Device and Method for Processing of Wafers

Specification

The invention relates to a device for processing of substrates or substrate pairs, especially wafers as wafer pairs~~, as claimed in Claim 1,~~ and a corresponding method ~~as claimed in Claim 8~~.

Process systems or process devices of semiconductor technology are generally of modular structure. They conventionally consist of different chambers in which various process steps are carried out. Thus, for example for pretreatment of wafers, process steps such as wet cleaning, plasma treatment, etching or heating can be used, while for primary treatment of a wafer, bonding, lacquering, imprinting, embossing and exposure are possible. In known process systems the wafers or wafer stacks are transported with cassettes between the process systems or modules of process systems.

During transport, the contamination, damage, fouling or oxidation and thus influencing of other process steps can occur.

Contamination of the primary treatment chambers between treatments of successive wafers, therefore in loading and unloading of wafers, is also a problem.

Furthermore it is critical with respect to time that in the primary treatment large pressure differences from atmospheric pressure as far as very low pressures of 10^{-6} bar or less must be overcome.

EmbodimentsThe object of this invention is therefore to optimize the processing of substrates both in terms of the sequence, and also to avoid contamination, damage, fouling or oxidation as much as possible.

According to an aspect, there is provided a process system for processing substrates or substrate pairs with at least one pretreatment module and at least one aftertreatment module, the pretreatment module and the aftertreatment module coupled to a main treatment module for executing a main process including at least bonding such that the main treatment module defines vacuum-tight locks for the adjacent pretreatment module and/or the adjacent aftertreatment module.

This object is achieved with the features of Claims 1 and 8. Advantageous developments of the invention are given in the dependent claims. All combinations of at least two of the features given in the specification, the claims and/or the figures also fall within the framework of the invention. At the given value ranges, values within the indicated limits will also be disclosed as boundary values and will be claimed in any combination.

Embodiments of tThe invention areis based on the idea of coupling a primary treatment module to at least one pretreatment module and at least one aftertreatment module such that at least one of the pretreatment modules and at least one of the aftertreatment modules and/or the primary treatment module each act as vacuum-tight locks for an adjacent pretreatment module, primary treatment module or aftertreatment module. At the same time, according to the invention in one embodiment of the invention it is provided that at least one of the pretreatment modules and/or the primary treatment module and/or at least one of the aftertreatment modules can be especially exposed to pressure, a vacuum, and/or can be temperature-treated, especially can be heated independently or regardless of an adjacent module.

In this way, in spite of a flexible structure of the process system according to the device as per embodiments ofelaimed in the invention a time-optimized, even parallel processing of several substrates is provided within the device as per embodiments ofelaimed in the invention, in which based on the lock-like coupling of the individual process modules contamination, damage, fouling or oxidation by decoupling of the substrates from external effects, especially in the loading and unloading of the individual modules,

is resolved.

It is especially advantageous if the primary treatment module can be loaded and unloaded exclusively via locks or a positing system. This is achieved as per embodiments of~~claimed in~~ the invention by there being both a pretreatment module which is coupled in the manner of a lock to the primary treatment module and also an aftertreatment module which is coupled in the manner of a lock to the primary treatment module. By this measure the generally especially critical primary treatment of the substrates or wafers which occurs under often extreme conditions does not take place at any instant of the processing nor during the loading and unloading of the primary treatment module with contact with the environment. The primary treatment module is accordingly completely decoupled from the environment so that contamination, damage, fouling or oxidation during the primary treatment of the substrates is essentially precluded. Furthermore, there is the advantage that the steps preparatory and subsequent to primary treatment can be moved into the pretreatment module and the aftertreatment module, especially at least partial exposure to pressure and/or temperature. In the primary treatment module as a result of this only a lower pressure difference and/or temperature difference than from the ambient/atmospheric pressure p_{ATM} need be overcome.

According to one advantageous embodiment of the invention, it is provided that the primary treatment chamber can be switched as a lock in the loading and unloading of the substrates. Thus, when the primary treatment chamber is being loaded, at the same time aftertreatment of the substrate which has been worked beforehand in the primary treatment chamber can take place. When the primary treatment chamber is being unloaded, conversely at the same time pretreatment of the next substrate which is to be worked in the primary treatment chamber can take place in the pretreatment chamber.

In another advantageous embodiment, it is provided that the pretreatment chamber and/or the primary treatment chamber and/or the aftertreatment chamber can be heated especially separately by means of a heating apparatus. It is especially advantageous here if the pretreatment chamber and/or the primary treatment chamber and/or the aftertreatment chamber are completely heat-insulated. In this way exact temperature control is possible with heat loss as low as possible.

To the extent other correspondingly made pretreatment modules can be connected upstream to the pretreatment module as locks and/or other correspondingly made aftertreatment modules can be connected downstream of the aftertreatment module as locks, the method sequence can be further subdivided so that optimization of the passage times in the process sequence arises. Here it is conceivable as per embodiments ofelaimed in the invention that at the same time several pretreatment modules are directly coupled to one pretreatment module via lock doors. In this way time-intensive pretreatment steps can proceed parallel and accordingly staggered in time in the upstream pretreatment modules. This applies analogously to the corresponding aftertreatment modules.

By the locks being made as pressure locks and/or temperature locks it is possible as per embodiments ofelaimed in the invention to control the pressure and/or the temperature by corresponding switching of the pretreatment modules and/or the aftertreatment modules.

For loading and unloading, as per embodiments ofelaimed in the invention there is a loading and unloading apparatus, especially at least one robot arm. The latter is used for loading and unloading of the substrates into/out of the primary treatment chamber and/or the pretreatment chamber and/or the aftertreatment chamber, and for parallel handling there can be several substrates/wafers in the process sequence, as per embodiments ofelaimed in the invention several robot arms. Thus for example in each pretreatment chamber and/or each aftertreatment chamber there can be exactly one robot arm which

can engage the respectively adjacent pretreatment chamber and/or primary treatment chamber for loading and unloading of the respectively adjacent chambers when the respective lock door is opened.

According to one ~~especially~~ advantageous embodiment of the invention it is provided that the primary treatment chamber can be loaded at the same time from the pretreatment chamber and can be unloaded into the aftertreatment chamber and/or the pretreatment chamber and the aftertreatment chamber can be loaded at the same time via the first lock door and unloaded via the second lock door.

Other advantages, features and details of the invention will become apparent from the following description of preferred exemplary embodiments and using the drawings.

Figure 1a shows a schematic plan view of a device as claimed in the invention with a pretreatment module, a primary treatment module and an aftertreatment module.

Figure 1b shows a schematic sectional view of the device as claimed in the invention according to cutting line A-A from Figure 1a,

Figure 2a shows a schematic plan view of a second embodiment of the device as claimed in the invention with a pretreatment module, a primary treatment module and an aftertreatment module,

Figure 2b shows a schematic sectional view of the device as claimed in the invention according to cutting line A-A from Figure 2a,

Figure 2c shows a schematic sectional view of the device as claimed in the invention according to cutting line B-B from Figure 2a,

Figure 3 shows a pressure/temperature diagram of a method as claimed in the invention for

Claims

1. A device for processing substrates or substrate pairs with at least one pretreatment module and at least one aftertreatment module, the pretreatment module and the aftertreatment module coupled to a main treatment module such that the main treatment module defines vacuum-tight locks for the adjacent pretreatment module and/or the adjacent aftertreatment module.

2. The device according to claim 1, wherein a main treatment chamber of the main treatment module can be switched as a lock during the loading and unloading of the substrate into the device.

3. The device according to claim 1, wherein a pretreatment chamber of the pretreatment module and/or a main treatment chamber of the main treatment module and/or an aftertreatment chamber of the aftertreatment module, can be heated or cooled off by means of a temperature exposure apparatus.

4 The device according to claim 1, wherein additional pretreatment modules are connected upstream of a first pretreatment module as locks and/or additional aftertreatment modules are connected downstream of a first aftertreatment module as locks.

5. The device according to claim 1, wherein the locks are formed as pressure and/or temperature locks.

6. The device according to claim 1, wherein a loading and unloading apparatus is provided for loading and unloading of the substrates into/ from the pretreatment module and/or the aftertreatment module.

7. The device according to claim 3, wherein the pretreatment chamber and/or the main treatment chamber and/or the aftertreatment chamber can be heated or cooled separately.

8. The device according to claim 6, wherein the loading and unloading apparatus is at least one robot arm.

Claims:

1. A process system for processing substrates or substrate pairs with

at least one pretreatment module and at least one aftertreatment module,

the pretreatment module and the aftertreatment module coupled to a main treatment module for executing a main process including at least bonding such that the main treatment module defines vacuum-tight locks for the adjacent pretreatment module and/or the adjacent aftertreatment module.

2. The process system according to claim 1, wherein a main treatment chamber of the main treatment module can be switched to define the vacuum-tight locks during the loading and/or unloading of the substrate into/from the process system.

3. The process system according to claim 1, wherein a pretreatment chamber of the pretreatment module and/or a main treatment chamber of the main treatment module and/or an aftertreatment chamber of the aftertreatment module can be heated or cooled off by means of a temperature exposure apparatus.

4. The process system according to claim 1, wherein additional pretreatment modules are connected upstream of a first pretreatment module and/or additional aftertreatment modules are connected downstream of a first aftertreatment module.

5. The process system according to claim 1, wherein the vacuum-tight locks are formed as pressure and/or temperature locks as well.

6. The process system according to claim 1, wherein a loading and unloading apparatus is provided for loading and unloading of the substrates into/from the pretreatment module and/or the aftertreatment module.

7. The process system according to claim 3, wherein the pretreatment chamber and/or the main treatment chamber and/or the aftertreatment chamber can be heated or cooled separately.

8. The process system according to claim 6, wherein the loading and unloading apparatus is at least one robot arm.