[Patent Literature 2]

Japanese Patent Laid-Open No. 2000-349041

[Patent Literature 3]

Japanese Patent No. 3502981

[Technical Problem]

[0004]

In the conventional invention, the glass substrate is loaded on a conveyance stage having a size equivalent to the glass substrate or a size greater than the glass substrate, and is moved together with the stage. Further, the laser emission portion is fixed to the emission apparatus.

Figures 5A, 5B show a schematic configuration of an example of the conventional apparatus. In a laser emitter 50, an inert gas injector 51 is provided. For example, nitrogen or an inert gas is injected downward from the inert gas injector 51, and a laser 50A is emitted to a glass substrate 100 to be conveyed with a stage 60, through the inert gas injector 51.

As shown in Figure 5A, when the glass substrate 100 comes to below the laser emitter 50 by the movement of the stage 60, an inert gas such as nitrogen, for example, is injected from the inert gas injector 51, simultaneously with the emission of the laser 50A, and thereby, the air on the glass substrate 100 is removed at the time of the laser emission.

[0005]

In the first place, the reason why the air is removed at the time of the laser emission is to prevent substances such as oxygen contained in the air from acting on the non-crystalline semiconductor film formed on the glass substrate during the laser emission. Further, it is said that the emitted laser is influenced by the fluid in the periphery, and therefore, it is desired that the injected inert gas flows as straight as possible, with no disturbance, at the laser emitter.

As described above, conventionally, the stage arrives at the laser emitter, and the inert gas atmosphere is produced around the laser emitter by the gap between the glass substrate loaded on the stage and the inert gas injector at an upper portion.

[0006]

However, in the conventional method, the inert gas atmosphere is formed only when the moving glass substrate arrives at the laser emitter, and therefore, at the vicinity of a position where the inert gas is injected, the laser emission is performed while the flow of the gas is disturbed. In the case where the glass substrate 100 is not below the laser emitter 50 as

shown in Figure 5B, the inert gas atmosphere is not formed because there is no gap around the inert gas injector 51.

Further, the flow volume of the inert gas that flows from the inert gas injector for realizing the straight flow is very small, and therefore, the air moving together with the stage cannot be perfectly removed at the laser emitter.

Thus, the laser emitter is fixed in the emission apparatus, and the laser is emitted to the glass substrate in a state where the conveyance stage having the glass substrate loaded is moving. Therefore, there is a problem in producing a local inert gas atmosphere with little disturbance.

[0007]

The invention has been made in the context of the above circumstance, and has an object to provide an atmosphere formation apparatus and a floating conveyance method that make it possible to form a stable atmosphere on the conveyance path regardless of the conveyance position of the workpiece.

[Summary]

[0008]

That is, according to a first aspect of the atmosphere formation apparatus in the invention is an atmosphere formation apparatus that is provided in a floatation conveyance apparatus, the floatation conveyance apparatus conveying a workpiece while performing floating support of the workpiece by gas injection,

the atmosphere formation apparatus including a small-range atmosphere formation device that forms a small-range atmosphere in a large-range atmosphere, the large-range atmosphere being an atmosphere in a large-range region containing a conveyance path along which the conveyance is performed, the small-range atmosphere being an atmosphere in a small-range region containing the conveyance path, the small-range atmosphere being different from the large-range atmosphere.

[0009]

According to the disclosure, by the small-range atmosphere formation device, the small-range atmosphere different from the large-range atmosphere is formed in the large-range atmosphere, and a stable small-range atmosphere is obtained on the conveyance path regardless of the existence of a workpiece.

[0010]

An atmosphere formation apparatus according to another embodiment, the large-range atmosphere and the small-range atmosphere contain a floating injection gas injected for the floating support, as part of atmosphere gases, and the floating injection gas in the large-range atmosphere and the floating injection gas in the small-range atmosphere are different from each other.

[0011]

According to the disclosure, it is possible to use the floating injection gas as part of the atmosphere gases, and to simplify the apparatus configuration.

[0012]

An atmosphere formation apparatus according to another embodiment, an atmosphere gas in the large-range atmosphere and an atmosphere gas in the small-range atmosphere are different from each other in gas component.

[0013]

According to the above disclosure, it is possible to adopt atmospheres different in gas component, in the large-range atmosphere and the small-range atmosphere, and to move the workpiece in the different gas atmospheres along the conveyance path.

[0014]

An atmosphere formation apparatus according to another embodiment, a gas in the large-range atmosphere and a gas in the small-range atmosphere are composed of an identical component and are different from each other in purity.

[0015]

According to the above disclosure, it is possible to form the atmospheres using gases composed of an identical component and different in purity, as the large-range atmosphere and the small-range atmosphere.

[0016]

An atmosphere formation apparatus according to another embodiment includes a large-range atmosphere formation device that forms the large-range atmosphere, the large-range atmosphere formation device including a large-range gas introducer that introduces an atmosphere gas from an exterior of the large-range region.

[0017]

According to the disclosure, the gas can be introduced from the exterior of the large-range region by the large-range gas introducer, and can be used as at least part of the atmosphere gas in the large-range atmosphere.

[0018]

An atmosphere formation apparatus according to another embodiment, the small-range atmosphere formation device includes a small-range gas introducer that introduces an atmosphere gas from an exterior of the large-range region and the small-range region.

[0019]

According to the disclosure, the gas can be introduced from the exterior of the large-range region and the small-range region by the small-range gas introducer, and can be used as at least part of the gas in the small-range atmosphere.

[0020]

An atmosphere formation apparatus according to another embodiment, the small-range atmosphere formation device includes a downward gas injector that injects an atmosphere gas from an upper side in accordance with at least the whole or part of a floating injection gas that is injected from a lower side.

[0021]

According to the disclosure, the small-range atmosphere is formed at least by the floating injection gas and the gas injected from the downward gas injector. Further, by moving the workpiece at a position where the floating injection gas and the gas injected from the downward gas injector are balanced, it is possible to reduce the disturbance of the gas due to the conveyance of the workpiece as much as possible.

[0022]

An atmosphere formation apparatus according to another embodiment, a downward gas injector is positioned such that the conveyance path for the workpiece is positioned between a gas injected from the downward gas injector and a floating injection gas.

[0023]

According to the disclosure, the workpiece is conveyed on the conveyance path between the gas injected from the downward gas injector and the gas injected from a gas floating gas injector, and the workpiece can be moved in the large-range atmosphere and the small-range atmosphere.

[0024]

An atmosphere formation apparatus according to another embodiment the small-range atmosphere is formed in a region containing a working area for the workpiece.

[0025]

According to the disclosure, the working area for the workpiece can be disposed in the small-range atmosphere, and the working can be performed in a desired atmosphere.

[0026]

An atmosphere formation apparatus according to another embodiment, the small-range atmosphere contains a region on a conveyance-directional upstream side of a working area for the workpiece.

[0027]

According to the disclosure, it is possible to cover the workpiece with the small-range atmosphere before the workpiece arrives at the working area, and to obtain a stable atmosphere before the working.

[0028]

An atmosphere formation apparatus according to another embodiment, the small-range atmosphere contains a region on a conveyance-directional downstream side of a working area for the workpiece.

[0029]

According to the disclosure, the small-range atmosphere exists on the upstream side of the working area, and therefore, it is possible to cover the workpiece after the working with the small-range atmosphere.

[0030]

An atmosphere formation apparatus according to another embodiment, the small-range atmosphere formation device is formed so as to cover both vertical sides and both conveyance-directional lateral sides of the workpiece that is conveyed in the small-range atmosphere.

[0031]

According to the disclosure, the small-range atmosphere is formed so as to surround the workpiece from both vertical sides and both lateral sides, at the conveyance position of the workpiece, and it is possible to secure a stable small-range atmosphere regardless of the conveyance position of the workpiece.

[0032]

An atmosphere formation apparatus according to another embodiment, the large-range region and the small-range region are included in a processing chamber in which the workpiece is processed.

[0033]

According to disclosure, the large-range atmosphere and the small-range atmosphere are formed in the processing chamber in which the workpiece is processed.

[0034]

An aspect relates to a floating conveyance method for conveying a workpiece while performing floating support of the workpiece by gas injection,

the floating conveyance method including: a step of forming a small-range atmosphere in a large-range atmosphere, the large-range atmosphere being an atmosphere in a large-range region containing a conveyance path along which the conveyance is performed, the small-range atmosphere being an atmosphere in a small-range region containing the conveyance path along which the conveyance is performed, the small-range atmosphere being different from the large-range atmosphere; and a step of conveying the workpiece along the conveyance path through the large-range atmosphere and the small-range atmosphere.

[0035]

An embodiment of a floating conveyance method includes a step of forming the large-range atmosphere in the large-range region.

[0035a]

An apparatus of another aspect of the present disclosure comprises a laser emitter emitting a laser light; a stage over which a workpiece is conveyed, the stage being configured to inject a first inert gas and float the workpiece to which the laser light is shone; a gas injector located over the workpiece and configured to inject a second inert gas to the workpiece; and a wall surface located over the workpiece and under the gas injector, the wall surface overlapping the workpiece in a plan view.

[0035b]

An apparatus of another aspect of the present disclosure comprises a laser emitter emitting a laser light; a stage over which a workpiece is conveyed, the stage being configured to inject a first inert gas and float the workpiece to which the laser light is shone; a gas injector located over the workpiece and configured to inject a second inert gas to the workpiece; and a wall surface located over the workpiece and under the gas injector, the wall surface overlapping the workpiece in a plan view, the wall surface having an opening through which the laser light is shone to the workpiece, wherein a local atmosphere comprising the first inert gas and the second inert gas is formed between the workpiece and the wall surface.

[0036]

That is, the invention has an effect of making it possible to form the small-range atmosphere in a predetermined region and form an atmosphere with no disturbance, regardless of the existence of a workpiece.

[Brief Description of Drawings]

[0037]

[Figure 1] Figure 1 is a diagram for describing a large-range atmosphere and a small-range atmosphere in the invention.

[Figure 2] Figure 2 is a diagram showing a laser processing apparatus that includes an atmosphere formation apparatus according to an embodiment of the invention, similarly.

the floating conveyance method comprising: a step of forming a small-range atmosphere in a large-range atmosphere, the large-range atmosphere being an atmosphere in a large-range region containing a conveyance path along which the conveyance is performed, the small-range atmosphere being an atmosphere in a small-range region containing the conveyance path along which the conveyance is performed, the small-range atmosphere being different from the large-range atmosphere; and a step of conveying the workpiece along the conveyance path through the large-range atmosphere and the small-range atmosphere.

[Claim 15]

The floating conveyance method according to claim 14, comprising a step of forming the large-range atmosphere in the large-range region.

[Claim 16]

An apparatus comprising:

a laser emitter emitting a laser light;

a stage over which a workpiece is conveyed,

the stage being configured to inject a first inert gas and float the workpiece to which the laser light is shone;

a gas injector located over the workpiece and configured to inject a second inert gas to the workpiece;

a wall surface located over the workpiece and under the gas injector,

the wall surface overlapping the workpiece in a plan view.

[Claim 17]

The apparatus according to Claim 16, wherein the second inert gas flows between the workpiece and the wall surface.

[Claim 18]

The apparatus according to Claims 16 or 17, wherein a local atmosphere comprising the first inert gas and the second inert gas is formed between the workpiece and the wall surface.

[Claim 19]

The apparatus according to in any one of claims 16 to 18, wherein the wall surface has an opening, wherein the laser light is shone to the workpiece through the opening.

[Claim 20]

The apparatus according to in any one of claims 16 to 19, wherein the workpiece is a glass substrate over which an amorphous semiconductor film is formed.

[Claim 21]

The apparatus according to in any one of claims 16 to 20, wherein the stage has a first region and a second region adjacent to the first region in a plan view, the laser light is located in the first region in the plan view, wherein the first inert gas in injected in the first region.

[Claim 22]

The apparatus according to in any one of claims 16 to 21, wherein the first inert gas and the second inert gas is a same gas.

[Claim 23]

The apparatus according to in any one of claims 16 to 22, wherein the first inert gas and the second inert gas is nitrogen.

[Claim 24]

An apparatus comprising:

a laser emitter emitting a laser light;

a stage over which a workpiece is conveyed,

the stage being configured to inject a first inert gas and float the workpiece to which the laser light is shone;

a gas injector located over the workpiece and configured to inject a second inert gas to the workpiece;

a wall surface located over the workpiece and under the gas injector,

the wall surface overlapping the workpiece in a plan view

the wall surface having an opening through which the laser light is shone to the workpiece,

wherein a local atmosphere comprising the first inert gas and the second inert gas is formed between the workpiece and the wall surface.

[Claim 25]

The apparatus according to Claim 24, wherein the workpiece is a glass substrate over which an amorphous semiconductor film is formed.

[Claim 26]

The apparatus according to Claim 24 or 25, wherein the stage has a first region and a second region adjacent to the first region in a plan view, the laser light is located in the first region in the plan view, wherein the first inert gas in injected in the first region.

[Claim 27]

The apparatus according to in any one of claims 24 to 26, wherein the first inert gas and the second inert gas is a same gas.

[Claim 28]

The apparatus according to in any one of claims 24 to 27, wherein the first inert gas and the second inert gas is nitrogen.