

However, in the above structure, after an ion beam is irradiated (implanted) into a certain wafer, it takes a rather long waste time to irradiate an ion beam into a next wafer. This waste time is a bottleneck in improving the throughput further.

[0005]

5 Specifically, after an ion beam is irradiated (an ion is implanted) into a certain wafer, the following process must be executed before an ion beam is irradiated into a next wafer: that is, the process in which the ion implanted wafer is transferred through a load lock chamber to the outside, and a next wafer is mounted onto a platen through the load lock chamber and is then transferred to an ion beam irradiation area. This process makes the
10 waste time rather long, which has a bad effect on the throughput and also, during the waste time, the ion beam is consumed wastefully.

These issues are found not only in the ion implantation system but also in the energy beam irradiation system for irradiating an energy beam into a work, in general.

[0006]

15 The invention aims at solving these issues and thus it is an object of the invention to provide this type of energy beam irradiation system which can improve its throughput outstandingly and can make efficient use of the energy beam.

[0007]

20 An energy beam irradiation system includes an energy beam emitting mechanism and a work holder. The energy beam emitting mechanism emits an energy beam toward a predetermined irradiation area. The work holder transfers works between a predetermined work delivery area and the irradiation area. The works are irradiated by the energy beam. The work delivery area includes two work delivery areas formed opposed to each other across a virtual straight line passing the energy beam irradiation area. The work holder
25 includes first and second work holders. The first work holder transfers the works between a first work delivery area and the irradiation area. The second work holder transfers the

works between a second work delivery area and the irradiation area.

[0008]

According to this system, while an energy beam is being irradiated into works transferred to an irradiation area by one work holder, irradiated works can be replaced with
5 un-irradiated works and the un-irradiated works can be held by the other work holder. Thus, after the irradiated-works are transferred by one work holder, next energy beam un-irradiated works can be transferred to the irradiation area by the other work holder speedily, thereby being able to start the irradiation of an energy beam into the next works.

[0009]

10 That is, according to the invention, it is possible to reduce greatly the time necessary from the end of the energy beam irradiation into works to the start of the energy beam irradiation into next works. Therefore, the throughput of the system can be improved greatly and also the energy beam can be used more efficiently.

[0010]

15 In order that the system can handle works respectively having different dimensions to thereby enhance the general purpose property thereof, preferably, the respective work holders may be structured such that they can transfer works respectively having different dimensions. More specifically, the respective work holders may be able to transfer works respectively having different dimensions in an intermingled manner; or, while works of the
20 same dimensions may be transferred within the same work holder, the dimensions of works to be transferred by one work holder may also be different from the dimensions of works to be transferred by the other work holder.

[0011]

When an energy beam emitting mechanism and work holders are arranged within
25 an energy beam irradiation chamber maintained at a predetermined degree of vacuum, there can be disposed a work mounting portion in a load lock chamber, which mounts works

transferred from the outside but not yet irradiated by an energy beam thereon intermediately and mounts irradiated works to be transferred to the outside.

[0012]

In order to apply this invention in such a case and in order to ensure the throughput of the system, it is prefer that a first work mounting portion and a second work mounting portion are formed in two portions opposed to each other across the virtual straight line. Further, it is prefer that first and second transfer members are formed. The first transfer member transfers works between the first work delivery area and the first work mounting portion and the second transfer member transfers works between the second work delivery area and the second work mounting portion.

[0013]

As a specific embodiment to improve the throughput of the system as much as possible, it is prefer to form an intermediate work mounting portion, a third transfer member and a fourth transfer member. The intermediate work mounting portion is formed between the first work mounting portion and the second work mounting portion. The third transfer member transfers works between the first work delivery area and the intermediate work mounting portion. The fourth transfer member transfers works between the second work delivery area and the intermediate work mounting portion.

[0014]

In order to simplify the structure of the transfer member, it is prefer that the respective transfer members are capable of transferring works different in size from each other.

As a successful example to prove the effect of this invention, it is a case where the energy beam is an ion beam and an ion is implanted into works.

[0015]

According to the above-structured invention, immediately after the irradiation of an

energy beam into first works is ended, the irradiation of an energy beam into next works can be started, thereby being able to enhance greatly the throughput of the system. Also, since the time necessary to consume the energy beam wastefully is reduced, the energy beam can be used efficiently.

5

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a typical plan view of the whole of an ion implantation system according to a first embodiment of the invention.

10 Fig. 2 is a partially perspective view of a wafer transfer mechanism according to the embodiment.

Figs. 3(i) to 3(vi) are flow charts of wafer transfer steps according to the embodiment.

15 Figs. 4(vii) to 4(xii) are flow charts of wafer transfer steps according to the embodiment.

Fig. 5 is a timing chart of the timings of ion implantation and wafer transfer according to the embodiment.

Fig. 6 is a timing chart of the timings of ion implantation and wafer transfer according to the embodiment.

20 Fig. 7 is a typical plan view of the whole of an ion implantation system according to a second embodiment of the invention.

Fig. 8(i) to 8(iv) are flow charts of wafer transfer steps according to the second embodiment.

25 Fig. 9(v) to 9(viii) are flow charts of wafer transfer steps according to the second embodiment.

DETAILED DESCRIPTION

[0017]

<First embodiment>

Now, description is given below of an ion implantation system 100 serving as an
5 energy beam irradiation system according to a first embodiment of the invention with
reference to the accompanying drawings. Here, in the following description and drawings,
when multiple members and structures of the same type exist and they must be
distinguished from each other, (1), (2) or the like is applied to the ends of their designations,
or “a first”, “a second” or the like is applied to such members and structures.

10 [0018]

This ion implantation system 100, as shown in Fig. 1, includes an ion beam
emitting apparatus for emitting an ion beam IB in an ion implantation chamber 10 set for a
vacuum, and a work transfer apparatus 20 which transfers works (here, wafers) W to an
irradiation area AR for irradiating the ion beam IB into the wafer W and also which allows
15 the ion beam IB to be irradiated into the works W.

[0019]

The ion beam emitting apparatus is used to emit the ion beam IB having, for
example, a ribbon-like shape toward the irradiation area AR. Here, the shape of the ion
beam IB is not limited to the ribbon-like shape but, for example, a square shape may also be
20 used. Also, reference numeral 9 shown in Fig. 1 designates a beam profiler for monitoring
the intensity distribution property of the ion beam IB and also for shielding the beam IB
having intensity greater than the range of the intensity distribution property.

[0020]

The work transfer apparatus 20 includes a work loading and unloading mechanism
25 1 for loading and unloading the works W between inside and outside the ion implantation
chamber 10, a work transfer mechanism 2 for transferring works W to the beam irradiation

area AR for implanting ions into the works W, and an intermediate transfer mechanism 3 interposed between the work loading and unloading mechanism 1 and work transfer mechanism 2 for delivering the works W between them.

Description is given below of the respective composing parts of the work transfer apparatus 20.

[0021]

The work loading and unloading mechanism 1 includes a load-lock chamber 11 (which is also called a load lock chamber 11) disposed adjacent to the ion implantation chamber 10, a work mounting table 12 serving as a work mounting portion, and an upward/downward driving actuator (not shown) for lifting and lowering the work mounting table 12. Since they are described specifically in the patent document 1, here, they are described simply. That is, the load lock chamber 11 is interposed between an openable and closeable upper cover and the work mounting table 12 disposed at a predetermined upper position. The work mounting table 12 is capable of mounting thereon multiple works W in a row; and, when it is situated at the above-mentioned upper position, it functions as a partition wall for shielding air tight the load lock chamber 11 and ion implantation chamber 10 from each other, while, at a predetermined lower position, it exists within the ion implantation chamber 10 and is capable of delivering the works W with respect to the intermediate transfer mechanism 3 which is discussed later.

[0022]

Thus, in this embodiment, two work loading and unloading mechanisms 1 (which make a pair) are disposed in line symmetry with respect to a virtual straight line C passing the irradiation area AR when viewed from above. The virtual straight line C is here coincident with the axis of the ion beam IB. However, they may not always be coincident.

[0023]

The work transfer mechanism 2 includes, for example, a platen 21 serving as a

work holder, a base member 22 for supporting the platen 21, and a linearly advancing and retreating mechanism 23 for advancing and retreating the base member 22 linearly. The mechanism 2 is used to receive the works W transferred by the intermediate transfer mechanism 3 (which is discussed later) in a predetermined work delivery area and transfer the works W to the irradiation area AR, and is also used to transfer the works W from the irradiation area AR to the work delivery area, thereby delivering it to the intermediate transfer mechanism 3.

[0024]

The platen 21 includes chuck plates (not shown) each which has a flat circular shape or the like and which are capable of chucking and holding works W in multiple rows (here 2 rows) on one surface thereof due to electrostatic chucks. In this embodiment, there are provided two paired platens 21 which respectively correspond to the two paired work loading and unloading mechanisms 1.

[0025]

The base member 22 is a block-shaped member provided in each of the platens 21 and, in a state where the surface plate portion of each platen 21 extends parallel to the advancing and retreating direction, it pivotally supports the base end portion of the platen 21 by the rotation shaft thereof extending parallel to the advancing and retreating direction. The base member 22 includes therein a toggle actuator (not shown) such as a motor, whereby the surface plate portion of the platen 21 can be laid down and raised up between its horizontal state providing its delivery posture and its vertical state providing its beam irradiation posture.

[0026]

The linearly advancing and retreating mechanism 23 includes, for example, a common rail member 231 which is laid in a horizontal straight line perpendicular to the axis of the ion beam IB and with which the base members 22 can be slidably engaged, and a

slide actuator (not shown) for advancing and retreating the base members 22 independently of each other along the rail member 231. The slide actuator is constituted of, for example, a belt (not shown) provided within the rail member 231 and a motor for rotating the belt. Thus, while being pulled by the belt, the base member 22 is caused to advance and retreat
5 on the rail member 231. Here, the linearly advancing and retreating mechanism 23 is not limited to this structure but, for example, a structure using a screw feed mechanism may also be used. Also, in the following description, the linearly advancing and retreating direction is defined as an x direction.

[0027]

10 The intermediate transfer mechanism 3 includes a transfer arm 31 constituted of a transfer member the base end portion of which is pivotally supported in such a manner that the transfer arm 31 can be turned horizontally, and a pivoting actuator (not shown) such as a motor for turning the transfer arm 31 forwardly and reversely, whereby the mechanism 3 can transfer the works W between the work mounting table 12 and delivery area.

15 [0028]

The transfer arm 31 has a long plate shape and includes a grasping claws (not shown) provided on the lower side thereof; and, by catching the claw-opposing section of the lower surface peripheral edge portion of the works W with the grasping claws, the arm 31 can hold the works W on the lower side of the transfer arm 31. In this embodiment, the
20 transfer arm 31 can hold multiple works W arranged in a row along the extending direction of the transfer arm 31.

[0029]

Thus, in this embodiment, as shown in Fig. 1, the paired intermediate transfer mechanisms 3 are provided in line symmetry with respect to the virtual straight line C, and
25 they are respectively arranged to correspond to their respective work loading and unloading mechanisms 1. Here, in the following description, the virtual straight line direction is

defined as a y direction and a direction perpendicular to both of the x direction and y direction is defined as a z direction.

[0030]

In addition to the above structure, the ion implantation system 100 further includes multiple external storage chambers 4 disposed outside the ion implantation chamber 10, and an external transfer mechanism 5 for transferring the works W between the external storage chambers 4 and the load lock chamber 11.

[0031]

Specifically, the external storage chambers 4 are used to store multiple works W in multiple stages, while the inside thereof is maintained at a predetermined clean degree. Here, the multiple external storage chambers 4 are arranged along the x direction.

[0032]

The external transfer mechanism 5 includes a rail 51 extending in the x direction and a transfer machine main body 52 capable of advancing and retreating along the rail 51.

The transfer machine main body 52 includes an arm 521 for chucking the works W. The transfer machine main body 52 moves along the rail 51 and also the arm 521 chucks the works W and turns. Accordingly, the works W are transferred between the external storage chambers 4 and load lock chamber 11. Here, the works W, which have been taken out from a certain external storage chamber 4 and have received ion implantation, are returned to the same external storage chamber 4.

Thus, in this embodiment, two external transfer mechanisms 5 while making a pair are disposed at positions opposed to each other with the virtual straight line C as the center thereof, and they are arranged to correspond to the work loading and unloading mechanisms 1 respectively.

[0033]

Next, description is given of the operation of the thus structured ion implantation

system 100 with reference to Figs. 3 and 4.

For convenience of explanation, description is started at a state shown in Fig. 3 (i).

In a state shown in Fig. 3 (i), a second platen 21 (2), while holding thereon large diameter works W (2) arranged in two rows, takes a vertical posture (the above-mentioned beam irradiation posture) and also exists in the irradiation area AR, and ion beams IB are irradiated into the works W (2).

[0034]

On the other hand, a first platen 21 (1) exists in a first work delivery area and waits in the above-mentioned delivery posture (horizontal posture). That is, in this state, a first transfer arm 31 (1) holding a row of small diameter works W (1) mounted on a first work mounting table 12 (1) has just been turned and moved to a position shown here.

[0035]

This position, that is, an area, to which the first transfer arm 31 (1) has been turned toward the rail member 231 up to an angle perpendicular to the x axis, is the first work delivery area in this embodiment.

[0036]

And, in the state of Fig. 3 (i), that is, when the first transfer arm 31 (1) holding the works W (1) turns and is positioned on the first platen 21 (1), the first platen 21 (1) lifts lifting pins (not shown) or the like from below to lift the works W (1) slightly, thereby removing the holding of the works W (1) by the grasping claws of the first transfer arm 31 (1). After then, the first transfer arm 31 (1) retreats from the work delivery area and turns again toward the first work mounting table 12 (1).

[0037]

The works W (1) held by the lifting pins are mounted at the positions of the first row on the first platen 21 (1) by downing the lifting pins, and are held there due to electrostatic chucks.

[0038]

On the other hand, the first work mounting table 12 (1) with the works W (1) removed therefrom is caused to enter the load lock chamber 11 again due to the function of the first work loading and unloading mechanism 1 (1) and, after receiving new works W (1) from a first external transfer mechanism 5 (1), it returns to the ion implantation chamber 10 and waits there.

[0039]

The first transfer arm 31 (1) having returned from the first platen 21 (1) holds new works W (1) with no ion implanted and turns again toward the first work delivery area.

During this, the first platen 21 (1) is moved in the x direction by an amount substantially corresponding to the distance between the works W (1) holding rows of the linearly advancing and retreating mechanism 23, and waits there.

[0040]

Then, as shown in Fig. 3 (ii), the first transfer arm 31 (1) turns and reaches there. Similarly to the above operation, the works W (1) are mounted at the positions of the second row on the first platen 21 (1) and are held due to electrostatic chucks. This state is shown in Fig. 3 (iii).

The first platen 21 (1) holding the works W (1) of the two rows in this manner, as shown in Fig. 3 (iv), takes a vertical beam irradiation posture and waits.

[0041]

After then, when the implantation of ions into the works W (2) held on the second platen 21 (2) is ended, the second platen 21 (2) slides toward the second work mounting table 12 (2) beyond the virtual straight line C and thus retreats from the irradiation area AR to a second work delivery area. Almost simultaneously with such retreat, the first platen 21 (1) holding the works W (1) instead moves to the irradiation area AR, where the irradiation of ion beams IB into the works W (1) is started.

[0042]

The retreated second platen 21 (2) changes from the beam irradiation posture to the delivery posture and waits in the second work delivery area. The second work delivery area is the position where the second transfer arm 31 (2) turns up to an angle perpendicular to the x axis and is set at the position opposed to the first work delivery area across the virtual straight line C.

[0043]

Then, the second transfer arm 31 (2) turns there and receives the works W (2) of the first row from the second platen 21 (2); and, as shown in Fig. 3 (v), it transfers and mounts the works W (2) onto the second work mounting table 12 (2). Here, the procedure when the second transfer arm 31 (2) receives the works W (2) from the second platen 21 (2) is reverse to the above-mentioned procedure when the works W are delivered from the transfer arm 31 to the platen 21. Thus, the specific description thereof is omitted here.

[0044]

The ion-implanted works W (2) mounted on the second work mounting table 12 (2) are transferred through the second work loading and unloading mechanism 1 (2) and second external transfer mechanism 5 (2) to the external storage chamber 4 where they were originally stored.

During this, the second platen 21 (2) moves in the x direction by an amount substantially corresponding to the distance between the works W (1) holding rows of the linearly advancing and retreating mechanism 23, and waits there.

[0045]

After then, as shown in Fig. 3 (vi), the empty second transfer arm 31 (2) turns there again, receives the works W (2) of the second row and mounts these works W (2) onto the second work mounting table 12 (2). These works W (2) are also transferred through the second work loading and unloading mechanism 1 (2) and second external transfer

mechanism 5 (2) to the external storage chamber 4 where they were originally stored.

[0046]

Next, works W (2) with no ion implanted are newly mounted through the second external transfer mechanism 5 (2) and second work loading and unloading mechanism 1 (2) onto the second work mounting table 12 (2). The second transfer arm 31 (2) transfers these works W (2) to the second platen 21 (2) according to a procedure similar to one when the first transfer arm 31 (1) transferred the works W (1) to the first platen 21 (1) (see Figs. 4 (vii) ~ (ix)).

After then, as shown in Fig. 4 (x), the second platen 21 (2) holding the works W (2) of the two rows takes a vertical beam irradiation posture and waits.

[0047]

And, when the implantation of ions into the works W (1) held on the first platen 21 (1) is ended, the first platen 21 (1) slides toward the first work mounting table 12 (1) beyond the virtual straight line C and thus retreats from the irradiation area AR to the first work delivery area. Almost simultaneously with such retreat, the second platen 21 (2) holding the works W (2) moves instead to the irradiation area AR, where the irradiation of ion beams IB into the works W (2) is started.

[0048]

The retreated first platen 21 (1) changes from the beam irradiation posture to the delivery posture in the first work delivery area. And, the ion-implanted works W (1) held on the first platen 21 (1) are returned through the first transfer arm 31 (1), first work loading and unloading mechanism 1 (1) and first external transfer mechanism 5 (1) to the external storage chamber where they were originally stored according to a procedure similar to one when the ion-implanted works W (2) were transferred in the second platen 21 (2) (see Figs. 4 (xi) and (xii)).

And, the operation is returned to Fig. 3 (i) and similar steps are repeated.

[0049]

According to the above structure, as shown by a timing chart of Fig. 5, while ions are being implanted into the works W (1) held on the first platen 21 (1), the ion-implanted works W (2) on the second platen 21 (1) are replaced with works with no ion implanted and the second platen 21 (2) takes an ion implantation wait posture in the vicinity of the irradiation area AR. Therefore, immediately after the end of the implantation of ions into the works W (1), the implantation of ions into the works W (2) can be started.

[0050]

Thus, since the ions can be implanted successively almost with no interruption, the throughput of the system can be improved greatly and the ion beams can be used very efficiently.

[0051]

Here, there can be a case where the ion implantation time is shorter than the work replacing time. However, even in such case, as the step timing chart thereof is shown in Fig. 6, since the first platen 21 (1), the first transfer arm 31 (1) and the like, and the second platen 21 (2), the second transfer arm 31 (2) and the like can be operated independently without interfering with each other, there is generated the simultaneous operation time thereof, which can reduce as much as possible a waste time which is produced between the time for implanting ions into the works W (1) and the time for implanting ions into the works W (2).

[0052]

<Second Embodiment>

An ion implantation system according to a second embodiment, as shown in Fig. 7, includes, as an intermediate transfer mechanism 3, in addition to the first and second transfer arms 31 (1) and 31 (2), a third transfer arm 31 (3) and a fourth transfer arm 31 (4).

Also, this system includes, as a work loading and unloading mechanism 1, a third

work loading and unloading mechanism 1 (3) interposed between the first and second work loading and unloading mechanisms 1 (1) and 1 (2).

[0053]

Specifically, the third transfer arm 31 (3) makes a pair with the first transfer arm 31 (1) and, when viewed from above (when viewed from the z direction), can be turned symmetrically with the first transfer arm 31 (1). The rotation axis thereof is spaced from that of the first transfer arm 31 (1) by an amount corresponding to the distance between the centers of the works W (1) of two rows to be held by the first platen 21 (1).

[0054]

The fourth transfer arm 31 (4) makes a pair with the second transfer arm 31 (2) and, when viewed from above (when viewed from the z direction), can be turned symmetrically with the second transfer arm 31 (2). The rotation axis thereof is spaced from that of the second transfer arm 31 (2) by an amount corresponding to the distance between the centers of the works W (2) of two rows to be held by the second platen 21 (2).

[0055]

Next, description is given of the operation of the thus structured ion implantation system 100 with reference to Figs. 8 and 9.

For convenience of explanation, description is started at a state shown in Fig. 8 (i).

[0056]

In this state, the second platen 21 (2), while holding large diameter works W (2) of two rows, takes a vertical posture (the above-mentioned beam irradiation posture) and also exists in the irradiation area AR; and, ion beams IB are being irradiated onto the works W (2).

On the other hand, the first platen 21 (1) exists in a first work delivery area and waits in the above-mentioned delivery posture (horizontal posture).

[0057]

Also, the first transfer arm 31 (1), after holding small diameter works W (1) of a row mounted on the first work mounting table 12 (1), turns to an angle perpendicular to the x axis and exists above the first platen 21 (1); and, the third transfer arm 31 (3) also, after holding small diameter works W (1) of a row mounted on the third work mounting table 12 (3), turns to an angle perpendicular to the x axis and exists above the first platen 21 (1) while it extends parallel to the first transfer arm 31 (1).

[0058]

In this state, the first platen 21 (1), without moving, receives the works W (1) from the first transfer arm 31 (1) and third transfer arm 31 (3) almost simultaneously.

After having transferred the works W (1), the first transfer arm 31 (1) and third transfer arm 31 (3), as shown in Fig. 8 (ii), turn and retreat from the first work delivery area.

Next, the first platen 21 (1) holding the works W (1) of two rows, as shown in Fig. 8 (iii), takes a vertical beam irradiation posture and waits.

[0059]

After then, when the implantation of ions into the works W (2) held by the second platen 21 (2) is ended, the second platen 21 (2) slides toward the second work mounting table 12 (2) beyond the virtual straight line C and thus retreats from the irradiation area AR; and, almost simultaneously with such retreat, the first platen 21 (1) holding the works W (1) moves instead to the irradiation area AR, where the irradiation of ion beams IB into the works W (1) is started.

The retreated second platen 21 (2) changes from the beam irradiation posture to the delivery posture and waits in the second work delivery area.

[0060]

In this state, as shown in Fig. 8 (iv), the second and fourth transfer arms 31 (2) and 31 (4) turn there; and, the second transfer arm 31 (2) receives the works W (2) of the first row, and the fourth transfer arm 31 (4) receives the works W (2) of the second row from the

second platen 21 (2), almost simultaneously. And, the second transfer arm 31 (2) transfers the works W (2) of the first row to the second work mounting table 12 (2) and the fourth transfer arm 31 (4) transfers the works W (2) of the second row to the third work mounting table 12 (3), respectively.

5 [0061]

The works W (2) mounted on the second work mounting table 12 (2) and third work mounting table 12 (3) are transferred through the second work loading and unloading mechanism 1 (2), the second external transfer mechanism 5 (2) and the third work loading and unloading mechanism 1 (3) to the external storage chamber 4 where they were
10 originally stored.

[0062]

Next, new works W (2) with no ion implanted are transferred from the external storage chamber 4 through the second external transfer mechanism 5 (2), the second work loading and unloading mechanism 1 (2) and the third work loading and unloading
15 mechanism 1 (3) are mounted onto the second work mounting table 12 (2) and third work mounting table 12 (3), respectively.

[0063]

The second transfer arm 31 (2) and fourth transfer arm 31 (4), as shown in Fig. 9 (v), hold these works W (2) and turn, and deliver them to the second platen 21 (2) waiting at
20 a delivery posture in the second work delivery area. After then, the second transfer arm 31 (2) and fourth transfer arm 31 (4), as shown in Fig. 9 (vi), turn and retreat from the second work delivery area.

On the other hand, the second platen 21 (2) holding the works W (2) of two rows, as shown in Fig. 9 (vii), takes a vertical beam irradiation posture and waits.

25 [0064]

And, when the implantation of ions into the works W (1) held by the first platen 21

(1) is ended, the first platen 21 (1) slides toward the first work mounting table 12 (1) beyond the virtual straight line C and thus retreats from the irradiation area AR; and, almost simultaneously with such retreat, the second platen 21 (2) holding the works W (2) moves instead to the irradiation area AR, where the irradiation of ion beams IB into the works W (2) is started.

[0065]

The retreated first platen 21 (1) changes from the beam irradiation posture to the delivery posture and waits in the first work delivery area. And, as shown in Fig. 9 (viii), the ion-implanted works W (1) held by the first platen 21 (1) are returned through the first and third transfer arms 31 (1) and 31 (3), first and third work loading and unloading mechanisms 1 (1) and 1 (3), and first external transfer mechanism 5 (1) to the external storage chamber 4 where they were originally stored according to a procedure similar to one when the ion-implanted works W (2) were transferred in the second platen 21 (2).

[0066]

According to the thus structured ion implantation system 100 of this embodiment, when compared with the system of the first embodiment, the work replacing time can be reduced further and the throughput of the system can be enhanced further. The major reason for this is that the works W of two rows can be transferred at a time by the two transfer arms 31 without moving the platen 21. When the works W are mounted in two rows by a single transfer arm 31, during this mounting time, the transfer arm 31 must be moved back and forth, and also the platen 21 holding the works of a first row must be slid and moved for delivery of the works W of a second row. In this movement, the system must wait until the works W can be fixed and held due to electrostatic chucks. However, according to the present embodiment which can reduce the waiting time, the work replacing time can be reduced greatly.

[0067]

Further, since the third work mounting table 12 is used in common for the works W (1) and works W (2), when compared with the ion implantation system of the first embodiment, there can be provided an effect that the footprint thereof is substantially the same.

5 However, the invention is not limited to the above embodiments.

[0068]

For example, transfer arms may also be provided in vertically multiple stages on a single shaft. In the case of two upper and lower stages, in the first embodiment, there are provided a total of four transfer arms; and, in the second embodiment, there are provided a
10 total of eight transfer arms.

[0069]

In this case, for example, an operation for one of the upper and lower transfer arms to receive processed works from a platen and transfer them to a work mounting table and an operation for the other to receive unprocessed works from a work mounting table and
15 transfer them to the platen can be carried out simultaneously, which can enhance the processing speed of the system.

[0070]

Specifically, in the case of the first embodiment, the operations of Fig. 3 (v) and Fig. 4 (viii), the operations of Fig. 4 (xi) and Fig. 3 (ii), the operations of Fig. 3 (vi) and Fig.
20 4 (vii), and the operations of Fig. 4 (xii) and Fig. 3 (i) can be respectively carried out simultaneously. And, in the case of the second embodiment, the operations of Fig. 8 (iv) and Fig. 9 (v), and the operations of Fig. 9 (viii) and Fig. 8 (i) can be carried out simultaneously.

The number of rows of works to be held by a work holder may be one or three or
25 more.

[0071]

In the case that the number of transfer arms (in this case, the number of transfer arms having different axes) is the same as the number of rows, as in the second embodiment, the throughput of the system can be enhanced greatly. For three or more rows, the heights of the transfer arms may be set different so that the transfer arms can be turned
5 independently.

The transfer sequence of works is also not limited to the above embodiments but various sequences may also be used.

[0072]

The arrangement of the works on the platen may also be zigzag. In this case, the
10 x-direction dimension of the system can be reduced. The moving direction of the platen need not be perpendicular to the beam irradiation direction.

A twist mechanism for adjusting the twist angles of the works may also be provided and the twist adjustment of the works may be made before or after the works enter the load lock chamber.

15 [0073]

The structure of the ion beam irradiation mechanism side of the system is not limited to any specific one. For example, there may also be employed a structure which includes a mass analysis magnet for analyzing the mass of a beam emitted from an ion source.

20 [0074]

The structures of the work loading and unloading mechanism, the work transfer mechanism, the intermediate transfer mechanism and the like are not limited to those shown in the above embodiments. For example, there may also be used a conveyor-system structure or a structure having a multi-axis articulated arm. Also, the paired mechanisms
25 need not be arranged symmetrically with respect to the virtual straight line, but one of them may be situated in one of two areas divided by the virtual straight line and the other may be

situated in the other area. That is, the expression “opposed to each other” used in Claims means the above-mentioned wide concept, of course, including symmetrical arrangement.

[0075]

The intermediate transfer mechanism is not always necessary. That is, the work
5 holder may also be structured such that it directly transfers works transferred into a chamber from a work mounting portion to an irradiation area. In this case, the work mounting portion serves as the work delivery area.

The work is not limited to a wafer but may be a metal substrate or a block member made of a predetermined material. And, the shape of the work is not limited to a circular
10 shape but may also be a rectangular shape.

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The energy beam to be irradiated is not limited to an ion beam but may also be an electron beam, a quantum beam, and electromagnetic wave or the like. For example, the invention can be applied to an electron beam irradiation system, a sputtering instrument, a
15 plasma doping system and the like.

The invention is not limited to the above-mentioned embodiments but can be modified variously without departing from the subject matter thereof.

WHAT IS CLAIMED IS:

1. An energy beam irradiation system, comprising:

an energy beam emitting mechanism that emits an energy beam toward a

5 predetermined irradiation area; and,

a work holder that transfers works between a predetermined work delivery area and the irradiation area, the works being irradiated by the energy beam,

wherein the work delivery area includes two work delivery areas formed opposed to each other across a virtual straight line passing the energy beam irradiation area, and

10 the work holder includes:

a first work holder that transfers the works between a first work delivery area and the irradiation area; and

a second work holder that transfers the works between a second work delivery area and the irradiation area.

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2. The energy beam irradiation system according to Claim 1,

wherein the first and second work holders are capable of transferring works different in size from each other.

20 3. The energy beam irradiation system according to Claim 1 or 2, further comprising:

a first work mounting portion and a second work mounting portion that are formed in two portions opposed to each other across the virtual straight line;

25 a first transfer member that transfers works between the first work delivery area and the first work mounting portion; and

a second transfer member that transfers works between the second work delivery

area and the second work mounting portion.

4. The energy beam irradiation system according to Claim 3, further comprising:

5 a third work mounting portion that is formed between the first work mounting portion and the second work mounting portion;

a third transfer member that transfers works between the first work delivery area and the third work mounting portion; and

10 a fourth transfer member that transfers works between the second work delivery area and the third work mounting portion.

5. The energy beam irradiation system according to Claim 3 or 4, wherein the respective transfer members are capable of transferring works different in size from each other.

15 6. The energy beam irradiation system according to any one of Claims 1 to 5, wherein one of the first and second work holders moves a predetermined distance after receiving works from a transfer member in the corresponding work delivery area and receives other works from the said transfer member to mount multiple rows of works in a
20 moving direction.

7. An energy beam irradiation system according to any one of Claims 1 to 6, wherein the energy beam is an ion beam and an ion is implanted into works.