DESCRIPTION

PROJECTION EXPOSURE DEVICE AND PROJECTION EXPOSURE METHOD THEREOF

TECHNICAL FIELD

[0001]

The present invention relates to a technology for improving the throughput of a projection exposure device, and more particularly, relates to a technology for improving throughput by reducing total projection exposure time.

BACKGROUND ART

[0002]

Projection exposure devices are used to transfer a pattern on a photomask (reticule) onto wafer, substrate or other workpiece using photolithography, and an example thereof is disclosed in Patent Document 1 or Patent Document 2.

[0003]

In Patent Document 1, a pattern on a negative plate (reticule: photomask) is projected through a projection lens onto an exposure target (workpiece) placed on a table (or stage) capable of moving in the X (horizontal), Y (vertical) and θ (rotation) directions. The location of the exposure target (workpiece) in each of the X and Y directions is detected with a position detection device using a laser interferometer. Patent Document 1 discloses a stepping movement direction for highly precisely aligning a reticule and wafer during stepping exposure and a movement direction of the wafer relative to the laser interferometer of the position detection device.

[0004]

In Patent Document 2, not only a table (or stage) having a single workpiece placed thereon is able to move in the X (horizontal), Y (vertical) and θ (rotation) directions, but also a table having a photomask (reticule) placed thereon is able to move in the X (horizontal), Y (vertical) and θ (rotation) directions. Patent Document 2 discloses that the scanning directions and scanning speeds of both tables can be set separately.

PRIOR ART LITERATURE

Patent Literature

[0005]

Patent Document 1: JP 2001-203161 A

Patent Document 2: JP H11-260697 A

[0006]

However, when using a brittle material in the manner of a crystalline material or a material such as glass, which although amorphous, is still brittle, for the material of the workpiece, it is necessary to handle the material with care, or in other words, handle the material at comparatively low speeds over longer periods of time. Consequently, the time required to load and unload workpieces to and from the exposable area on the stage requires an extremely long time of, for example, 70 seconds.

[0007]

In addition, in response to the higher levels of definition of transfer patterns in recent years, the position detection of workpieces on the stage requires higher levels of

accuracy when transferring a pattern onto a workpiece with a projection exposure device, thereby tending to result in an increase in the amount of time required for position detection. In addition, even longer position detection times are required when carrying out multiple rounds of exposure while moving the workpiece to multiple locations in the manner of stepping exposure.

[0008]

In the projection exposure devices of the prior art as described in Patent Documents 1 and 2, exposure is carried out by first loading a workpiece at a prescribed position on the stage followed by detecting the position of the workpiece on the stage, and finally adjusting the position of the stage or photomask in each direction by aligning with the detected position of the workpiece. In other words, when projection exposure devices of the prior art and projection exposure methods thereof, each process is carried out separately in order one process at a time, and in order to shorten total processing time, there was no choice but to shorten the time required by each individual process or shorten the time required to switch between each process.

SUMMARY OF THE INVENTION

[0009]

With the foregoing in view, an object of the present invention is to provide a projection exposure device, and projection exposure method thereof, that are capable of shortening total processing time to a greater degree than the prior art by carrying out at least two of each of the processes in the projection exposure step, consisting of loading and unloading workpieces, detecting the position of the workpiece placed on the stage, and projecting exposure light corresponding to the location of the workpiece, in parallel.

[0010]

In order to achieve the aforementioned object, one embodiment of the projection exposure device according to the present invention is a projection exposure device that forms a prescribed pattern of a photomask on a workpiece by aligning a prescribed pattern at a prescribed position on the workpiece and projecting exposure light from a light source, having: a sliding table composed by forming two first and second areas on the uppermost surface of sites where the workpieces are placed so as to enable two workpieces to be placed simultaneously without overlapping, and being able to alternately slide in opposite directions and temporarily stop at a prescribed first stopping position and second stopping position at the endpoint in each direction, two first loaders able to respectively and individually load and unload the workpiece located within each area of the sliding table, a first position detection device arranged directly above the first area on the sliding table so as to detect the loaded position of the workpiece placed within the first area when the sliding table has temporarily stopped at the specified first stopping position, a second position detection device arranged directly above the second area on the sliding table so as to detect the loaded position of the workpiece placed within the second area when the sliding table has temporarily stopped at the prescribed second stopping position, a light source, a photomask and a projection optical system arranged directly above the second area on the sliding table that is able to project exposure light onto the workpiece placed in the second area when the sliding table has temporarily stopped at the prescribed first stopping position and arranged directly above the first area on the sliding table that is able to project exposure light onto the workpiece placed in the first area when the sliding table has temporarily stopped at the prescribed second stopping position, and a control unit that controls sliding and stopping at each

stopping position of the sliding table, loading and unloading of the workpiece in each area by the first loader, detection of the loaded position of the workpiece in each area by the position detection device, and projection of exposure light onto the workpiece in each area by the light source, the photomask and the projection optical system; wherein, the control unit carries out parallel processing consisting of detecting the loaded position of the workpiece placed in the first area with the position detection device when exposure light is projected onto the workpiece loaded in the second area by the light source, photomask and projection optical system, and conversely detecting the loaded position of the workpiece placed in the second area with the position detection device when exposure light is projected onto the workpiece loaded in the first area by the light source, photomask and projection optical system.

[0011]

In order to achieve the aforementioned object, one embodiment of the projection exposure method according to the present invention is a projection exposure method for forming a prescribed pattern on a workpiece by aligning a prescribed pattern of a photomask at a prescribed position on the workpiece and projecting exposure light from a light source using a projection exposure device having a sliding table composed by forming two first and second areas on the uppermost surface of sites where the workpieces are placed so as to be able to be placed simultaneously without overlapping, and being able to alternately slide in opposite directions and temporarily stop at a prescribed first stopping position and second stopping position at the endpoint in each direction; comprising: (A) a step for sliding the sliding table and temporarily stopping in the first area at the prescribed first stopping position, (B) a step for loading the workpiece in the first area of the sliding table, (C) a step for detecting the loaded position of the workpiece in the first area, (D) a step for sliding the sliding table again and temporarily stopping in the first area at the prescribed second stopping position, (E) a step for projecting exposure light of a pattern on a photomask onto the workpiece in the first area, (F) a step for unloading the workpiece on which projection exposure has been completed from the second area in parallel with the projection exposure processing of (E) when there is the workpiece in the second area of the sliding table on which projection exposure has been completed, and (G) a step for switching from the first area of the prescribed first stopping position of the steps (A) to (F) to the second area of the prescribed second stopping position, carrying out the next cycle of processing, and alternately switching between the first area and second area for subsequent cycles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIGS. 1(a) to 1(c) are drawings indicating the general configuration when a sliding table of an exposure device of a first embodiment of the present invention having stopped at a first stopping position, with (a) being a side view when the first stopping position, (b) being a side when a second stopping position, and (c) being an overhead view.

FIG. 2 is a flow chart indicating the operation of an exposure device of a first embodiment of the present invention.

[0013]

DETAILED DESCRIPTION OF THE INVENTION

Overall Explanation

In one embodiment of the projection exposure device according to the present invention,

the projection exposure device of the present invention is a projection exposure device that forms a prescribed pattern of a photomask on a workpiece by aligning a prescribed pattern at a prescribed position on the workpiece and projecting exposure light from a light source, having: a sliding table composed by forming two first and second areas on the uppermost surface of sites where the workpieces are placed so as to enable two workpieces to be placed simultaneously without overlapping, and being able to alternately slide in opposite directions and temporarily stop at a prescribed first stopping position and second stopping position at the endpoint in each direction, two first loaders able to respectively and individually load and unload the workpiece located within each area of the sliding table, a first position detection device arranged directly above the first area on the sliding table so as to detect the loaded position of the workpiece placed within the first area when the sliding table has temporarily stopped at the first stopping position, a second position detection device arranged directly above the second area on the sliding table so as to detect the loaded position of the workpiece placed within the second area when the sliding table has temporarily stopped at the prescribed second stopping position, a light source, a photomask and a projection optical system arranged directly above the second area on the sliding table that is able to project exposure light onto the workpiece placed in the second area when the sliding table has temporarily stopped at the prescribed first stopping position and arranged directly above the first area on the sliding table that is able to project exposure light onto the workpiece placed in the first area when the sliding table has temporarily stopped at the prescribed second stopping position, and a control unit that controls sliding and stopping at each stopping position of the sliding table, loading and unloading of the workpiece in each area by the first loader, detection of the loaded position of the workpiece in each area by the position detection device, and projection of exposure light onto the workpiece in each area by the light source, the photomask and the projection optical system; wherein, the control unit carries out parallel processing consisting of detecting the loaded position of the workpiece placed in the first area with the position detection device when exposure light is projected onto the workpiece loaded in the second area by the light source, photomask and projection optical system, and conversely detecting the loaded position of the workpiece placed in the second area with the position detection device when exposure light is projected onto the workpiece loaded in the first area by the light source, photomask and projection optical system.

[0014]

In another embodiment of the projection exposure device according to the present invention, the projection exposure device is a projection exposure device that carries out stepping exposure of a single workpiece by projecting a projection exposure pattern in a plurality of shots.

[0015]

In another embodiment of the projection exposure device according to the present invention, the device that aligns the position of the projection exposure pattern with the position of a workpiece for which position has been detected includes a drive device that linearly moves the photomask in at least one of the vertical (Y), horizontal (X) and height (Z) directions.

[0016]

In another embodiment of the projection exposure device according to the present invention, the device that aligns the position of the projection exposure pattern with the position of a workpiece for which position has been detected includes a tilt drive device

that changes the angle of the photomask relative to exposure light from the orthogonal plane.

[0017]

In another embodiment of the projection exposure device according to the present invention, the device that aligns the position of the projection exposure pattern with the position of a workpiece for which position has been detected includes a drive device that linearly moves a stage arranged beneath the sliding table in at least one direction consisting of the vertical (Y), horizontal (X) and height (Z) directions.

[0018]

In another embodiment of the projection exposure device according to the present invention, the device that aligns the position of the projection exposure pattern with the position of a workpiece for which position has been detected includes a drive device that linearly moves the projection optical system in at least one direction consisting of the vertical (Y), horizontal (X) and height (Z) directions.

[0019]

One embodiment of the projection exposure method using the projection exposure device according to the present invention is a projection exposure method for forming a prescribed pattern on a workpiece by aligning a prescribed pattern of a photomask at a prescribed position on the workpiece and projecting exposure light from a light source using a projection exposure device having a sliding table composed by forming two first and second areas on the uppermost surface of sites where the workpieces are placed so as to be able to be placed simultaneously without overlapping, and being able to alternately slide in opposite directions and temporarily stop at a prescribed first stopping position and second stopping position at the endpoint in each direction; comprising: (A) a step for sliding the sliding table and temporarily stopping in the first area at the prescribed first stopping position, (B) a step for loading the workpiece in the first area of the sliding table, (C) a step for detecting the loaded position of the workpiece in the first area, (D) a step for sliding the sliding table again and temporarily stopping in the first area at the prescribed second stopping position, (E) a step for projecting exposure light of a pattern on a photomask onto the workpiece in the first area, (F) a step for unloading the workpiece on which projection exposure has been completed from the second area in parallel with the projection exposure processing of (E) when there is the workpiece in the second area of the sliding table on which projection exposure has been completed, and (G) a step for switching from the first area of the prescribed first stopping position of the steps (A) to (F) to the second area of the prescribed second stopping position, carrying out the next cycle of processing, and alternately switching between the first area and second area for subsequent cycles.

[0020]

Effects of the Invention

According to the exposure device of the present invention, together with forming a plurality of areas on the uppermost surface of a site where workpieces are placed so that a plurality of workpieces can be placed simultaneously without overlapping and providing a sliding table of the reciprocating motion type composed to be able to slide and temporarily stop at a plurality of prescribed stopping positions, by arranging a first workpiece loader and a position detection device on the sliding table respectively corresponding to different areas on the sliding table on both sides in the direction of sliding thereof while centered on a projection optical system that projects a pattern on a photomask onto the workpiece, each process can be carried out in parallel. As a result,

a projection exposure device, and a projection exposure method thereof, can be provided that are able to shorten total exposure time of the workpiece to a greater degree than the prior art.

DESCRIPTION OF EMBODIMENTS

[0021]

<First Embodiment>

The following provides an explanation of a first embodiment according to the present invention with reference to the drawings. FIGS. 1(a) and 1(b) indicate the general configuration of an exposure device 1 of a first embodiment of the present invention, and a roughly rectangular workpiece sliding table 120 is installed on a workpiece stage base 140.

[0022]

On the workpiece sliding table 120, two workpiece placement areas consisting of a first area 110 and a second area 111 are arranged on both ends along the long sides of the sliding table 120. The first workpiece placement area 110 and the second workpiece placement area 111 have a larger surface area than each of the surface areas of a first workpiece 510 and a second workpiece 511, have sufficient area for respectively placing each workpiece thereon, and each area may be provided with a marker indicating a position recognition mark (ID) or position measurement reference point (not shown) at a location that does interfere with each workpiece.

[0023]

The workpiece sliding table 120 is connected to a control unit 410, containing a microcomputer or central processing unit (CPU), through an XYZ tilt drive unit 150. Drive signals are sent to the workpiece sliding table 120 from the XYZ tilt drive unit 150 according to commands from the control unit 410. Sliding distance and stopping position on the flat surface of the workpiece sliding table 120 can be precisely controlled by a drive mechanism and the like not shown. In addition, the workpiece sliding table 120 is supplied with the required electrical power for sliding by being connected to a power supply not shown.

[0024]

The workpiece stage base 140 is a base for sliding or tilting the workpiece sliding table 120 in each of the X, Y and Z directions, and may be provided with a drive mechanism or guide rails and the like as necessary. In the present embodiment, although the case of sliding in the X direction only is explained, other direction and tilt functions can also be used such as for positioning in order to expose a prescribed pattern.

[0025]

The first workpiece placement area 110 moves to a first stopping position 610 or a second stopping position 611 and is able to stop at that position by sliding the workpiece sliding table 120 through the XYZ tilt drive unit 150 controlled by the control unit 410. The greater the fineness of the exposed pattern, the greater the need for high sliding accuracy and stopping accuracy as well as precision control thereof. A first position detection unit 210, for example, is arranged directly above the first workpiece placement area 110 when having temporarily stopped at the first stopping position 610. In addition, in FIG. 1(a), a first loader 310 is arranged above or in the vicinity of the first workpiece placement area 110 when having temporarily stopped at the first stopping position 610. The first loader 310 is able to unload a workpiece for which exposure has been completed from the first workpiece placement area 110 after

having temporarily stopped at the first stopping position 610, and is then able to load a workpiece that has yet to be exposed from that area. A conveyor, for example, not shown can be used to send exposed workpieces that have been removed from the workpiece sliding table 120 to the next step or transfer unexposed workpieces to the vicinity of the first loader 310. In addition, a projection optical system 50 for exposure is arranged directly above the second stopping position 611.

[0026]

The second workpiece placement area 111 can also be moved to the first stopping position 610 or the second stopping position 611 and stopped at that position by sliding the workpiece sliding table 120 controlled by the control unit 410. Since the first stopping position 610 and the second stopping position 611 are arranged on both ends along the long side of the roughly rectangular workpiece sliding table 120, although the first position detection unit 210 is arranged directly above the first workpiece placement area 110, the first loader 310 is arranged above or in the vicinity of the first workpiece placement area 110, and the projection optical system 50 for exposure is arranged directly above the second workpiece placement area 111 when the workpiece sliding table 120 has stopped at the first stopping position 610, when the workpiece sliding table 120 has stopped at the second stopping position 611, the second position detection unit 211 is arranged directly above the second workpiece placement area 111, the second loader 311 is arranged above or in the vicinity of the second workpiece placement area 111, and the projection optical system 50 for exposure is arranged directly above the first workpiece placement area 110.

[0027]

A light source unit 10, a photomask 20, a mask XYθ stage 30, and a mask tilt stage 40 are arranged further above the projection optical system 50 for exposure. In case of FIG. 1(a), exposure light from the light source unit 10 passes through the photomask 20 and the projection optical system 50 for exposure to expose the second workpiece 511 placed in the second workpiece placement area 111 when temporarily stopped at the first stopping position 610, and as a result thereof, a prescribed pattern on the photomask 20 is transferred onto the second workpiece 511.

[0028]

The mask XYθ stage 30 is connected to the control unit 410, containing a microcomputer of central processing unit (CPU), via a mask XYθ stage drive unit 60. Drive signals from the mask XYθ stage drive unit 60 are sent to the mask XYθ stage 30 according to commands from the control unit 410. Stopping positions of the mask XYθ stage 30 in the X, Y and θ directions (vertical, horizontal and rotation) on the flat surface of the stage can be precisely controlled by the mask XYθ stage drive unit 60 that is able to move in the X direction (horizontal), Y direction (vertical) or θ (rotation) on the flat surface of a stage not shown. In addition, the mask XYθ stage 30 is also supplied with the required electrical power for movement in the X, Y and θ directions (vertical, horizontal and rotation) by being connected to a power supply not shown.

[0029]

The mask tilt stage 40 is connected to the control unit 410, containing a microcomputer or central processing unit (CPU), via a mask tilt stage drive unit 70. Drive signals are sent from the mask tilt stage drive unit 70 to the mask tilt stage 40 according to commands from the control unit 410. The stopping position of the mask tilt stage 40 where the flat surface of the stage is in an inclined (tilted) state can be precisely controlled by the mask tilt stage drive unit 70 capable of tilting the flat surface of a

stage not shown by inclining from an angle perpendicular to the optical axis. In addition, the mask tilt stage 40 is also supplied with the required electrical power for tilting the flat surface of the stage by being connected to a power supply not shown.

[0030]

The control unit 410 controls the planar position, planar angle and tilt angle of the workpiece sliding table 120, the workpiece stage base 140, the mask XYθ stage 30 and the mask tilt stage 40 so that a prescribed pattern on the photomask 20 is accurately transferred to a prescribed position on the second workpiece 511. At that time, a photomask microscope or workpiece microscope not shown, for example, can be used to carry out control so that a mask alignment mark not shown present on the photomask aligns with a workpiece alignment mark on the workpiece. In addition, a drive unit can also be provided in the projection optical system 50 and that can be used for control to project a prescribed pattern on the photomask at a prescribed position on the workpiece.

[0031]

Next, an explanation is provided of the operation of the present embodiment using FIG. 2. First, when processing is started, the sliding table 120 is confirmed as to whether or not it is temporarily stopped at the first stopping position 610 (S1). If the sliding table 120 is temporarily stopped at the first stopping position 610 (S1: Yes), an unexposed workpiece is confirmed as to whether or not it has been placed in the first workpiece placement area 110 of the sliding table 120 (S2). If the sliding table 120 is not temporarily stopped at the first stopping position 610 (S1: No), since this means that the sliding table 120 is temporarily stopped at the second stopping position 611, processing proceeds to Step S7.

[0032]

When an unexposed workpiece has not been placed in the first workpiece placement area 110 of the sliding table 120 (S2: Yes), the control unit 410 outputs a command to the first loader 310 so that an unexposed workpiece is loaded into the first workpiece placement area 110 (S3). When an unexposed workpiece has been placed in the first workpiece placement area 110 (S2: No), processing proceeds to Step S4 since it is not necessary to load an unexposed workpiece and the position of the first workpiece 510 in the first workpiece placement area 110 is detected with the first position detection unit 210 according to a command from the control unit 410 (Step S4). At that time, a stage alignment mark on the stage or a workpiece alignment mark on the workpiece, for example, may also be detected with a workpiece microscope.

[0033]

Once the position of the first workpiece 510 has been detected at the first workpiece placement area 110, the control unit 410 outputs a command to the XYZ tilt drive unit 150 that causes the sliding table 120 to slide from the first stopping position 610 to the second stopping position 611 (S5), and outputs a temporarily stop command once the first workpiece placement area 110 on the sliding table 120 has reached a location directly below the projection optical system 50 when the second stopping position 611 (S6).

[0034]

Once the sliding table 120 has temporarily stopped at the second stopping position 611, an exposed workpiece is confirmed as to whether or not it is present in the second workpiece placement area 111 of the sliding table 120 at the first stopping position 610 (S7). When the exposed workpiece is present in the second workpiece placement area

111 (S7: Yes), the control unit 410 outputs a command to the second loader 311 to unload the exposed workpiece from the second workpiece placement area 111 (S8) and load an unexposed workpiece to the second workpiece placement area 111 (S9). When the exposed workpiece is not present in the second workpiece placement area 111 (S7: No), processing proceeds to S9 and an unexposed workpiece is loaded in the second workpiece placement area 111 (S9) since it is not necessary to unload a workpiece.

[0035]

A prescribed pattern of the photomask 20 is transferred onto the first workpiece 510 by projection exposure at the second stopping position 611 of the first workpiece 510 for which the position thereof has been detected in the first workpiece placement area 110 simultaneous to and in parallel with loading of a workpiece in the second workpiece placement area 111 following the processing of Step S7 (S10). When transfer of that prescribed pattern is completed, the control unit 410 outputs a command to the XYZ tilt drive unit 150 to slide again (S11) and outputs a command to the drive table 120 to temporarily stop once it has reached the first stopping position 610 (S12).

[0036]

Once the sliding table 120 has temporarily stopped at the first stopping position 610, an exposed workpiece is confirmed as to whether or not it is present in the first workpiece placement area 110 of the sliding table 12 at the first stopping position 610 (S13). When the exposed workpiece is present in the first workpiece placement area 110 (S13: Yes), the control unit 410 outputs a command to the first loader 310 to unload the exposed workpiece from the first workpiece placement area 110 (S14), after which the process proceeds to Step S16 and confirmation is made as to whether or not there are any unexposed workpieces remaining (S16). When an exposed workpiece is not present in the first workpiece placement area 110 (S13: No), processing proceeds to Step S16 and confirmation is made as to whether or not there are any unexposed workpieces remaining (S16).

[0037]

A prescribed pattern of the photomask 20 is transferred onto the second workpiece 511 by projection exposure at the second stopping position 611 of the second workpiece 511 for which the position thereof has been detected in the second workpiece placement area 111 simultaneous to and in parallel with confirming whether or not an exposed workpiece is present in the first workpiece placement area 110 of the sliding table 120 at the first stopping position 610 following the processing of Step S12 (S15), and the control unit 410 confirms whether or not there are any unexposed workpieces remaining (S16).

[0038]

When there are no unexposed workpieces remaining (S16: Yes), processing ends, while when there are unexposed workpieces remaining (S16: No), processing returns to Step S1 and the first workpiece placement area 110 is confirmed as to whether or not it is temporarily stopped at the first stopping position 610 (S1), after which processing is repeated.

[0039]

Thus, the projection exposure device 1 of the present embodiment is a projection exposure device that forms a prescribed pattern on the workpieces 510 and 511 by aligning the prescribed pattern of the photomask 20 with the prescribed positions of the workpieces 510 and 511 and projecting exposure light from a light source, and has a

sliding table 120 composed by forming two areas consisting of a first area 110 and a second area 111 on the uppermost surface of sites where the workpieces 510 and 511 are placed so as to enable the two workpieces 510 and 511 to be placed simultaneously without overlapping, and being able to alternately slide in opposite directions and temporarily stop at a prescribed first stopping position 610 and second stopping position 611 at the endpoint in each direction, two loaders consisting of a first loader 310 and second loader 311 able to respectively and individually load and unload the workpieces 510 and 511 located within each area of the sliding table 120, a first position detection unit 210 arranged directly above the first area 110 on the sliding table 120 so as to detect the loaded position of the workpiece 510 or 511 placed within the first area 110 when the sliding table 120 has temporarily stopped at the prescribed first stopping position 610, a second position detection unit 211 arranged directly above the second area 111 on the sliding table 120 so as to detect the loaded position of the workpiece 510 or 511 placed within the second area 111 when the sliding table 120 has temporarily stopped at the prescribed second stopping position 611, a light source unit 10, a photomask 20 and a projection optical system 50 arranged directly above the second area 111 on the sliding table 120 that is able to project exposure light onto a workpiece 510 or 511 placed in the second area 111 when the sliding table 120 has temporarily stopped at the prescribed first stopping position 610 and arranged directly above the first area 110 on the sliding table 120 that is able to project exposure light onto a workpiece 510 or 511 placed in the first area 110 when the sliding table 120 has temporarily stopped at the prescribed second stopping position 611, and a control unit 410 that controls sliding and stopping at each stopping position 610 and 611 of the sliding table 120, loading and unloading of a workpiece 510 or 511 in each area by the first loader 310, detection of the loaded position of a workpiece 510 or 511 in each area by the position detection unit 210 or 211, and projection of exposure light onto a workpiece 510 or 511 in each area by the light source 10, the photomask 20 and the projection optical system 50; wherein, the control unit 410 carries out parallel processing consisting of detecting the loaded position of the workpiece 510 placed in the first area 110 with the position detection unit 210 when exposure light is projected onto the workpiece 511 loaded in the second area 111 by the light source unit 10, photomask 20 and projection optical system 50, and conversely detecting the loaded position of the workpiece 511 placed in the second area 111 with the position detection unit 211 when exposure light is projected onto the workpiece 510 loaded in the first area 110 by the light source unit 10, photomask 20 and projection optical system 50.

[0040]

In addition, the projection exposure device 1 of the present embodiment can also be an exposure device that carries out stepping exposure of a single workpiece 510 or 511 by projecting a projection exposure pattern in a plurality of shots. In addition, in the projection exposure device 1 of each of the aforementioned embodiments, a device that aligns the position of a projection exposure pattern with the positions of workpieces 510 and 511 for which the positions thereof have been detected can include a drive unit 60 that linearly drives the photomask 20 in at least one of the vertical (Y), horizontal (X) and height (Z) directions, and/or a device that aligns the position of a projection exposure pattern with the positions of workpieces 510 and 511 for which the positions thereof have been detected can include tilt drive units 40 and 70 that change the angle of the photomask 20 relative to exposure light from the orthogonal plane, and/or a device that aligns the position of a projection exposure pattern with the positions of workpieces

510 and 511 for which the positions thereof have been detected can include a drive device 150 that linearly moves a stage arranged beneath the sliding table 120 in at least one direction consisting of the vertical (Y), horizontal (X) and height (Z) directions, and/or a device that aligns the position of a projection exposure pattern with the positions of workpieces 510 and 511 for which the positions thereof have been detected can include a drive device that linearly moves the projection optical system 50 in at least one direction consisting of the vertical (Y), horizontal (X) and height (Z) directions.

[0041]

In addition, the projection exposure method of the projection exposure device 11 of the present embodiment is a projection exposure method for forming a prescribed pattern on workpieces 510 and 511 by aligning a prescribed pattern of a photomask 20 at a prescribed position on the workpieces 510 and 511 and projecting exposure light from a light source unit 10 using the projection exposure device 1 having a sliding table 120 composed by forming two areas consisting of a first area 110 and a second area 111 on the uppermost surface of sites where workpieces 510 and 511 are placed so that the two workpieces 510 and 511 are able to be placed simultaneously without overlapping, and being able to alternately slide in opposite directions and temporarily stopped at a prescribed first stopping position 610 and second stopping position 611 at the endpoint in each direction; including: (A) a step for sliding the sliding table 120 and temporarily stopping in the first area 110 at the prescribed first stopping position 610, (B) a step for loading a workpiece 510 or 511 in the first area 110 of the sliding table 120, (C) a step for detecting the loaded position of the workpiece 510 or 511 in the first area 110, (D) a step for sliding the sliding table 120 again and temporarily stopping in the first area 110 at the prescribed second stopping position 611, (E) a step for projecting exposure light of a pattern on a photomask 20 onto the workpiece 510 or 511 in the first area 110, (F) a step for unloading the workpiece 510 or 511 on which projection exposure has been completed from the second area 111 in parallel with the projection exposure processing of (E) when there is a workpiece 510 or 511 in the second area 111 of the sliding table 120 on which projection exposure has been completed, and (G) a step for switching from the first area 110 of the prescribed first stopping position 610 of the steps (A) to (F) to the second area 111 of the prescribed second stopping position 611, carrying out the next cycle of processing, and alternately switching between the first area 110 and the second area 111 for subsequent cycles.

[0042]

As has been described above, in the first embodiment, the projection optical system 50, the first position detection unit 210, the second position detection unit 211, the first loader 310 and the second loader 311 are able to carry out different processing simultaneous and in parallel with workpiece loading and unloading, position detection or projection exposure on different workpieces present in different first and second workpiece placement areas when having temporarily stopped at each of the first and second stopping positions. Thus, in comparison with the case of the prior art in which each process is carried out continuously in series at the same location, the present embodiment is able to shorten processing time as a result of being able to carry out processing in parallel.

BRIEF DESCRIPTION OF THE REFERENCE NUMERALS

[0043]

1 Projection exposure device
10 Light source unit
20 Photomask (reticule)
30 Mask XYθ stage
40 Mask tilt stage
50 Projection optical system
60 Mask XYθ stage drive unit
70 Mask tilt stage drive unit
110 First workpiece placement area
111 Second workpiece placement area
120 Workpiece sliding table
140 Workpiece stage base
150 XYZ tilt drive unit
210 First position detection unit
211 Second position detection unit
310 First loader
311 Second loader
410 Control unit
510 First workpiece
511 Second workpiece
610 First stopping position
611 Second stopping position

CLAIMS

1. A projection exposure device that forms a prescribed pattern of a photomask on a workpiece by aligning the prescribed pattern at a prescribed position on the workpiece and projecting exposure light from a light source, having:

a sliding table composed by forming two first and second areas on the uppermost surface of sites where the workpieces are placed so as to enable two workpieces to be placed simultaneously without overlapping, and being able to alternately slide in opposite directions and temporarily stop at a prescribed first stopping position and second stopping position at the endpoint in each direction,

two first loaders able to respectively and individually load and unload the workpieces located within each of the areas of the sliding table,

a first position detection device arranged directly above the first area on the sliding table so as to detect the loaded position of the workpiece placed within the first area when the sliding table has temporarily stopped at the prescribed first stopping position,

a second position detection device arranged directly above the second area on the sliding table so as to detect the loaded position of the workpiece placed within the second area when the sliding table has temporarily stopped at the prescribed second stopping position,

a light source, a photomask and a projection optical system arranged directly above the second area on the sliding table that is able to project exposure light onto the workpiece placed in the second area when the sliding table has temporarily stopped at the prescribed first stopping position and arranged directly above the first area on the sliding table that is able to project exposure light onto the workpiece placed in the first area when the sliding table has temporarily stopped at the prescribed second stopping position, and

a control unit that controls sliding and stopping at each stopping position of the sliding table, loading and unloading of the workpiece in each area by the first loader, detection of the loaded position of the workpiece in each area by the position detection devices, and projection of exposure light onto the workpiece in each area by the light source, the photomask and the projection optical system; wherein,

the control unit carries out parallel processing consisting of detecting the loaded position of the workpiece placed in the first area with the position detection device when exposure light is projected onto the workpiece loaded in the second area by the light source, photomask and projection optical system, and conversely detecting the loaded position of the workpiece placed in the second area with the position detection device when exposure light is projected onto the workpiece loaded in the first area by the light source, photomask and projection optical system.

2. The projection exposure device according to claim 1, wherein the projection exposure device is a projection exposure device that carries out stepping exposure of the single workpiece by projecting a projection exposure pattern in a plurality of shots.

3. The projection exposure device according to claim 1 or 2, wherein a device that aligns the position of the projection exposure pattern with the position of the workpiece for which position has been detected includes a drive device that linearly moves the photomask in at least one of the vertical (Y), horizontal (X) and height (Z) directions.

4. The projection exposure device according to any of claims 1 to 3, wherein a device that aligns the position of the projection exposure pattern with the position of the workpiece for which position has been detected includes a tilt drive device that changes the angle of the photomask relative to exposure light from the orthogonal plane.

5. The projection exposure device according to any of claims 1 to 3, wherein a device that aligns the position of the projection exposure pattern with the position of the workpiece for which position has been detected includes a drive device that linearly moves a stage arranged beneath the sliding table in at least one direction consisting of the vertical (Y), horizontal (X) and height (Z) directions.

6. The projection exposure device according to any of claims 1 to 3, wherein a device that aligns the position of the projection exposure pattern with the position of the workpiece for which position has been detected includes a drive device that linearly moves the projection optical system in at least one direction consisting of the vertical (Y), horizontal (X) and height (Z) directions.

7. A projection exposure method for forming a prescribed pattern on a workpiece by aligning the prescribed pattern of a photomask at a prescribed position on the workpiece and projecting exposure light from a light source using a projection exposure device having a sliding table composed by forming two first and second areas on the uppermost surface of sites where the workpieces are placed so as to be able to be placed simultaneously without overlapping, and being able to alternately slide in opposite directions and temporarily stop at a prescribed first stopping position and second stopping position at the endpoint in each direction; comprising:

(A) a step for sliding the sliding table and temporarily stopping in the first area at the prescribed first stopping position,

(B) a step for loading the workpiece in the first area of the sliding table,

(C) a step for detecting the loaded position of the workpiece in the first area,

(D) a step for sliding the sliding table again and temporarily stopping in the first area at the prescribed second stopping position,

(E) a step for projecting exposure light of a pattern on a photomask onto the workpiece in the first area,

(F) a step for unloading the workpiece on which projection exposure has been completed from the second area in parallel with the projection exposure processing of (E) when there is the workpiece in the second area of the sliding table on which projection exposure has been completed, and

(G) a step for switching from the first area of the prescribed first stopping position of the steps (A) to (F) to the second area of the prescribed second stopping position, carrying out the next cycle of processing, and alternately switching between the first area and second area for subsequent cycles.