

Method for producing a gas curtain of purge gas in a slit valve tunnel, and slit valve tunnel

5 The invention provides a method for producing a gas curtain of purge gas in a slit valve tunnel of an apparatus for treating a semiconductor wafer, for example an apparatus for heat treating the semiconductor wafer or for depositing a layer on an upper side of the semiconductor wafer. The invention also provides a slit valve tunnel for such an apparatus.

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Prior art / problems

In US 2010 0 190 343 A1 there is disclosed an apparatus for treating a semiconductor wafer which comprises typical modules, in particular a process chamber, a transfer
15 chamber and a load lock. A semiconductor wafer to be treated is transported into the modules in a predefined order. The modules are separated by ports.

In KR 10 1 875 305 B1 it is proposed to use a slit valve tunnel as the port and to direct a purge gas over the semiconductor wafer while the semiconductor wafer is being
20 transported through the slit valve tunnel, in order to protect the semiconductor wafer from contamination by particles.

In US 2015 0 083 330 A1 there is described a slit valve tunnel in which the purge gas is directed through holes from top to bottom to the semiconductor wafer being
25 transported through the tunnel.

There is a further need for improvement because particles can accumulate in the slit valve tunnel and the slit valve tunnel can itself become a particle source over time.

30 The object of the present invention is to largely eliminate the risk of semiconductor wafers being contaminated by particles as they are being transported through a slit valve tunnel.

The object of the invention is achieved by a method for producing a gas curtain of purge gas in a slit valve tunnel of an apparatus for treating a semiconductor wafer, wherein the purge gas is directed to two ends of a channel which is arranged in a top portion of the slit valve tunnel and covered with a removable cover, and the purge gas
5 is directed in the form of a gas curtain through a slit in the bottom of the channel to a bottom portion of the slit valve tunnel while a semiconductor wafer is being transported through a through-opening between the top portion and the bottom portion of the slit valve tunnel.

10 In the direction of movement from the top portion to the bottom portion, the gas curtain preferably impinges on the surface of the semiconductor wafer at a right angle.

According to another preferred embodiment of the invention, the slit in the bottom of the channel is laterally delimited by a wall which is beveled, whereby the gas curtain
15 directed to the bottom portion of the slit valve tunnel is diverted so that it impinges on the surface of the semiconductor wafer at an angle not equal to 90°. Preferably, particles lying on the semiconductor wafer are subjected, owing to the gas curtain impinging obliquely on the surface of the semiconductor wafer, to a movement impetus which is directed counter to the direction of movement of the semiconductor
20 wafer, if the semiconductor wafer is transported from a transfer chamber to a process chamber or to a lock chamber. In this way, particles are cleaned from the surface of the semiconductor wafer and particles in the slit valve tunnel are moved away from the process chamber.

25 The invention additionally provides a slit valve tunnel of an apparatus for treating a semiconductor wafer, comprising a top portion, a bottom portion and a through-opening between the top portion and the bottom portion for the transport of the semiconductor wafer through the slit valve tunnel along a transport path, comprising a recess on an upper side of the top portion;
30 a removable cover for covering the recess;
a channel in the recess, which channel extends transversely to the transport path;
a slit in the bottom of the channel for the passage of purge gas;

holes in the top portion for feeding the purge gas to two ends of the channel, whereby, on feeding of the gas, there is formed a gas curtain which is oriented from the top portion to the bottom portion of the slit valve tunnel.

- 5 By directing the purge gas to both ends of the channel and through the slit in the channel to the semiconductor wafer, a homogeneous gas curtain is formed, so that particles can be removed with the same effectiveness regardless of their position on the semiconductor wafer. Because the channel is accessible through a removable cover, the critical region, in which particles can accumulate and which can become a
10 source of contamination of semiconductor wafers by particles, is readily accessible for cleaning measures.

The gas curtain extends over a distance which is greater than the diameter of a semiconductor wafer transported through the through-opening of the slit valve tunnel.

- 15 According to one embodiment, the length of the distance, and thus the length of the channel, is more than 300 mm, particularly preferably 320 mm. According to one embodiment, the width of the slit in the bottom of the channel is adjusted in order to achieve a desired flow speed of the gas curtain.

- 20 According to a preferred embodiment, the slit in the bottom of the channel has vertical walls laterally delimiting said slit, so that the gas curtain impinges on the surface of the semiconductor wafer at an angle of 90°.

- 25 According to another preferred embodiment, the slit in the bottom of the channel has a wall laterally delimiting said slit and arranged in an oblique manner. The gas curtain is diverted by the wall so that it impinges on the surface of the semiconductor wafer at an angle not equal to 90°.

- 30 The cover is preferably removed at predetermined intervals, for example in the course of maintenance of the apparatus for treating the semiconductor wafer, and the cover, the recess that receives it and the channel are then cleaned and dried. Cleaning and drying can be carried out comparatively quickly and without any special effort.

The cover fills the recess and is removably fastened to the upper side of the top portion of the slit valve tunnel. According to one embodiment, the fastening means are screws, preferably screws of plastics material or ceramics. According to one embodiment, a seal is present, which prevents the passage of purge gas between the cover and the recess.

The slit valve tunnel has a front side and a rear side. According to one embodiment, the front side is the side that is adjacent to a transfer chamber and the rear side is the side that is adjacent to a process chamber or a lock chamber.

In the top portion of the slit valve tunnel there are arranged two holes for feeding purge gas to the two ends of the channel. According to one embodiment, the holes are situated on the rear side of the slit valve tunnel in the region of two rounded upper corners of the rear side.

The slit valve tunnel is able to be closed by a door. According to one embodiment, the door closes the through-opening on the front side of the slit valve tunnel.

The slit valve tunnel is part of an apparatus for treating a semiconductor wafer. According to one embodiment, the apparatus is an apparatus for depositing an epitaxial layer on a substrate wafer, preferably an apparatus for depositing an epitaxial layer of silicon on a substrate wafer of single-crystal silicon. According to another embodiment, it is an apparatus for heat treating a semiconductor wafer, preferably a semiconductor wafer of single-crystal silicon.

The invention will be described further hereinbelow with reference to drawings.

Brief description of the figures

Fig. 1 shows a preferred embodiment of the slit valve tunnel in a perspective view.

Fig. 2 shows the slit valve tunnel according to Fig. 1 with the cover removed.

Fig. 3 is a view of the rear side of the slit valve tunnel according to Fig. 1 with an active gas curtain.

Fig. 4 is a schematic diagram of the slit valve tunnel according to Fig. 1 from the side.

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Fig. 5 is a diagram of a section of the slit valve tunnel according to Fig. 1 in a preferred embodiment.

Fig. 6 is a diagram of a section of the slit valve tunnel according to Fig. 1 in another preferred embodiment.

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List of reference numerals used

	1	slit valve tunnel
15	2	top portion
	3	bottom portion
	4	through-opening
	5	rear side
	6	cover
20	7	holes
	8	recess
	9	channel
	10	ends
	11	gas curtain
25	12	transport path
	13	wall
	A	module
	B	module

30 Detailed description of exemplary embodiments according to the invention

Fig. 1 shows a preferred embodiment of the slit valve tunnel 1 in a perspective view. The slit valve tunnel 1 comprises a top portion 2, a bottom portion 3 and a through-

opening 4 between the top portion and the bottom portion. In this view, the rear side 5 of the slit valve tunnel 1 can be seen. A removable cover 6 is fastened to the upper side of the top portion by means of screws. In the region of two rounded upper corners of the rear side 5 of the slit valve tunnel 1 there are provided two holes 7
5 through which purge gas is directed to the two ends of a channel which is covered by the cover 6. Arrows symbolize the direction of flow of the purge gas.

Fig. 2 shows the slit valve tunnel 1 according to Fig. 1 with the cover 6 removed. On the upper side of the top portion 2 there is provided a recess 8 into which the cover 6
10 fits positively. A channel 9 having two ends 10 is incorporated in the recess, which channel extends almost over the width of the through-opening 4 and is open at the bottom to a slit (not shown).

Fig. 3 is a view of the rear side 3 of the slit valve tunnel according to Fig. 1 with an
15 active gas curtain 11 of purge gas.

Fig. 4 is a schematic diagram of the slit valve tunnel according to Fig. 1 from the side, wherein the rear side 5 of the slit valve tunnel 1 is adjacent to a module A of the apparatus for treating a semiconductor wafer and the front side of the slit valve tunnel
20 1 is adjacent to a module B of the apparatus. The arrow symbolizes the direction of movement of a door (not shown) for closing the through-opening 4. The module A is, for example, a process chamber or a lock chamber and module B is a transfer chamber.

25 Fig. 5 is a diagram of a section of the slit valve tunnel in a preferred embodiment, in which the slit in the bottom of the channel is delimited by a vertical wall 13. The gas curtain impinges on the wafer at an angle of 90°.

Fig. 6 is a diagram of a section of the slit valve tunnel in another preferred
30 embodiment, in which the slit in the bottom of the channel is delimited by a wall 13 which is beveled. Owing to the wall, the gas curtain is diverted into the direction in which the arrow points.

The above description of exemplary embodiments is to be understood as being by way of example. The disclosure made thereby on the one hand makes it possible for the skilled person to understand the present invention and the advantages associated therewith and on the other hand also includes variations and modifications of the

5 described structures and method that are obvious in the understanding of the skilled person. All such variations and modifications as well as equivalents are therefore to be covered by the scope of protection of the claims.

Patent claims

1. A method for producing a gas curtain of purge gas in a slit valve tunnel of an apparatus for treating a semiconductor wafer, wherein
5 the purge gas is directed to two ends of a channel which is arranged in a top portion of the slit valve tunnel and covered with a removable cover, and the purge gas is directed in the form of a gas curtain through a slit in the bottom of the channel to a bottom portion of the slit valve tunnel while a semiconductor wafer is being transported through a through-opening between the top portion and the bottom portion
10 of the slit valve tunnel.
2. The method as claimed in claim 1, wherein the cover is removed before or after the gas curtain is produced, and the cover, a recess that receives it and the channel are cleaned.
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3. The method as claimed in claim 1 or claim 2, wherein the gas curtain directed to the bottom portion of the slit valve tunnel impinges on the surface of the semiconductor wafer at an angle of 90°.
- 20 4. The method as claimed in claim 1 or claim 2, wherein the slit in the bottom of the channel is laterally delimited by a wall which is beveled, whereby the gas curtain directed to the bottom portion of the slit valve tunnel is diverted so that it impinges on the surface of the semiconductor wafer at an angle not equal to 90°.
- 25 5. A slit valve tunnel of an apparatus for treating a semiconductor wafer, comprising a top portion, a bottom portion and a through-opening between the top portion and the bottom portion for the transport of the semiconductor wafer through the slit valve tunnel along a transport path, comprising
a recess on an upper side of the top portion;
30 a removable cover for covering the recess;
a channel in the recess, which channel extends transversely to the transport path;
a slit in the bottom of the channel for the passage of purge gas;
holes in the top portion for feeding the purge gas to two ends of the channel,

whereby, on feeding of the purge gas, there is formed a gas curtain which is oriented from the top portion to the bottom portion of the slit valve tunnel.

6. The slit valve tunnel as claimed in claim 5, characterized by vertical walls laterally
5 delimiting the slit.

7. The slit valve tunnel as claimed in claim 5, characterized by a beveled wall laterally delimiting the slit.