[CLAIMS]

[Claim 1]

A substrate processing apparatus comprising:

~~a vaporizer configured to generate a source gas by vaporizing a liquid source supplied thereto;~~

a plurality of tanks in which a~~the~~ source gas ejected from a~~the~~ vaporizer is stored;

a flow controller provided at a pipe connecting the vaporizer with the plurality of tanks and configured to control a flow rate of the source gas supplied to each of the plurality of tanks;

a plurality of first valves provided at the pipe in a manner respectively corresponding to the plurality of tanks to open and close a flow path of the pipe;

a plurality of second valves provided downstream of the plurality of tanks, respectively, to release the source gas accumulated in the plurality of tanks;

a process chamber provided downstream of the plurality of second valves and to which the source gas is supplied; and

a controller configured to be capable of controlling the plurality of first valves and the plurality of second valves so as to alternately and repeatedly perform an accumulation of the source gas from the vaporizer into each of the plurality of tanks and a release of the source gas from each of the plurality of tanks to the process chamber,

wherein the plurality of first valves are controlled for the source gas to be supplied alternately or cyclically in a continuous manner during the accumulation of the source gas from the vaporizer into each of the plurality of tanks.

[Claim 2]

The substrate processing apparatus of claim 1, further comprising:

~~a plurality of tanks comprising the tank wherein the source gas ejected from~~ the vaporizer configured to generate the source gas by vaporizing a liquid source supplied thereto,~~is stored in the plurality of the tanks;~~

~~a plurality of first valves comprising the first valve, and provided at a plurality of pipes respectively corresponding to the plurality of the tanks to open and close a flow path of each of the pipes; and~~

wherein the flow controller controls the flow rate of~~a plurality of second valves comprising the second valve, and provided downstream of the plurality of tanks in a manner respectively corresponding to the plurality of the tanks to release~~ the source gas free of any carrier gas~~accumulated in the plurality of the tanks~~, and

~~wherein the accumulation of the source gas and the release of the source gas are alternately or cyclically performed using~~ the plurality of ~~the~~ tanks has substantially equal volumes.

[Claim 3]

The substrate processing apparatus of claim 1 or 2, wherein the flow controller comprises a mass flow controller, and

the controller is further configured to control an accumulation time of the source gas in each of the plurality of tanks to be~~is~~ determined by a time for an accumulation amount of the source gas to reach a predetermined amount at a constant flow rate.

[Claim 4]

The substrate processing apparatus of claim 1, further comprising

a nozzle provided in the process chamber and through which the source gas released via each of the plurality of second valves is ejected into the process chamber in a decompressed state,

wherein the flow controller is further configured to control the source gas accumulated in each of the plurality of tanks to be~~is~~ flush supplied into the process chamber through the nozzle in a time shorter than an accumulation time for the source gas to have been accumulated in each of the plurality of tanks.

[Claim 5]

The substrate processing apparatus of claim 2, wherein the flow controller is

commonly used for each of the plurality of tanks.

[Claim 6]

The substrate processing apparatus of claim 2, further comprising:

a plurality of vaporizers comprising the vaporizer, and configured to generate the source gas by vaporizing the liquid source supplied thereto; and

a plurality of flow controllers comprising the flow controller, connecting the plurality of ~~the~~ vaporizers with the plurality of ~~the~~ tanks, respectively, and configured to control flow rates of the source gas supplied to the plurality of ~~the~~ tanks,

wherein number of the vaporizers is equal to N, number of the flow controllers is equal to N, and the plurality of ~~the~~ vaporizers are arranged in parallel with the plurality of ~~the~~ flow controllers (wherein N is a natural number equal to or greater than two), and

the controller is further configured to ensure the flow rate of the source gas for a specified amount of the source gas to be accumulated in each of the plurality of tanks within a specified length of time by operating the plurality of ~~the~~ vaporizers in coordination with the plurality of ~~the~~ flow controllers, wherein the specified amount of the source gas is equal to an amount for the source gas to be released a single time, and the specified length of time is equal to N times of a single flush period.

[Claim 7]

The substrate processing apparatus of claim 2, wherein the vaporizer is further configured to supply the source gas to the plurality of ~~the~~ tanks without supplying the~~a~~ carrier gas.

[Claim 8]

The substrate processing apparatus of claim 4, wherein the controller is further configured to control the source gas to be~~is~~ released into the process chamber through the nozzle without supplying the~~a~~ carrier gas through the nozzle for a predetermined time.

[Claim 9]

The substrate processing apparatus of claim 2, wherein the controller is further configured to adjust the release of the source gas such that the source gas is released from each of the plurality of ~~the~~ tanks to the process chamber at a certain timing within a time range from a completion of the accumulation of the source gas into each of the plurality of tanks to a start of a subsequent accumulation of the source gas into each of the plurality of tanks.

[Claim 10]

The substrate processing apparatus of claim 2, wherein the process chamber is configured to accommodate a wafer whose aspect ratio is 100 or more to be~~is accommodated in the process chamber, and the wafer is~~ processed by being exposed to the source gas.

[Claim 11]

The substrate processing apparatus of claim 2, wherein a cross-sectional area of the flow path of ~~each of~~ the pipe~~s~~ connecting the ~~plurality of the~~ vaporizer~~s~~ with the plurality of ~~the~~ tanks is equal to or greater than a cross-sectional area of a flow path of a pipe connecting each of the plurality of tanks with a nozzle.

[Claim 12]

The substrate processing apparatus of claim 2, further comprising

a nozzle provided in the process chamber and through which the source gas alternately or cyclically released from each of the plurality of tanks is ejected into the process chamber in a decompressed state,

wherein the nozzle is configured to allow~~s~~ the source gas to be released from each of the plurality of tanks to form a substantially same flow in the process chamber.

[Claim 13]

The substrate processing apparatus of claim 2, wherein the flow controller is further configured to perform a pressure control utilizing a choked flow in an orifice, and is capable of maintaining the flow rate of the source gas to each of the plurality of tanks constant with respect to a pressure change in the vaporizer.

[Claim 14]

The substrate processing apparatus of claim 2, wherein the flow controller is further configured to control an accumulation time and a flush period of the source gas in each of the plurality of tanks ~~and a flush period thereof are controlled~~ such that an inner pressure of each of the plurality of tanks maintains a pressure value that satisfies a choked flow condition in an orifice in the flow controller.

[Claim 15]

A method of manufacturing a semiconductor device, comprising:

(a) generating a source gas by a vaporizer by vaporizing a liquid source supplied thereto;

(b) accumulating the source gas into a plurality of tanks by opening a plurality of first valves provided at a pipe in a manner respectively corresponding to the plurality of tanks, which connect~~ing~~ the vaporizer with the plurality of tanks while controlling a flow rate of the source gas supplied to each of the plurality of tanks by a flow controller provided at the pipe;

(c) supplying the source gas to a process chamber provided downstream of a plurality of second valves by opening the plurality of second valves respectively provided downstream of the plurality of tanks; and

(d) controlling the plurality of first valves and the plurality of second valves so as to alternately and repeatedly perform an accumulation of the source gas from the vaporizer into each of the plurality of tanks and a release of the source gas from each of the plurality of tanks to the process chamber such that the source gas is supplied alternately or cyclically in a continuous manner during the accumulation of the source gas from the vaporizer into each of the plurality of tanks.

[Claim 16]

A non-transitory tangible medium storing a program that causes, by a computer, a substrate processing apparatus to perform:

(a) generating a source gas by a vaporizer by vaporizing a liquid source supplied thereto;

(b) accumulating the source gas into a plurality of tanks by opening a plurality of first valves provided at a pipe in a manner respectively corresponding to the plurality of tanks, which connects~~ing~~ the vaporizer with the plurality of tanks while controlling a flow rate of the source gas supplied to each of the plurality of tanks by a flow controller provided at the pipe;

(c) supplying the source gas to a process chamber provided downstream of a plurality of second valves by opening the plurality of second valves respectively provided downstream of the plurality of tanks; and

(d) controlling the plurality of first valves and the plurality of second valves so as to alternately and repeatedly perform an accumulation of the source gas from the vaporizer into each of the plurality of tanks and a release of the source gas from each of the plurality of tanks to the process chamber such that the source gas is supplied alternately or cyclically in a continuous manner during the accumulation of the source gas from the vaporizer into each of the plurality of tanks.