

WAFER CASSETTE FOR INTERCHANGEABLE SQUARE PANEL SIZES OF 600MM AND 620MM

FIELD OF THE INVENTION

- 5 The present invention generally relates to a wafer cassette and more particularly, relates to a light weight panel cassette for Panel FOUP (Front Opening Unified/Universal Pod) for Panel Level Packaging to carry panel sheets of 600 mm and 620 mm by changing a plurality of support rods of different sizes.

BACKGROUND OF THE INVENTION

- 10 In the manufacturing of a semiconductor device, the device is usually processed at many work stations or processing machines. The transporting or conveying of partially finished device, or a finished product is an important aspect in the entire manufacturing process. Accordingly, the part or product must be stored or transported between various process stations or in a storage site for packaging or preparing to deliver.
- 15 Wafer cassettes are used to transport and store wafers during semiconductor manufacturing operations, and are designed to house or carry several wafers of the same size and are available in a range of materials to support specific applications, such as thermal processing.

- Wafer cassettes can be characterized by a number of important dimensions such as overall length, width, and height, as well as specific dimensions. Currently wafer carriers are designed to fit only a specific wafer sizes, for instance from 2.5 inches to 450mm. As semiconductor fabrication technology has advanced to produce more sophisticated devices, wafer cassette design has kept pace. Semiconductor fabrication now involves higher automation levels, greater tool uptime and throughput,
- 25 higher process temperatures, additional mask layers, and compound semiconductor materials. Wafer cassettes are designed to suit a wide variety of applications and may possess the following qualities:

- Capability to hold from one to multiple wafers, commonly up to 25 for transport or storage and of various sizes. Wafer cassettes are manufactured from a variety of materials tailored to specific semiconductor applications.
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China Patent Application No, CN201611258613 discloses a wafer holder, which includes at least one support and a framework. The support is adaptable to hold at least one wafer, and has at least one opening, wherein when the wafer in the support is being held by the support, the opening is exposed to the open air by the wafer at least in part.

US Patent Publication No. 20060226093A1, entitled "Glass cassette for loading glass substrates of display panels" discloses a glass cassette including an upper plate, a lower plate, side plates, a stopper and stepped support members. The lower plate is disposed substantially parallel to the upper plate. The side plates are disposed spaced apart from each other in a first direction and substantially parallel to each other. The side plates are connected to the upper plate and the lower plate. The stopper is disposed at an end portion of the glass cassette to limit a movement of the glass substrates in a second direction that is substantially perpendicular to the first direction to stop the movement of the glass substrates upon insertion. The stopper is connected between the upper plate and the lower plate. The stepped support members are disposed at each of the side plates while facing each other in the first direction in order to flatly support the glass substrates.

SUMMARY OF THE PRESENT INVENTION

An object of the present invention is to provide a wafer cassette that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm, wherein the wafer cassette comprises: a top plate having four corners; a bottom plate having four corners disposed in parallel to the top plate; four corner pillars disposed spaced apart from each other and at the four corners of both the top plate and the bottom plate to form into a hexahedron, wherein the top plate is connected to the bottom plate via the four corner pillars; and a plurality of panel support pillars disposed at two opposite sides of hexahedron while another side of the hexahedron is disposed with a plurality of end pillar, wherein the plurality of panel support pillars are provided with a plurality of holes, and a distance of 600 mm apart between each two holes for supporting panel sheet of 600 mm placed in horizontal to the top plate and bottom plate or the distance apart formed by two holes is adaptable to support panel sheet of 600mm, or a distance of 620 mm apart between each two holes for supporting panel sheet of 620 mm placed

in horizontal to the top plate and bottom plate or the distance apart formed by two holes is adaptable to support panel sheet of 620mm.

Still an object of the present invention is to provide a wafer cassette that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm, further comprising a central panel support with a plurality of equal distance holes thereon mounted at the center position of the side of the hexahedron other than the two opposite sides of the hexahedron such that the central panel support is provided with a plurality of long panel support rods.

Yet a further object of the present invention is to provide a wafer cassette that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm, wherein the plurality of the panel support pillars are provided with panel support rods with one end inserted into the holes on the pillars and the rods are disposed substantially parallel to the top plate or the bottom plate.

Another object of the present invention is to provide a wafer cassette that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm, wherein the bottom plate has an external face which is provided with information pad and KCP groove.

Yet still a further object of the present invention is to provide a wafer cassette that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm, wherein the plurality of holes on the central panel support are inserted with a plurality of center panel support rods.

Another further object of the present invention is to provide a wafer cassette that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm, wherein a pair of handle plates (12) are provided on the top plate (14) at both the side edge thereof, facilitating handling of the wafer cassette, and the hexahedron has one side which is a rectangle opening for inserting the panel sheet into the hexahedron of the wafer cassette.

A further object of the present invention is to provide a wafer cassette that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm, wherein the panel sheet is held by slots form between any two panel support rods of

the side pillar at one of the edge of the panel sheet and the slot formed between two central panel support rods of the pillar (44).

Yet another object of the present invention is to provide a a wafer cassette that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm, wherein the slots formed by two adjacent panel support rod and by two adjacent central panel support rods are interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm.

Still another object of the present invention is to provide a wafer cassette that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm, wherein a plurality of 12 slots are formed for panel sheet of 600 mm by 600 mm, and a plurality of 6 slots are formed for panel sheet of 620 mm by 620 mm.

Another object of the present invention is to provide a wafer cassette that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm, wherein the central pillar (44) is a stopper disposed at the side of the hexahedron opposite to the opening of the hexahedron to position the glass panel, the central pillar (44) being connected between top plate and the bottom plate.

Yet another object of the present invention is to provide a wafer cassette that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm, wherein the plurality of the cornered pillar, the central panel support pillar, and the side panel support pillar are integrally formed with one of the top plate or the bottom plate.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the present invention will become apparent from the following detailed description and the appended drawings in which:

FIG. 1A is a perspective view of a wafer cassette for 620 mm square panel sheets in accordance with the present invention, wherein a panel sheet sits in the wafer cassette and the wafer cassette is provided with 6 slots.

FIG. 1B is a perspective view of a wafer cassette for 600 mm square panel sheets in accordance with the present invention, wherein a panel sheet sits in the wafer cassette and the wafer cassette is provided with 12 slots.

FIG. 1C is a schematically shown the bottom view of the wafer cassette in accordance with the present invention, wherein kinematic coupling pin grooves and info pads disposed at the bottom surface of the bottom plate are shown.

FIG. 1D is the bottom view of the bottom plate, showing the position of the kinematic coupling pin groove and the info pad in accordance with the present invention.

FIG. 2 is a perspective partial view of the wafer cassette for 600/620 mm square panel sheets, showing the mounting of a plurality of vertical pillars along the three edges of the bottom plate of the wafer cassette, in accordance with the preferred embodiment of the present invention, wherein the edges of the bottom plate include two side edges, one end edge, and a front edge.

FIG. 3 is a perspective partial view of the wafer cassette for 600/620 mm square panel sheets, showing the mounting of a plurality of side supporting rods onto the vertical pillars and a plurality of centre rods onto a center pillar positioned at the end edge of the bottom plate of the wafer cassette, in accordance with the preferred embodiment of the present invention.

FIG. 4 is a perspective view of a wafer cassette for 600/620 mm square panel sheets in accordance with the present invention, wherein a top plate is mounted onto the plurality of pillars to form into a box-like structure.

FIG. 5 is a perspective view of a wafer cassette for 600/620 mm square panel sheets in accordance with the present invention, wherein a plurality of handle spacers are vertically mounted at the side edge of the top plate for the securing of a pair of handle plate.

FIG. 6 is a perspective partial view of the wafer cassette for 620 mm square panel sheets, showing the mounting of a plurality of side supporting rods onto the vertical pillars and a plurality of centre rods onto a center pillar positioned at the end edge of the bottom plate of the wafer cassette, in accordance with the preferred embodiment

of the present invention, wherein the gap or the space between two side supporting rods, and the gap or the space between two center rods are identical and are larger than those for 600 mm.

DETAILED DESCRIPTION OF THE PREFERRED AND ALTERNATE EMBODIMENTS

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to FIGS. 1A, 1B, 1C, 1D to 6. The embodiments herein explained are intended only to exemplify the present invention, and thus the present invention is not limited thereto. The present invention discloses a wafer cassette (10) that is interchangeable for panel sheet (16) of 600 mm by 600 mm and 620 mm by 620 mm. The wafer cassette (10) is in compliance with SEMI E181 for Panel FOPUP for Panel Level Packaging of Semi Standards. The wafer cassette (10) is convertible or interchangeable to carry 600 mm square panel sheets (16) or 620 mm square panel sheets during panel sheets process flow.

FIG. 1A is a perspective view of a wafer cassette (10) for 620 mm square panel sheets (16) in accordance with the present invention, wherein a panel sheet (16) sits in the wafer cassette (10) and the wafer cassette (10) is provided with 6 slots. In accordance with a preferred embodiment, there is shown in FIG. 1A, 1B, 1C & 1D, the wafer cassette (10) for holding square panel sheets (16) of size 620 mm x 620 mm. A structure of the wafer cassette (10) shown in these figures is merely to illustrate an exemplary embodiment of the present invention and the present invention is not limited thereto. Accordingly, the structure of the wafer cassette (10) may be modified into other forms, shapes and sizes.

The wafer cassette (10) is used throughout the manufacturing processes of glass panels (16), mainly for high temperature curing steps. The wafer cassette (10) is also used like a FOUP with an additional door throughout the manufacturing processes. It is a specialised plastic enclosure functioned to hold silicon wafers/panel securedly and safely in a controlled environment, and to allow the workpiece to be transferred between machines for processing or for measurement.

A shape of the wafer cassette (10) shown in FIG.s 1A to 1D is similar to a hexahedron. The wafer cassette (10) comprises: a top frame (14) having four corners and four edges; a bottom plate (24) having four corners and four edges, said bottom plate (24)

being disposed in parallel to the top frame (14) forming into a hexahedron together with the supporting of a plurality of side pillars (41S), corner pillars (41C), end pillars (41E), and a back pillar (41B) disposed spaced apart from each other and perpendicularly to the bottom plate (24) and the top frame (14), wherein the plurality
 5 of side pillars (41S) are each located at two opposite faces of the hexahedron, and a plurality of corner pillars (41) are being disposed at the four corners of both the top frame (14) and the bottom plate (24) to form into the hexahedron, wherein the top frame (14) is being connected to the bottom plate (24) by the four corner pillars (41C), and the back pillar (41B) is disposed at the central between two corner pillar (41C) at
 10 one face of the hexahedron with a pair of end pillars (41E), this face of the hexahedron is located opposite to the entrance face of the wafer cassette (10) in the course of loading panel sheet (16); wherein the end pillar (41E) is positioned in between the corner pillar (41) and the back pillar (41B), and the plurality of side pillars (41S) is being disposed at two opposite sides of hexahedron and along the side edges of the
 15 bottom plate (24), and

a plurality of side supporting rods (18) mounted onto the side pillars (41S) ,and a plurality of centre supporting rods (50) is mounted to the back pillar (41B), wherein the end pillars (41E) are used as a structural support for the wafer cassette (10),

wherein the plurality of side pillars (41S) are provided with a plurality of holes , and a
 20 distance of 600 mm apart between each two holes for supporting panel sheet (16) of 600 mm by 600 mm placed in horizontal to the top frame (14) and the bottom plate (24) or the distance apart formed by two adjacent holes is adaptable to support panel sheet of 620mm by 620 mm, and the plurality of adjacent holes provide variable gap space by the side supporting rods (18) so as to allow the placement of glass panel
 25 sheets. The panel sheet (16) sits in the wafer cassette (10) and the wafer cassette (10) is provided with 6 slots for holding panel sheet (16) of size 620 mm by 620 mm.

Referring to FIG. 1B, which shows a perspective view of a wafer cassette for 600 mm square panel sheets in accordance with the present invention, wherein a panel sheet (16) sits in the wafer cassette (10) and the wafer cassette (10) is provided with 12
 30 slots. As shown, the wafer cassette (10) is used for holding square panel sheets (16) of size 600 mm x 600 mm. The structure of the wafer cassette (10) shown in FIG.

1B is merely to illustrate an exemplary embodiment of the present invention and the present invention is not limited thereto.

As shown in FIGs. 1A and 1B, a pair of handle plates (12) are provided onto the top frame (14) of the wafer cassette (10) facilitating the lifting of the cassette (10) and for automated transportation such as Overhead transportation, which in compliance to requirement of SemiE181.

FIG. 1C is a schematically shown the bottom view of the wafer cassette (10) in accordance with the present invention, showing a plurality of kinematic coupling pin (KCP) grooves (26) and info pads(25) disposed at the bottom surface of the bottom plate (24) are shown. The front two KCP groove is positioned at an angle of 34 degree with respect to the facial plane, and the centreline of the rear KCP grove is located along the bilateral plane of the bottom plate (24).

FIG. 1D is the bottom view of the bottom plate, showing the position of the kinematic coupling pin groove (26) and the info pads (25) in accordance with the present invention. The info pad is aligned symmetrically about the bilateral plate of the bottom plate (24), and there are three info pads as a row.

The KCP groove (26) is to achieve a proper control contact pressures of the wafer cassette (10) and the groove is to ensure that the wafer cassette is fully sat onto the KCP of the load port.

FIG. 2 is a perspective partial view of the wafer cassette (10) for 600/620 mm square panel sheets (16), showing the mounting of a plurality of vertical pillars (41C, 41S, 41E, 41B) along the three edges of the bottom plate (24) of the wafer cassette (10), in accordance with the preferred embodiment of the present invention, wherein the edges of the bottom plate (24) include two side edges, one end edge, and a front edge. In the preferred embodiment, the 4 corners of the bottom plate (24) are each vertically mounted with a corner pillar (41C), and along the side edges of the bottom plate (24) a plurality of side pillars (41S) are provided. The end edge (81) of the bottom plate (24) is provided with a back pillar (41B) and each an end pillar (41E) adjacent to the corner pillar (41) on the end edge (81). All the pillars (41C, 41S, 41E, 41B) are perpendicularly mounted to both the bottom plate (24) and the top frame (14). On the surface of the side pillars (41E) and the back pillar (41C) , a plurality of equal spaced apart holes (42) are provided such that the holes (42) are of sufficient large to insert

with side supporting rods (18). Similarly, the back pillar (41C) is also provided with a plurality of holes (42) for the insertion of a plurality of central rods (46). These can be seen in FIG. 3, which is a perspective partial view of the wafer cassette (10) for 600/620 mm square panel sheets (16), showing the mounting of a plurality of side supporting rods (18) onto the side pillars (41S) and a plurality of centre rods (50) onto the back pillar (41B) positioned at the end edge (52) of the bottom plate (24) of the wafer cassette (10), in accordance with the preferred embodiment of the present invention. The bottom plate (24) has a front edge (43) and two side edge (44). As shown in FIG.3, the plurality of the side pillars (41S) are provided with equally spaced holes (42) to be inserted with the side supporting rods (18). The back pillar (41B) is similarly provided with equally spaced apart holes (42) for the insertion of central supporting rods (50), wherein the length of the central supporting rods (50) is longer than the side supporting rods (18). The end pillars (41E) on the end edge (52) are being used to block or limit the movement of a glass panel (16). For holding glass panels (16) of 600 mm by 600 mm, the gap or the slot formed by the adjacent side supporting rods (18) are the same as that formed by the adjacent central supporting rods (50).

FIG. 4 is a perspective view of a wafer cassette (10) for 600/620 mm square panel sheets (16) in accordance with the present invention, wherein a top frame (14) is mounted onto the plurality of pillars (41C, 41S, 41E, 41B) to form into a box-like structure. The top frame (14) is mounted onto one end of the pillars (41C, 41S, 41E, 41B) such that a hexahedron structure is formed, which is the wafer cassette (10) in accordance with the present invention. The top frame (14) is precisely and indently aligned with the pillars (41C, 41S, 41E, 41B).

FIG. 5 is a perspective view of a wafer cassette (10) for 600/620 mm square panel sheets in accordance with the present invention, wherein a plurality of handle spacers (28) are vertically mounted at the side edge of the top frame (14) for the securing of a pair of handle plate (12) (not shown). The handle spacers (28) can be any support which functions as supporting base for the handle plate (12). In the present preferred embodiment, the handle spacers (28) are mounted on the indent of the top frame (14).

FIG. 6 is a perspective partial view of the wafer cassette (10) for 620 mm square panel sheets (16) (not shown), showing the mounting of a plurality of side supporting rods

(18) onto the side supporting pillars (41S) and a plurality of central supporting rods (50) onto the back pillar (41B) positioned at the end edge (52) of the bottom plate (24) of the wafer cassette (10) , in accordance with the preferred embodiment of the present invention, wherein the gap or the slot the between two side supporting rods (18) , and the gap or the slot between two central supporting rods (50) are identical and are larger than those for 600 mm by 600 mm glass panel (16). The width of the gap or slot is adjustable by varying the position of the side supporting rods (18) and the position of the centre supporting rods (50).

Accordingly, the wafer cassette (10) as shown is a design which can be changed for panel size between 600 mm and 620 mm, which means that the wafer cassette (10) provides conversion between 600 mm to 620 mm glass panels vice versa by changing the side supporting rods (18). In the preferred embodiment, the panel sheets (16) are placed into the wafer cassette (10) either manually or by using robotic machine or the like.

For the size of 600 mm and 620 mm glass panel (16), the side supporting rods (18) and the central supporting rods (50) are needed to be shifted from one hole (42) on the side supporting pillars (41S) to another hole on the same pillar when different size of panel is to be hold in the wafer cassette (10).

Since certain changes may be made in the foregoing disclosure without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description and depicted in the accompanying drawings be construed in an illustrative and not limiting sense.

What is claimed is:

1. A wafer cassette (10) that is interchangeable for panel sheet (16) of 600 mm by 600 mm and 620 mm by 620 mm, comprising
 - (a) a top frame (14) having four corners and four edges;
 - 5 (b) a bottom plate (24) having four corners and four edges, said bottom plate (24) being disposed in parallel to the top frame (14) forming into a hexahedron together with the support of a plurality of side pillars (41S), four corner pillars (41C), a pair of end pillars (41E), and a back pillar (41B), wherein the side pillars (41S) are disposed spaced apart from each other and perpendicularly to the bottom plate (24) and the top frame (14), wherein
 - 10 the plurality of side pillars (41S) are each located at two opposite faces of the hexahedron, and the plurality of corner pillars (41) are being disposed at the four corners of both the top frame (14) and the bottom plate (24) to form into the hexahedron, wherein the top frame (14) is being connected to the bottom plate (24) by the four corner pillars (41C) and the side pillars (41S), and the back pillar (41B) is disposed at the central between the two corner pillar (41C) at one face of the hexahedron having the pair of end pillars (41E), said end pillars is located at one face of the hexahedron which is opposite to an entrance face of the wafer cassette (10) for the loading of panel sheets (16); wherein the end pillar (41E) is positioned in between the corner pillar (41) and the back pillar (41B), and the plurality of side pillars (41S) is being disposed at two opposite faces of hexahedron and along the side edges of the bottom plate (24), and
 - 15 (c) a plurality of side supporting rods (18) mounted onto the side pillars (41S), and a plurality of central supporting rods (50) mounted onto the back pillar (41B), wherein the end pillars (41E) are used as a structural support for the wafer cassette (10), and wherein the plurality of side pillars (41S) are provided with a plurality of holes (42) , and a distance of 600 mm apart between each two holes (42) for supporting panel sheet (16) of 600 mm by 600 mm placed in horizontal to the top frame (14) and the bottom plate (24) or the distance apart formed by two adjacent holes (42) is adaptable to support panel sheet (16) of 620mm by 620 mm, and the plurality of adjacent
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holes (42) provide variable gap or slot by the side supporting rods (18) so as to allow the placement of glass panel sheets.

- 5 2. The wafer cassette (10) that is interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm as set forth in Claim 1, wherein the plurality of the panel supporting pillars (41S) are provided with panel supporting rods (18) with one end inserted into the holes (42) on the side pillars (41S) and the supporting rods (18) are disposed substantially parallel to the top frame (14) or the bottom plate (24).

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3. The wafer cassette (10) as set forth in Claim 1, wherein the bottom plate (24) has a bottom surface which is provided with info pads (25) pad and KCP groove (26).
- 15 4. The wafer cassette (10) as set forth in Claim 2, wherein the plurality of holes (42) on the back pillar (41B) are inserted with a plurality of center panel supporting rods (50).
5. The wafer cassette as set forth in Claim 1, wherein a pair of handle plates (12) are provided on the top frame (14), facilitating the lifting of the wafer cassette (10) and for automated transportation such as Overhead transportation.

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6. The wafer cassette as set forth in Claim 1, wherein the hexahedron has one face which is a rectangle opening as entrance for inserting the panel sheet (16) into the hexahedron of the wafer cassette (10).

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7. The wafer cassette as set forth in Claim 6, wherein the panel sheet (16) is held by gaps or slots formed between any two panel supporting rods (18) on the side pillar (41S) and the gaps or slot formed between two central panel supporting rods (50) on the back pillar (41B).

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8. The wafer cassette as set forth in Claim 3, wherein the slots formed by two adjacent side supporting rods (18) and by two adjacent central supporting rods (50) are interchangeable for panel sheet of 600 mm by 600 mm and 620 mm by 620 mm.

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9. The wafer cassette as set forth in Claim 8, wherein a plurality of 12 slots are formed for panel sheet of 600 mm by 600 mm.
- 5 10. The wafer cassette as set forth in Claim 8, wherein a plurality of 6 slots are formed for panel sheet of 620 mm by 620 mm.
- 10 11. The wafer cassette as set forth in Claim 1, wherein the back pillar (41B) is positioned at the center of the end edge (52) of the bottom plate (24) and the top frame (14) to hold the glass panel (16) in place.