[DESCRIPTION]

[Title]

METHOD OF MANUFACTURING SEMICONDUCTOR DEVICE, SUBSTRATE PROCESSING METHOD, PROGRAM AND SUBSTRATE PROCESSING APPARATUS

[Technical Field]

[0001]

The present disclosure relates to a method of manufacturing a semiconductor device, a substrate processing method, a program and a substrate processing apparatus.

[Related Art]

[0002]

In a semiconductor manufacturing apparatus serving as a substrate processing apparatus, a maintenance process may be performed before or after performing a film-forming-process. In the present specification, the maintenance process may refer to various processes such as a process of removing by-products in a furnace and a purge process of maintaining an environment in the furnace under specific conditions. Recently, in order to improve a productivity of an apparatus such as the semiconductor manufacturing apparatus (that is, in order to reduce a downtime of the apparatus), a function of automatically performing the maintenance process is widely used in the apparatus.

[0003]

For example, according to Patent Document 1, an alarm is generated and a cleaning recipe is executed when a current value of apparatus data to be monitored reaches a predetermined condition. For example, according to Patent Document 2, an error correction process is performed in a first step (leading step) of a film-forming step even when an error occurs in a preparation step performed before the film-forming step.

[0004]

However, when the current value reaches a predetermined threshold value and the

[CLAIMS]

[Claim 1]

A method of manufacturing a semiconductor device, comprising:

pre-processing of preparing a process environment in a process chamber of a substrate processing apparatus;

processing a substrate; and

post-processing,

wherein the pre-processing comprises (a1) determining whether a setting for a maintenance item is valid and determining whether to execute a maintenance recipe for a target object in the process chamber, based on a maintenance process for the maintenance item determined as valid,

wherein (a1) is performed in a first step in the pre-processing so as not to affect the processing of the substrate,

when it is determined in (a1) that the maintenance recipe is to be executed, the maintenance recipe is executed during the pre-processing, and

when the maintenance recipe is not normally terminated, the post-processing is performed by forcibly terminating the pre-processing.

[Claim 2]

The method of claim 1, wherein (a1) comprises executing a sub recipe, and

the sub recipe comprises (b1) determining whether to execute the maintenance recipe, wherein (b1) is performed first in the sub recipe.

[Claim 3]

The method of claim 2, wherein (b1) comprises:

(c1) checking execution settings for the maintenance recipe; and

(c2) comparing a current value of a pre-set maintenance item with a threshold value, based on the maintenance process for the maintenance item determined as valid.

[Claim 4]

The method of claim 2 or 3, wherein, when the current value of the pre-set maintenance item reaches the threshold value, the maintenance recipe is executed and a next step of (b1) is performed.

[Claim 5]

The method of any one of claims 2 to 4, wherein the sub recipe further comprises (b2) transferring the substrate, and (b2) is performed after (b1) is performed.

[Claim 6]

The method of claim 5, wherein the sub recipe is terminated after (b2) is performed so as to proceed to a next step of (a1).

[Claim 7]

The method of any one of claims 1 to 6, wherein the current value of the pre-set maintenance item is reset to zero (0) when the maintenance recipe is completed.

[Claim 8]

The method of claim 1, wherein a sub recipe is executed if the maintenance recipe is set up in (a1), and

the pre-processing is performed without executing the sub recipe if the maintenance recipe is not set up in (a1).

[Claim 9]

The method of any one of claims 1 to 8, wherein the pre-processing further comprises:

(a2) transferring the substrate into a substrate retainer; and

(a3) preparing a transfer environment in which the substrate retainer and the substrate are in standby below the process chamber.

[Claim 10]

The method of any one of claims 1 to 9, wherein the maintenance recipe comprises at least one selected from a group consisting of a purge recipe, a warm-up recipe and a cleaning recipe.

[Claim 11]

The method of claim 10, wherein the purge recipe comprises:

(d1) supplying a purge gas while an inner pressure and an inner temperature of the process chamber are maintained at a predetermined pressure and a predetermined temperature, respectively.

[Claim 12]

The method of claim 11, wherein the purge recipe further comprises:

(d2) inserting the substrate retainer into the process chamber; and

(d3) transferring the substrate retainer out of the process chamber.

[Claim 13]

The method of claim 12, wherein the purge recipe further comprises:

(d4) cooling the substrate retainer.

[Claim 14]

The method of claim 12 or 13, wherein it is possible to set whether to load the substrate into the substrate retainer in (d2).

[Claim 15]

The method of claim 14, wherein the substrate loaded into the substrate retainer in (d2) is for use in in-furnace adjustment.

[Claim 16]

The method of any one of claims 1 to 14, wherein a time period from a termination of (a1) until a start of the processing of the substrate is equal to a predetermined time that does not affect a result of the processing of the substrate.

[Claim 17]

The method of any one of claims 1 to 16, wherein the maintenance item comprises at least one selected from a group consisting of: the number of times that a main processing is performed; a usage time of the target object; an amount of time that the target object has spent in the substrate processing apparatus; an accumulative thickness of a film registered in advance; the number of usable substrates remaining; a standby time; the number of times that the maintenance process is performed; the number of times that dummy wafers are used; and

an accumulative thickness of a film formed on the dummy wafers.

[Claim 18]

The method of claim 8, wherein one is selected as the maintenance process from a group consisting of: no designation; notifying an alarm; suspending a next process when a current process is completed; starting the maintenance process after receiving a start instruction; starting the maintenance process automatically unless another process is being performed; and executing a predetermined alarm recipe.

[Claim 19]

The method of claim 18, wherein the sub recipe is executed if executing the predetermined alarm recipe is selected as the maintenance process.

[Claim 20]

The method of claim 1, wherein the target object comprises at least one selected from a group consisting of the substrate, a boat and a reaction tube.

[Claim 21]

The method of any one of claims 1 to 20, wherein, when it is determined in (a1) that the maintenance recipe is to be executed, the maintenance recipe is executed without the substrate being loaded in the process chamber.

[Claim 22]

A substrate processing method, comprising:

pre-processing of preparing a process environment in a process chamber of a

substrate processing apparatus;

processing a substrate; and

post-processing,

wherein the pre-processing comprises (a1) determining whether a setting for a maintenance item is valid and determining whether to execute a maintenance recipe for a target object in the process chamber, based on a maintenance process for the maintenance item determined as valid,

wherein (a1) is performed in a first step in the pre-processing so as not to affect the processing of the substrate,

when it is determined in (a1) that the maintenance recipe is to be executed, the maintenance recipe is executed during the pre-processing, and

when the maintenance recipe is not normally terminated, the post-processing is performed by forcibly terminating the pre-processing.

[Claim 23]

A program related to a substrate processing apparatus comprising a memory and a controller, wherein the memory stores a file at least comprising: a main recipe comprising pre-processing of preparing a process environment in a process chamber, processing a substrate, and post-processing; and a maintenance recipe configured to maintain a component constituting the process chamber, and wherein the pre-processing comprises (a1) determining whether a setting of a maintenance item is valid and determining whether to execute the maintenance recipe, and the controller is configured to execute the main recipe and the maintenance recipe through a recipe execution controller by selecting the main recipe and the maintenance recipe appropriately based on a maintenance process for the maintenance item determined as valid,

wherein the program causes, by a computer, the substrate processing apparatus to perform:

executing the maintenance recipe through the recipe execution controller in a first step in the pre-processing so as not to affect the processing of the substrate,

the maintenance recipe is executed during the pre-processing, and

when the maintenance recipe is not normally terminated, the post-processing is performed by forcibly terminating the pre-processing.

[Claim 24]

A substrate processing apparatus comprising:

a memory configured to store a file at least comprising:

a main recipe comprising:

pre-processing of preparing a process environment in a process chamber;

processing a substrate; and

post-processing; and

a maintenance recipe configured to maintain a component constituting the process chamber,

wherein the pre-processing comprises (a1) determining whether a setting of a maintenance item is valid and determining whether to execute the maintenance recipe; and

a controller configured to be capable of causing a recipe execution controller to execute the main recipe and the maintenance recipe by selecting the main recipe and the maintenance recipe appropriately, based on a maintenance process for the maintenance item determined as valid,

wherein the recipe execution controller is configured to be capable of executing the

maintenance recipe in a first step of the pre-processing so as not to affect the processing of the substrate,

the maintenance recipe is executed during the pre-processing, and

when the maintenance recipe is not normally terminated, the post-processing is performed by forcibly terminating the pre-processing.