during handling and shipping. In this application the locking tab is placed within a recessed pocket where the latches are protected and enclosed in a powered well.

There are a number of different holding and clamping features in wafer shipping containers. All of these prior designs rely on multiple parts to create a clamping lip. These designs have several drawbacks including but not limited to the parts not being rigid with respect to the bottom assembly because they must be sonic welded, bonded or snapped together and that secondary parts or assembly operations are more expensive to produce.

The engagement of latches that secure the top and bottom housings together have a number of limitations. Specifically, prior art latches provide a raised straight slope ramp. The raise straight sloped surface is susceptible to damage and also, the straight slope does not provide an ideal self gripping to engage between the top and bottom housings. The top cover orientation features use differing wall engagement angles or large latches as opposed to small slots as presented in this pending application.

What is needed is a semiconductor wafer container with improvements in side protection to the wafers, improved cover design to minimize rotation, a simplified top cover orientation mechanism and an improved bottom holding mechanism for automation. This pending application satisfies these requirements with novel improvements in the identified areas.

BRIEF SUMMARY OF THE INVENTION

It is an object of the semiconductor wafer container that has an overlapping double wall. The wall structure comprises multiple outer walls and multiple inner walls. The overlapping double containment wall increases semiconductor wafer protection during impact or shipping. Each inner wall shares a minimal percentage of a common angular sector with each adjacent outer wall. The inner wall is generally very stiff and does not absorb and cushion the wafers if the container is dropped or subject to impact. On the bottom assembly, the inner walls and outer walls are positioned in an offset and overlapping configuration provides maximum protection to the semiconductor wafers.

It is an object of the semiconductor wafer container to improve alignment of the top cover with the base. The alignment system includes reference tabs that are

received by the cover and a visual identifier for guiding an operator in the proper alignment of the two halves of the container. The top cover orientation features prevent improper installation of the top cover to the bottom member. The top cover orientation feature is incorporated into the top cover that mates with the features of the double locking location feature. This orientation feature prevents installation of the top cover in plus or minus 90 degree locations about the central axis.

It is an object of the semiconductor wafer container to provide an improved locking mechanism for securing two halves of a wafer container together. The bottom half comprises a wall structure perpendicular to the base. The wall structure comprises segmented inner and outer walls, where each portion of the wall structure has a distinctive arc length. The arc length of each inner wall does not completely overlap with the arc length of any outer wall.

It is an object of the semiconductor wafer container to provide an improved engagement feature for the locking tabs. These improved tabs include a cover for a wafer container that engages to a base. The cover includes one or more notches, each having a ramp that easily receive latches from the base.

It is another object of the semiconductor wafer container to incorporate bi-directional rotation locking feature(s). These features improve orienting, the top member on the bottom member that decreases the amount of top cover rotation and movement with respect to the bottom member. This feature creates a double locking location that securely locates and locks the top cover in place during top cover assembly. The bi-directional rotation locking feature is located on both sides of the perpendicular top cover surfaces of a single wall on both the interior and the exterior simultaneously. This improvement provides bi-directional locking of the captured surface decreases the amount of top cover rotation and movement with respect to the bottom member and increases the rigidity of the containment device when the members are assembled.

It is another object of the semiconductor wafer container to incorporate a protective latch well. The latch well is a recess that is incorporated into the top cover which protects the latch arm from being accidentally bumped or inadvertently opened. The tip of the latch surrounded by a wall that protects the latch by lowering the tip of the latch below the planar surface of the Top Cover by at least 2mm. This recess

distance or greater is considered to be adequate to protect the latch from accidental opening.

It is still another object of the semiconductor wafer container to include an improved holding and clamping feature to allow for automated machinery to latch onto and hold the bottom member and secure it firmly to the machinery nesting locations. This mechanism is comprised of a single piece feature that is molded into the bottom member. The holding and clamping feature on the bottom member improves equipment interface where these containers are used. The feature is a holding mechanism to allow for automated machinery to latch onto and hold the bottom member and secure it firmly to the machinery nesting locations.

It is still another object of the semiconductor wafer container to include an improved curved latch recess for improved closure and retention of the containment device latches. In the improved latch and latch recess the height of the latch is equal to or lower than the inner wall structure. This allows equipment to interface with the bottom member of the container without interference with the equipment and latch height. A curvature on the mating surface provides superior holding and self centering and gripping during handling and after impact. This recessed feature also protects the mating surface from damage when the top cover is disassembled from the bottom member. The latch recess and curved surface also provides increased latch retention and container integrity during impact or shipping. This includes a lowered latch equal to or less than the inner wall height.

Various objects, features, aspects, and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the invention, along with the accompanying drawings in which like numerals represent like components.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 shows a perspective exploded view of the wafer container with a plurality of wafers disposed between the two wafer container halves.

FIG. 2 shows a top view of the bottom housing with the overlapping rib wall pattern.

FIG. 3 shows a detailed perspective view of the overlapping inner rib walls.

of semiconductor wafers 20, 21 and 22 are shown between the top 50 and bottom 100 housing with wafer separators 25. The top housing 50 has a planar top surface 105. The inside base surface 102 extends to the outside of the base surface 103 where the bottom housing has a ribbed pattern 101 that supports the bottom of the bottom most semiconductor wafer 20 and provides increased structural strength to the fairly plainer base surface 102 and 103. Both the top 50 and the bottom housings 100 have essentially planar rectangular or square bases. A plurality of inner rib walls 110 and 111 of the bottom housing 100 protect the semiconductor wafers from shifting side damage. These walls can flex to cushion side impact. They are formed in a segmented pattern in the bottom housing. The segmented ribs are shown and described in more detail with figure 2. A second set of segmented outer ribs 112 and 113 exist outside of the inner rib walls 110 and 111. The rib walls exist in an overlapped 120 and 121 pattern to prevent debris from passing directly through the segmented ribs.

FIG. 2 shows a top view of the bottom housing with the overlapping rib wall pattern. Note that some features, such as bottom ribs, have been deleted from the bottom surface 102 and 103 and the overlapping ribs have been moved slightly to improve clarity of the overlapping rib features being discussed herein. FIG. 3 shows a detailed perspective view of the overlapping inner rib walls. While in Figures 2 and 3 only one section of overlapping ribs is identified, the overlapping condition exists in eight places in the bottom housing 100. While the preferred embodiment shows four inner rib walls 110 – 113 and four outer rib walls 114-117 it is contemplated that a greater or lesser number of overlapping can be used. In Figures 2 and 3 the overlap 120 is labeled, and in the preferred embodiment the overlap angle is between 5 and 15 degrees, but prototypes have been made using an overlap angle 120 of 7.5 degrees. The ribs 110-117 are arc segments that extend perpendicular from the essentially planar base 102 and 103. These angles are variable based upon the height of the rib, the material, the thickness of the rib, the desired cushion and the distance between the inner and outer ribs. In general the distance between the inner and outer ribs is controlled based upon the annular rib in the top clam shell housing.

The overlapping double wall provides maximum protection from shock or impact to the exterior of the containment device by positioning the inner and outer

latch engaged between the top and bottom housings. FIG 19 shows a detailed view of the engaged between the top and bottom housings. The bottom housing 100 has at least one latch that engages in a corresponding notch 75 located on the top housing 50.

The top surface 74 of said latch 70 is located at a height 76 that is below the top surface of said at least one rib 141. The height 76 of the latch 70 is equal to or lower than the inner wall 141 structure. This allows equipment to interface with the bottom member of the container without interference with the equipment and latch height. This further reduces the possibility of damage to the latch 70 if the bottom housing 100 is dragged on a surface. In the preferred embodiment there are four latches 70 and four corresponding notches 75 located in each corner region of said top housing 50 or said bottom 100 housing, but as few as one or two are contemplate as well as four or more latches. Figure 19 shows that the notch 70 has a curve entry ramp 77 and a recess 78 that elevates the latch 70 above said entry ramp 77 and lowers said latch 70 into the recess 78 to retain the latch 70 in the recess 78. When the latch(s) are secured the top of the inner rib wall 111 is tightly engaged and captured on the corresponding surface 84 of the top housing 50. The notch 75 is located in a protective latch well 140 that protects the latch 70 during handling and impact. The protective latch well 140 exists below the planar rectangular surface 105 of the top housing 50. The protective latch well is sufficiently sized to limit accidental opening of the latch, and is also sufficiently sized to allows access for human fingers and automated machines that will open the housings. The side walls 142 protective latch well provides only limited clearance between the side walls 142 and the hook 74 / notch 75.

FIG 20 shows a perspective view of the top and bottom housings in an open exploded view for reference of the internal components. This view provides a view into the open cavity of the top housing 50 and the bottom housing 100 without obstruction of the semiconductor wafers.

Thus, specific embodiments of a semiconductor wafer container have been disclosed. It should be apparent, however, to those skilled in the art that many more modifications besides those described are possible without departing from the

inventive concepts herein. The inventive subject matter, therefore, is not to be restricted except in the spirit of the appended claims.

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There are a number of different holding and clamping features in wafer shipping containers. All of these prior designs rely on multiple parts to create a clamping lip. These designs have several drawbacks including but not limited to the parts not being rigid with respect to the bottom assembly because they must be sonic welded, bonded or snapped together and that secondary parts or assembly operations are more expensive to produce.

The engagement of latches that secure the top and bottom housings together have a number of limitations. Specifically, prior art latches provide a raised straight slope ramp. The raise straight sloped surface is susceptible to damage and also, the straight slope does not provide an ideal self gripping to engage between the top and bottom housings. The top cover orientation features use differing wall engagement angles or large latches as opposed to small slots as presented in this pending application.

What is needed is a semiconductor wafer container with improvements in side protection to the wafers, improved cover design to minimize rotation, a simplified top cover orientation mechanism and an improved bottom holding mechanism for automation. This pending application satisfies these requirements with novel improvements in the identified areas.

BRIEF SUMMARY OF THE INVENTION

The invention is defined in the independent claim. Some optional features of the invention are also defined in the dependent claims.

In an exemplary arrangement, there is a semiconductor wafer container that has an overlapping double wall. The wall structure comprises multiple outer walls and multiple inner walls. The overlapping double containment wall increases semiconductor wafer protection during impact or shipping. Each inner wall shares a minimal percentage of a common angular sector with each adjacent outer wall. The inner wall is generally very stiff and does not absorb and cushion the wafers if the container is dropped or subject to impact. On the bottom assembly, the inner walls and outer walls are positioned in an offset and overlapping configuration provides maximum protection to the semiconductor wafers.

In an exemplary arrangement, a semiconductor wafer container may improve alignment of the top cover with the base. The alignment system includes reference tabs that are

received by the cover and a visual identifier for guiding an operator in the proper alignment of the two halves of the container. The top cover orientation features prevent improper installation of the top cover to the bottom member. The top cover orientation feature is incorporated into the top cover that mates with the features of the double locking location feature. This orientation feature prevents installation of the top cover in plus or minus 90 degree locations about the central axis.

In an exemplary arrangement, a semiconductor wafer container may provide an improved locking mechanism for securing two halves of a wafer container together. The bottom half comprises a wall structure perpendicular to the base. The wall structure comprises segmented inner and outer walls, where each portion of the wall structure has a distinctive arc length. The arc length of each inner wall does not completely overlap with the arc length of any outer wall.

In an exemplary arrangement, a semiconductor wafer container may provide an improved engagement feature for the locking tabs. These improved tabs include a cover for a wafer container that engages to a base. The cover includes one or more notches, each having a ramp that easily receive latches from the base.

In another exemplary arrangement, a semiconductor wafer container may incorporate bi-directional rotation locking feature(s). These features may improve orienting, the top member on the bottom member that decreases the amount of top cover rotation and movement with respect to the bottom member. This feature creates a double locking location that securely locates and locks the top cover in place during top cover assembly. The bi-directional rotation locking feature is located on both sides of the perpendicular top cover surfaces of a single wall on both the interior and the exterior simultaneously. This improvement provides bi-directional locking of the captured surface decreases the amount of top cover rotation and movement with respect to the bottom member and increases the rigidity of the containment device when the members are assembled.

In another exemplary arrangement, a semiconductor wafer container may incorporate a protective latch well. The latch well is a recess that is incorporated into the top cover which protects the latch arm from being accidentally bumped or inadvertently opened. The tip of the latch surrounded by a wall that protects the latch by lowering the tip of the latch below the planar surface of the Top Cover by at least 2mm. This recess

distance or greater is considered to be adequate to protect the latch from accidental opening.

In another exemplary arrangement, a semiconductor wafer container may include an improved holding and clamping feature to allow for automated machinery to latch onto and hold the bottom member and secure it firmly to the machinery nesting locations. This mechanism is comprised of a single piece feature that is molded into the bottom member. The holding and clamping feature on the bottom member improves equipment interface where these containers are used. The feature is a holding mechanism to allow for automated machinery to latch onto and hold the bottom member and secure it firmly to the machinery nesting locations.

In another exemplary arrangement, a semiconductor wafer container may include an improved curved latch recess for improved closure and retention of the containment device latches. In the improved latch and latch recess the height of the latch is equal to or lower than the inner wall structure. This allows equipment to interface with the bottom member of the container without interference with the equipment and latch height. A curvature on the mating surface provides superior holding and self centering and gripping during handling and after impact. This recessed feature also protects the mating surface from damage when the top cover is disassembled from the bottom member. The latch recess and curved surface also provides increased latch retention and container integrity during impact or shipping. This includes a lowered latch equal to or less than the inner wall height.

Various objects, features, aspects, and advantages of the present invention will become more apparent from the following detailed description of disclosed arrangements, along with the accompanying drawings in which like numerals represent like components.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 shows a perspective exploded view of the wafer container with a plurality of wafers disposed between the two wafer container halves.

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inventive concepts herein. The inventive subject matter, therefore, is not to be restricted except in the scope of the appended claims.