11, wherein

in a case in which the film formed over the substrate is Fe,

the first cleaning gas is a Cl_2 gas, and the second cleaning gas is an Hacac gas.

[Claim 15]

The cleaning method according to claim 11, wherein

in a case in which the film formed over the substrate is Mo,

the first cleaning gas is an O_3 gas, and the second cleaning gas is a BCl_3 gas.

[Claim 16]

The cleaning method according to claim 11, wherein

in a case in which the film formed over the substrate is Ni,

the first cleaning gas is an O_2 gas, and the second cleaning gas is an Hhfac gas.

[Claim 17]

The cleaning method according to any one of claims 1 to 3, wherein

the first cleaning gas and the second cleaning gas are repeatedly supplied in an alternating manner, and a period per cycle of the repeated supply is 2 seconds or less.

[Claim 18]

The cleaning method according to any one of claims 1 to 3, wherein

a pressure of the processing space in the cleaning of the interior of the processing space is higher than a pressure of the processing space in the formation of the film over the substrate.

[Claim 19]

A film-forming apparatus, comprising:

a film-forming raw material gas supply source;

a film-forming reaction gas supply source;

a first cleaning gas supply source;

a second cleaning gas supply source;

a stage that is provided in a processing chamber and is configured to receive a substrate and to be elevatable;

a cap member that is provided in the processing chamber and faces the stage to form a processing space;

a first cleaning gas line connecting the processing chamber and the first cleaning gas supply source;

a second cleaning gas line connecting the processing chamber and the second cleaning gas supply source; and

a controller, wherein

the controller is configured to:

form a film over the substrate by supplying, to the processing space, a film-forming raw material gas from the film-forming raw material gas supply source and a film-forming reaction gas from the film-forming reaction gas supply source, and

clean an interior of the processing space by transferring the substrate out after the formation of the film, and supplying, to the processing space, a first cleaning gas from the first cleaning gas supply source through the first cleaning gas line and a second cleaning gas from the second cleaning gas supply source through the second cleaning gas line, in an alternating manner.