transfer robot. The load lock module includes: a plurality of stage regions arranged around a center of a rotary support; the rotary support including a plurality of fixed support pins for supporting the substrates and configured to be rotatable about the center as a rotation axis above the plurality of stage regions; and a drive mechanism configured to drive the rotary support in a rotational direction. When transferring the substrates between the load lock module and the first transfer module or the second transfer module, the first transfer robot or the second transfer robot transfers the substrates with respect to the plurality of fixed support pins.

[0006] According to the present disclosure, it is possible to improve a substrate transfer accuracy in a substrate processing apparatus that collectively transfers and processes a plurality of substrates.

BRIEF DESCRIPTION OF DRAWINGS

[0007] FIG. 1 is a plan view showing a schematic configuration of a wafer processing apparatus according to an embodiment.

FIG. 2 is a perspective view showing a schematic configuration of an atmospheric transfer robot.

FIG. 3 is a perspective view showing a schematic configuration of a vacuum transfer robot.

FIG. 4 is a plan view showing a schematic configuration of a processing module.

FIG. 5 is a cross-sectional view showing a schematic configuration of the processing module.

FIG. 6 is a perspective view showing a schematic configuration of a load lock module.

FIG. 7 is a plan view showing a schematic configuration of the load lock module.

FIG. 8 is a cross-sectional view showing a schematic configuration of the load lock module.

FIG. 9 is a perspective view showing a schematic configuration of a rotary plate.

FIG. 10 is an explanatory diagram showing a state in which an atmospheric transfer robot or a vacuum transfer robot enter the load-lock module.

restrictive. That is, the technique of the present disclosure may obtain other effects obvious to those skilled in the art from the description herein in addition to or in place of the above effects.

[0149] The following configuration examples also belong to the technical scope of the present disclosure.

(1) A substrate processing apparatus for processing substrates, comprising:

a processing module including a plurality of stages and configured to process the substrates placed on the plurality of stages;

a first transfer module including a first transfer robot configured to collectively transfer the substrates with respect to the processing module;

a second transfer module including a second transfer robot configured to transfer the substrates with respect to a container capable of accommodating the substrates; and

a load lock module provided between the first transfer module and the second transfer module and configured to accommodate the substrates transferred by the first transfer robot or the second transfer robot,

wherein the load lock module includes:

a plurality of stage regions arranged around a center of a rotary support;

the rotary support including a plurality of fixed support pins for supporting the substrates and configured to be rotatable about the center as a rotation axis above the plurality of stage regions; and

a drive mechanism configured to drive the rotary support in a rotational direction, and

wherein, when transferring the substrates between the load lock module and the first transfer module or the second transfer module, the first transfer robot or the second transfer robot transfers the substrates with respect to the plurality of fixed support pins.

(2) In the substrate processing apparatus of (1) above, an arrangement of the substrates placed on the plurality of stages in the processing module is identical to an arrangement of the substrates supported on the rotary support in the load lock module, and

support includes a plurality of arms having a substantially arc-like shape in a plan view and configured to be capable of supporting the substrates,

the plurality of fixed support pins are arranged at positions where the plurality of fixed support pins do not interfere with the first transfer robot when the first transfer robot transfers the substrates with respect to the plurality of fixed support pins, and where the plurality of fixed support pins do not interfere with the second transfer robot when the second transfer robot transfers the substrates with respect to the plurality of fixed support pins, and

each of the plurality of fixed support pins is provided inward of each of the plurality of arms to protrude upward of an upper surface of each of the plurality of arms.

(8) In the substrate processing apparatus of any one of (1) to (7) above, the plurality of fixed support pins come into point-contact with each of the substrates and support each of the substrates by a frictional force.

(9) In the substrate processing apparatus of any one of (1) to (8) above, the load lock module includes an orienter configured to control an orientation of a notch of each of the substrates with respect to the rotary support.

(10) In the substrate processing apparatus of (9) above, the orienter is configured to control an orientation of each of the substrates so that the notch of each of the substrates is oriented toward the center of the rotary support or a side opposite the center.

(11) In the substrate processing apparatus of (9) or (10) above, the orienter includes:

a notch detector configured to detect the notch of each of the substrates; and

a support pin provided in each of the plurality of stage regions and configured to be capable of supporting each of the substrates, rotatable in the rotational direction and movable in a vertical direction.

a load lock module provided between the first transfer module and the second transfer module and configured to accommodate the substrates transferred by the first transfer robot or the second transfer robot, and

wherein the load lock module includes:

a plurality of stage regions arranged around a center of a rotary support;

the rotary support including a plurality of fixed support pins for supporting the substrates and configured to be rotatable about the center as a rotation axis above the plurality of stage regions; and

a drive mechanism configured to drive the rotary support in a rotational direction, and

wherein the substrate processing method comprises:

an operation (a) of delivering the substrates from the second transfer robot to the plurality of fixed support pins and loading the substrates from the second transfer module into the load lock module;

an operation (b) of accommodating the substrates in the load lock module by repeatedly performing the operation (a) while rotating the rotary support;

an operation (c) of receiving the substrates supported by the plurality of fixed support pins by the first transfer robot and collectively unloading the substrates from the load lock module;

an operation (d) of delivering the substrates from the first transfer robot to the plurality of stages and collectively loading the substrates into the processing module from the first transfer module; and

an operation (e) of processing the substrates in the processing module.

(17) The substrate processing method of (16) above further includes:

an operation (f) of receiving the substrates placed on the plurality of stages by the first transfer robot and collectively unloading the substrates from the processing module to the first transfer module;

an operation (g) of delivering the substrates from the first transfer robot to the plurality

WHAT IS CLAIMED IS:

1. A substrate processing apparatus for processing substrates, comprising:

a processing module including a plurality of stages and configured to process the substrates placed on the plurality of stages;

a first transfer module including a first transfer robot configured to collectively transfer the substrates with respect to the processing module;

a second transfer module including a second transfer robot configured to transfer the substrates with respect to a container capable of accommodating the substrates; and

a load lock module provided between the first transfer module and the second transfer module and configured to accommodate the substrates transferred by the first transfer robot or the second transfer robot,

wherein the load lock module includes:

a plurality of stage regions arranged around a center of a rotary support;

the rotary support including a plurality of fixed support pins for supporting the substrates and configured to be rotatable about the center as a rotation axis above the plurality of stage regions; and

a drive mechanism configured to drive the rotary support in a rotational direction, and

wherein, when transferring the substrates between the load lock module and the first transfer module or the second transfer module, the first transfer robot or the second transfer robot transfers the substrates with respect to the plurality of fixed support pins.

2. The substrate processing apparatus of Claim 1, wherein an arrangement of the substrates placed on the plurality of stages in the processing module is identical to an arrangement of the substrates supported on the rotary support in the load lock module, and

wherein a distance between adjacent substrates in the arrangements of the plurality of substrates is less than 1/2 of a radius of each of the substrates.

3. The substrate processing apparatus of Claim 1, wherein the processing module includes:

a chamber in which the plurality of stages is accommodated;

a gas supply configured to supply a processing gas into the chamber; and

an exhauster configured to exhaust an interior of the chamber.

4. The substrate processing apparatus of Claim 1, wherein the first transfer robot includes a first pick configured to be capable of holding the substrates and movable in a vertical direction,

wherein the first transfer robot is configured to move the first pick in the vertical direction and transfer the substrates with respect to the plurality of fixed support pins,

wherein the second transfer robot includes a second pick configured to be capable of holding the substrates and movable in the vertical direction, and

wherein the second transfer robot is configured to move the second pick in the vertical direction and transfer the substrates with respect to the plurality of fixed support pins.

5. The substrate processing apparatus of Claim 1, wherein the rotary support is configured to be movable in a vertical direction with respect to the plurality of stage regions, and

wherein the drive mechanism is configured to drive the rotary support in the vertical direction.

6. The substrate processing apparatus of Claim 5, wherein a stage including a heat treatment mechanism is provided in each of the plurality of stage regions.

7. The substrate processing apparatus of Claim 1, wherein the rotary support includes a plurality of arms having a substantially arc-like shape in a plan view and configured to be capable of supporting the substrates,

wherein the plurality of fixed support pins are arranged at positions where the plurality of fixed support pins do not interfere with the first transfer robot when the first transfer robot

transfers the substrates with respect to the plurality of fixed support pins, and where the plurality of fixed support pins do not interfere with the second transfer robot when the second transfer robot transfers the substrates with respect to the plurality of fixed support pins, and

wherein each of the plurality of fixed support pins is provided inward of each of the plurality of arms to protrude upward of an upper surface of each of the plurality of arms.

8. The substrate processing apparatus of Claim 1, wherein the plurality of fixed support pins come into point-contact with each of the substrates and support each of the substrates by a frictional force.

9. The substrate processing apparatus of Claim 1, wherein the load lock module includes an orienter configured to control an orientation of a notch of each of the substrates with respect to the rotary support.

10. The substrate processing apparatus of Claim 9, wherein the orienter is configured to control an orientation of each of the substrates so that the notch of each of the substrates is oriented toward the center of the rotary support or a side opposite the center.

11. The substrate processing apparatus of Claim 9, wherein the orienter includes:

a notch detector configured to detect the notch of each of the substrates; and

a support pin provided in each of the plurality of stage regions and configured to be capable of supporting each of the substrates, rotatable in the rotational direction and movable in a vertical direction.

12. The substrate processing apparatus of Claim 9, wherein the orienter is provided at a position corresponding to the substrate supported by the rotary support while being spaced apart from a substrate loading/unloading port of the load lock module, which is provided near the second transfer module.

13. The substrate processing apparatus of Claim 1, further comprising:

a position measurer provided near the load lock module in the second transfer module and configured to measure a horizontal position of each of the substrates.

14. The substrate processing apparatus of Claim 1, wherein the load lock module includes two load lock modules which are integrated.

15. The substrate processing apparatus of any one of Claims 1 to 14, wherein the plurality of stages provided in the processing module include four stages,

wherein the first transfer robot is configured to be capable of collectively transferring four substrates, and

wherein the rotary support in the load lock module is configured to be capable of supporting four substrates.

16. A substrate processing method of processing substrates using a substrate processing apparatus,

wherein the substrate processing apparatus includes:

a processing module including a plurality of stages and configured to process the substrates placed on the plurality of stages;

a first transfer module including a first transfer robot configured to collectively transfer the substrates with respect to the processing module;

a second transfer module including a second transfer robot configured to transfer the substrates with respect to a container capable of accommodating the substrates; and

a load lock module provided between the first transfer module and the second transfer module and configured to accommodate the substrates transferred by the first transfer robot or the second transfer robot, and

wherein the load lock module includes:

a plurality of stage regions arranged around a center of a rotary support;

the rotary support including a plurality of fixed support pins for supporting the substrates and configured to be rotatable about the center as a rotation axis above the plurality of stage regions; and

a drive mechanism configured to drive the rotary support in a rotational direction, and

wherein the substrate processing method comprises:

an operation (a) of delivering the substrates from the second transfer robot to the plurality of fixed support pins and loading the substrates from the second transfer module into the load lock module;

an operation (b) of accommodating the substrates in the load lock module by repeatedly performing the operation (a) while rotating the rotary support;

an operation (c) of receiving the substrates supported by the plurality of fixed support pins by the first transfer robot and collectively unloading the substrates from the load lock module;

an operation (d) of delivering the substrates from the first transfer robot to the plurality of stages and collectively loading the substrates into the processing module from the first transfer module; and

an operation (e) of processing the substrates in the processing module.

17. The substrate processing method of Claim 16, further comprising:

an operation (f) of receiving the substrates placed on the plurality of stages by the first transfer robot and collectively unloading the substrates from the processing module to the first transfer module;

an operation (g) of delivering the substrates from the first transfer robot to the plurality of fixed support pins and collectively loading the substrates from the first transfer module to the load lock module; and

an operation (h) of receiving the substrates supported by the plurality of fixed support

pins by the second transfer robot and unloading the substrates from the load lock module to the second transfer module.

18. The substrate processing method of Claim 16, wherein an arrangement of the substrates placed on the plurality of stages in the processing module is identical to an arrangement of the substrates supported on the rotary support in the load lock module, and

wherein a distance between adjacent substrates in the arrangements of the substrates is less than 1/2 of a radius of each of the substrates.

19. The substrate processing method of Claim 16, wherein the processing module includes:

a chamber in which the plurality of stages is accommodated;

a gas supply configured to supply a processing gas into the chamber; and

an exhauster configured to exhaust an interior of the chamber, and

wherein, in the operation (e), the substrates placed on the plurality of stages are processed by supplying the processing gas from the gas supply into the chamber and exhausting the interior of the chamber by the exhauster.

20. The substrate processing method of Claim 16, wherein the first transfer robot includes a first pick configured to be capable of holding the substrate and movable in a vertical direction,

wherein the second transfer robot includes a second pick configured to be capable of holding the substrates and movable in the vertical direction,

wherein, in the operation (a), when the second transfer robot delivers the substrates to the plurality of fixed support pins, the second pick moves in the vertical direction, and

wherein, in the operation (c), when the first transfer robot receives the substrates from the plurality of fixed support pins, the first pick moves in the vertical direction.