# DEVICE FOR THE TRANSPORT, STORAGE, AND TRANSFER OF SUBSTRATES

The invention pertains to the transport, storage, and transfer of substrates, particularly between the steps of manufacturing microelectronic components, for example for manufacturing microelectromechanical systems (MEMS) or micro-opto-electromechanical systems (MOEMS). More particularly, the invention pertains to a pod for transporting and storing substrates and an interface for transferring these substrates.

The substrates mainly come in the form of square-shaped masks or circular wafers made of a semiconducting material such as silicon.

In currently-used devices, between the various steps of manufacturing semiconductors, the substrates are transported and stored in transport pods which protect them from pollution by particles found in the atmospheres of cold sites. Usually, the transport pods contain one substrate or multiple stacked substrates. A substrate may be a mask or silicon wafer, 200 mm in diameter or 300 mm in diameter, for example. Currently, the commonly used transport pods contain from 1 to 25 substrates.

Inside a transport pod, the substrates are stacked near one another in a sort of single-piece rack which is also known as a cassette or basket.

A transport pod comprises a pod casing with an opening that may be blocked by a door, and a basket in which substrates may be stored.

The transport pods may be coupled with input-output interfaces of semiconductor manufacturing equipment. They are coupled using robotized locks. A first robot transports each substrate individually from the transport pod to an intermediary lock, which may be a transfer chamber, or load lock. The transfer chamber or load lock is at a low pressure. Next, the transfer chamber's robot transports the substrate from the load lock to a process chamber. The space available beneath the substrate that the robot is to handle must be sufficient to, firstly, allow the robot's arm to fit below the substrate. Secondly, this robot arm must be able to sufficiently rise, moving the substrate, so that the substrate is no longer resting on its mount, but rather is resting only on the robot's arm, which will then be able to move the substrate to the process chamber.

In this manner, the transport pod's basket must be sufficient in size so that the adjacent substrates that it contains are permanently separated by enough distance to allow a robot arm to fit in between. As a result, the transport pods, which must contain the basket, are relatively voluminous, and may not contain a large number of substrates.

## CLAIMS

1. A transport pod (1) for substrates (4) such a semiconductor substrates, having a pod casing (1a) equipped with walls and comprising an opening (1b), a door (1c) blocking the opening (1b) in a sealed matter, and a basket (3) inserted into the pod casing (1a) in which substrates (4) may be stored, characterized in that:
- the basket (3) may be moved through the opening (1b) so that it may be inserted in the pod casing (1a) and be removed from the pod casing (1a), and
- the basket (3) is made up of a stacked series of parallel plates (3a-3f), each one supporting a substrate (4), the plates (3a-3f) being stacked atop one another when the door (1c) is closed, and the plates being moveable away from one another, along the direction of movement perpendicular to the plane of the substrates (4), when the door (1c) is open.

2. A transport pod in accordance with claim 1, wherein, when the plates (3a-3f) are in a stacked position, the distance (E) between the adjacent substrates (4) is less than about 5 mm.

3. A transport pod in accordance with claims 1 and 2, wherein the basket (3) is integral with the door (1c).

4. A transport pod according to one of the above claims, wherein, when the plates (3a-3f) are in a stacked position, the peripheral areas of the adjacent plates are close together over at least one portion of the edge of the substrates (4).

5. A transport pod according to one of the above claims, further comprising means (1c, 1h, 1i) for compressing the plates (3a-3f) against one another within the pod casing (1a) when the pod casing is closed by the door (1c).

6. A transport pod according to one of the above claims, wherein each plate (3a-3f) comprises:
- a side recess (34a) open to the outside capable of receiving a plate locking system (2f-2i),
- opposing main surfaces (35a, 36a) with interlocking shapes to cooperate with the adjacent plates and to ensure that the plates are prevented from relative movement transversally parallel to the planes of the substrates (4),

- a support surface (236a) for receiving the first surface of the peripheral portion of a substrate (4),
- a holding surface (235a) to push against the second surface of the peripheral portion of another substrate,
- the support surface (236a) and holding surface (235a) being designed to lock the peripheral portion of a substrate (4) between two adjacent plates.

7. A transport pod according to claim 6, wherein the holding surface (235a) comprises a rounded edge (335a).

8. A transport pod according to one of claims 6 or 7, wherein the holding surface (235a) comprises an elastic relief (335).

9. A transport pod according to one of the above claims, wherein the plates (3a-3f) are designed to allow them to rotate relative to one another, within their plane, along a range of angles that makes it possible to correct the alignment of the substrates (4) which they carry.

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10. An interface (2) between at least one transport pod (1) in accordance with one of claims 1 to 13, and a piece of substrate treatment equipment (200), comprising
- an interface chamber (2a) comprising an access hole (2b) for being coupled to the transport pod (1), preferentially in a sealed manner by means of a gasket (2m), and a through hole (2c) cooperating with the equipment (200),
- receiving means (2k), for receiving and holding the transport pod (1), with its door (1c) facing the access hole (2b),
- basket-controlling means for moving the basket (3) containing the substrates (4) between the transport pod (1) and the interface chamber (2a),
- a robot (5) for grasping and transferring the substrates (4) between the basket (3) inside the chamber (2a) of the interface (2) and the equipment (200),
- plate-controlling means (2e, 2f-2i) designed to selectively separate a chosen plate (3c) from one or more adjacent plates (3b, 3d), along their direction of movement, so as to enable the robot (5) to selectively take a substrate (4a) and move it towards or away from the chosen plate (3c).

11. An interface according to one of claims 10, intended to co-operate with at least one transport pod having horizontal plates, wherein the plate-controlling means comprise plate-locking means (2f-2i) designed to selectively prevent the downward movement of a chosen plate (3c), in order to separate the chosen plate (3c) from the adjacent plate (3b) below it, and/or plate-locking means (2f-2i) designed to selectively prevent the downward movement of the adjacent plate above (3d) the chosen plate (3c), in order to separate the chosen plate (3c) from the adjacent plate above it (3d).

12. An interface according to claim 11, wherein the plate-locking means (2f-2i) comprise locking pins whose end engages into to a recess (34a) of the corresponding plate (3a) by the action of a cylinder (2j).

13. An interface according to claim 11, wherein the plate-locking means comprise motorized locking pins (2f-2i).

14. An interface according to claim 11, wherein the plate-locking means (2f-2i) comprise one or more electromagnets acting upon a magnetic portion of the plate (3a-3f) in order to ensure locking.

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Inside a transport pod, the substrates are stacked near one another in a sort of single-piece rack which is also known as a cassette or basket.

A transport pod comprises a pod casing with an opening that may be blocked by a door, and a basket in which substrates may be stored.

The transport pods may be coupled with input-output interfaces of semiconductor manufacturing equipment. They are coupled using robotized locks. A first robot transports each substrate individually from the transport pod to an intermediary lock, which may be a transfer chamber, or load lock. The transfer chamber or load lock is at a low pressure. Next, the transfer chamber's robot transports the substrate from the load lock to a process chamber. The space available beneath the substrate that the robot is to handle must be sufficient to, firstly, allow the robot's arm to fit below the substrate. Secondly, this robot arm must be able to sufficiently rise, moving the substrate, so that the substrate is no longer resting on its mount, but rather is resting only on the robot's arm, which will then be able to move the substrate to the process chamber.

In this manner, the transport pod's basket must be sufficient in size so that the adjacent substrates that it contains are permanently separated by enough distance to allow a robot arm to fit in between. As a result, the transport pods, which must contain the basket, are relatively voluminous, and may not contain a large number of substrates.

Claims

1. A device including:

- a transport pod (1) for substrates (4) such as semiconductor substrates, having a pod casing (1a) equipped with walls and comprising an opening (1b), a door (1c) blocking the opening (1b) in a sealed matter, and a basket (3) inserted into the pod casing (1a) in which substrates (4) may be stored, characterized in that:

- the basket (3) may be moved through the opening (1b) so that it may be inserted in the pod casing (1a) and be removed from the pod casing (1a), and

- the basket (3) is made up of a stacked series of parallel plates (3a-3f), each one supporting a substrate (4), the plates (3a-3f) being stacked atop one another when the door (1c) is closed, and the plates being moveable away from one another, along the direction of movement perpendicular to the plane of the substrates (4), when the door (1c) is open;

- an interface (2) between at least one transport pod and a piece of substrate treatment equipment (200), comprising :

- an interface chamber (2a) comprising an access hole (2b) for being coupled to the transport pod (1), in a sealed manner by means of an interface front gasket (2m), and a through hole (2c) cooperating with the equipment (200),

- receiving means (2k), for receiving and holding the transport pod (1), with its door (1c) facing the access hole (2b),

- basket-controlling means for moving the basket (3) containing the substrates (4) between the transport pod (1) and the interface chamber (2a),

- a robot (5) for grasping and transferring the substrates (4) between the basket (3) inside the chamber (2a) of the interface (2) and the equipment (200),

- plate-controlling means (2e, 2f-2i) comprising:

plate-locking means (2f-2i) designed to selectively prevent the downward movement of a chosen plate (3c) in order to separate the chosen plate (3c) from the adjacent plate (3b) below it,

plate-locking means (2f-2i) designed to selectively prevent the downward movement of the adjacent plate (3d) above the chosen plate (3c), in order to separate the chosen plate (3c) from the adjacent plate (3d) above it,

plate-locking means (2f-2i), and

a cylinder (2e) operable to move the plates locked by the plate-locking means (2f-2i) upward and downward, so as to enable the robot (5) to selectively take a substrate (4a) and move it towards or away from the chosen plate (3c),

- wherein the interface front gasket (2m) is placed between the transport pod (1) and the interface (2), said interface front gasket (2m) constituting a peripheral sealing means which isolates from the outer atmosphere a coupling area (6) between the corresponding front faces of the transport pod (1) and the interface (2) around the opening (1b) of the transport pod (1) and the access hole (2b) of the interface (2),

- connection pumping means able to create a vacuum within said coupling area (6).

2. A device according to claim 1, wherein, when the plates (3a-3f) are in a stacked position, the distance (E) between the adjacent substrates (4) is less than about 5 mm.

3. A device according to claim 1 or 2, wherein the basket (3) is integral with the door (1c).

4. A device according to one of the preceding claims, wherein, when the plates (3a-3f) are in a stacked position, the peripheral areas of the adjacent plates are close together over at least one portion of the edge of the substrates (4).

5. A device according to one of the preceding claims, further comprising means (1c, 1h, 1i) for compressing the plates (3a-3f) against one another within the pod casing (1a) when the pod casing is closed by the door (1c).

6. A device according to one of the preceding claims, wherein each plate (3a-3f) comprises:

- a side recess (34a) open to the outside capable of receiving a plate locking system (2f-2i),

- opposing main surfaces (35a, 36a) with interlocking shapes to cooperate with the

adjacent plates and to ensure that the plates are prevented from relative movement transversally parallel to the planes of the substrates (4),

- a support surface (236a) for receiving a first surface of a peripheral portion of a substrate (4),

- a holding surface (235a) to push a second surface of a peripheral portion of another substrate,

- the support surface (236a) and the holding surface (235a) being designed to lock a peripheral portion of a substrate (4) between two adjacent plates.

7. A device according to claim 6, wherein the holding surface (235a) comprises a rounded edge (335a).

8. A device according to claim 6 or 7, wherein the holding surface (235a) comprises an elastic relief (335).

9. A device according to one of the preceding claims, wherein the plates (3a-3f) are designed to allow them to rotate relative to one another, within their plane, along a range of angles that makes it possible to correct the alignment of the substrates (4) which they carry.

10. A device according to claim 1, further comprising door-controlling means (2e) for opening and closing the door (1c) of the transport pod (1).

11. A device according to claim 1 or 10, wherein the transport pod (1) has horizontal plates.

12. A device according to claim 1, wherein the plate-locking means (2f-2i) comprise locking pins whose end engages into to a recess (34a) of the corresponding plate (3a) by the action of the cylinder (2j).

13. A device according to claim 1, wherein the plate-locking means comprise

motorized locking pins (2f-2i).

14. A device according to claim 1, wherein the plate-locking means (2f-2i) comprise one or more electromagnets acting upon a magnetic portion of the plates (3a-3f) in order to ensure locking.