has movable side walls that push against opposing sides of the wafer to eliminate movement of the wafer within the carrier. 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 to limit the amount of radial movement of the wafer within in the container. Limiting radial movement is important because when shipping "bumped" wafers that must be stacked on spacer rings where the rings must only touch the periphery of the wafer will not shift radially into the areas containing the solder bumps. The improvements increase the wafer containment device's ability to protect semiconductor wafers and reduce radial wafer shift for both bumped and non-bumped wafers. This design can be used with or without spacer rings between the wafers in the vertical stack.

It is an object of the semiconductor wafer container to incorporate flexible wall segments. The flexible wall or wall segments moves radially inward to take up the excess space between the wafer and the main inner diameter of the container. The flexible walls reduce the movement of the wafers or can contain inserts that move with the walls to reduce the movement of the wafers. These wall segments create an interference fit between the top cover and panel or by use of a ramped engagement surfaces in either the Top Cover and/or the Bottom Member. The flexible wall segments can consist of individual components with flexible inserts, or can be integral to the base where they are molded as one part.

It is an object of the semiconductor wafer container to include flexible panels within a constraining wall. The flexible panel is contained within the main inner walls of the wafer container. The flexible wall segments can be simply a flexible portion of the wall or a distinct panel that reduces the radial gap between the wafer container and the wafer or wafer stack. This mechanism could also include the radial movement of resilient inserts imbedded into the side walls and are engaged by the top cover to move vertical features of the resilient insert radially inward.

It is another object of the semiconductor wafer container to include flexible inserts that are embedded onto or into the flexible wall. The insert is a flexible or resilient inserts, whether separate pieces or overmolded onto the walls, using a

resilient materials. The wall may include holes or slots for insertion and retention of the insert.

It is still another object of the semiconductor wafer container to include ramped engagement surfaces. When the wall segments are pushed radially inward they are in a generally vertical direction. The use of ramped surfaces minimize the amount of force required to assemble the Top Cover and Bottom Member together when loaded with the wafer stack. The ramped surface is on the backside of the flexible wall or panel segment and has a corresponding ramp on the top cover which engages the flexible wall ramp and drives the panel radially inward.

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 ribs and the flexible walls.

FIG. 3 shows a perspective view of the rib with two flexible wall segments.

FIG. 4 shows a perspective cut away view of the top housing showing the ramped engagement rib.

FIG. 5 shows a perspective cut away view of the bottom housing showing the flexible wall segments.

FIG 6 shows a perspective cut away view of the flexible wall and the ramped engagement rib.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a perspective exploded view of the wafer container with a plurality of wafers disposed between the two wafer container clam shells. A plurality of semiconductor wafers 20, 21 and 22 are shown between the top 50 and bottom 100 housing with wafer separators or spacer rings 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 111that extend essentially perpendicular from the bottom housing 100 protect the semiconductor wafers 20-22 from shifting side damage. A rib 115 rises from the outer edge of the bottom housing to provide an area for labeling the wafer carrier. In addition to the label area, the wafer carrier has an area for a RF ID tag 65 (Also show in Figure 5) to be inserted into the wafer carrier housing. This area is of the part is marked to identify the location of the RF ID to aid in scanning for the RF ID and eliminate the need to scan all the sides of the carrier to locate the RF ID.

The inner rib walls are formed in the top housing provide flexible wall segments that are bent with when the top housing 50 is inserted onto the bottom housing 100. In this preferred embodiment, there are four vertical ribs and each vertical rib has two flexible walls. When the walls are flexed, the walls push radially inward or concentrically into the center of the wafer carrier to reduce the inside diameter of the central cavity and to clamp the wafers 20-22, wafer separators and or space rings 25. This is shown and described in more detail in the Figures 2-6 of this application.

FIG. 2 shows a top view of the bottom housing with the ribs 110, 111, 112 and 113 all having two each flexible walls. The flexible wall is better shown with FIG. 3 that shows a perspective view of the rib with two flexible wall segments 122 and 123 on rib 110. Each flexible wall 122 and 123 has an associated boss, 124 and 125 respectively, that is pushed upon by a mating rib located in the top housing. As the top housing is pushed down onto the bottom housing, the bosses 124 and 125 are pushed towards the center of the wafer carrier.

The walls 122 and 123 will flex on the outer restrained portion of the rib 110 and bends into the center of the wafer carrier. Because there are eight flexible walls located around the wafer carrier the walls all will move inward in unison to push in on the wafer from all directions to clamp the wafer into the center of the wafer carrier. Moving all of the walls together further prevents damage to the wafers because they are not being pushed in only one direction and when the top housing is removed the

FIG 6 shows a perspective cut away view of the flexible wall 123 on rib 110 of the bottom housing 100 and the ramped engagement rib 143 on the top housing. The top housing 50 is pushed down onto the bottom housing 100 until the locking tab or latch 70 engages and locks into the notch 75 in the top housing 50. To separate the two housings the locking tab or latch 70 is pushed out of the notch 75 and the housings can be pulled apart. As the housings are pulled apart the engagement rib 143 slides off of the boss 125 such that flexible wall 123 springs back away thereby releasing the wafers. In this figure, an insert or pad 127 is shown on the inside of the flexible wall. The pad 127 can be an inserted, over molded or integrated into or from the wall. This pad 127 is preferably an elastomeric and provides an additional cushion to the wafer as well as increasing the coefficient of friction of the flexible wall to grip the silicon wafers, or spacers. It should be noted that the location of this cushion or pad 127 is not placed at the hinge end or directly behind where a boss 125 would exist. The location of the cushion or pad 127 is paced between these two locations to allow the flexible wall to bend at the point of contact with the wafer(s). Because the point of contact is between the hinge location and the boss location the flexible wall provides additional flexing to further cushion the wafers. The cushions, pads or flexible inserts 127 can be embedded onto or into the flexible wall. The insert is a flexible or resilient inserts, whether separate pieces or over molded onto the walls, using a resilient materials. The wall may include holes or slots for insertion and retention of the insert. In this Figure, the living hinge area 128 is shown where the wall is thinned to allow for flexing. The living hinge is a hinge that is formed from the wall material where the wall material is unsupported on three sides. Pressure on the end of the free end of the hinge allows the wall to bend. The wall is thinned at location 128 to allows for easier flexing or hinging at a more localized area of the wall.

A radial support for the wafer ring 129 is also shown to support the lowermost wafer ring.

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.

has movable side walls that push against opposing sides of the wafer to eliminate movement of the wafer within the carrier. This pending application may provide improvements in the identified areas.

BRIEF SUMMARY OF THE INVENTION

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

The semiconductor wafer container disclosed herein may limit the amount of radial movement of the wafer within in the container. Limiting radial movement may be important because when shipping "bumped" wafers that must be stacked on spacer rings where the rings must only touch the periphery of the wafer will not shift radially into the areas containing the solder bumps. The improvements may increase the wafer containment device's ability to protect semiconductor wafers and may reduce radial wafer shift for both bumped and non-bumped wafers. This design can be used with or without spacer rings between the wafers in the vertical stack.

The semiconductor wafer container disclosed herein may incorporate flexible wall segments. The flexible wall or wall segments may move radially inward to take up the excess space between the wafer and the main inner diameter of the container. The flexible walls may reduce the movement of the wafers or can contain inserts that move with the walls to reduce the movement of the wafers. These wall segments may create an interference fit between the top cover and panel or by use of a ramped engagement surfaces in either the Top Cover and/or the Bottom Member. The flexible wall segments can consist of individual components with flexible inserts, or can be integral to the base where they are molded as one part.

The semiconductor wafer container disclosed herein may include flexible panels within a constraining wall. The flexible panel may be contained within the main inner walls of the wafer container. The flexible wall segments can be simply a flexible portion of the wall or a distinct panel that reduces the radial gap between the wafer container and the wafer or wafer stack. This mechanism could also include the radial movement of resilient inserts imbedded into the side walls and are engaged by the top cover to move vertical features of the resilient insert radially inward.

The semiconductor wafer container disclosed herein may include flexible inserts that are embedded onto or into the flexible wall. The insert may be a flexible or resilient inserts, whether separate pieces or overmolded onto the walls, using a

resilient materials. The wall may include holes or slots for insertion and retention of the insert.

The semiconductor wafer container disclosed herein may include ramped engagement surfaces. When the wall segments are pushed radially inward they are in a generally vertical direction. The use of ramped surfaces may minimize the amount of force required to assemble the Top Cover and Bottom Member together when loaded with the wafer stack. The ramped surface may be on the backside of the flexible wall or panel segment and may have a corresponding ramp on the top cover which engages the flexible wall ramp and drives the panel radially inward.

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 ribs and the flexible walls.

FIG. 3 shows a perspective view of the rib with two flexible wall segments.

FIG. 4 shows a perspective cut away view of the top housing showing the ramped engagement rib.

FIG. 5 shows a perspective cut away view of the bottom housing showing the flexible wall segments.

FIG 6 shows a perspective cut away view of the flexible wall and the ramped engagement rib.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a perspective exploded view of the wafer container with a plurality of wafers disposed between the two wafer container clam shells. A plurality of semiconductor wafers 20, 21 and 22 are shown between the top 50 and bottom 100 housing with wafer separators or spacer rings 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 that extend essentially perpendicular from the bottom housing 100 protect the semiconductor wafers 20-22 from shifting side damage. A rib 115 rises from the outer edge of the bottom housing to provide an area for labeling the wafer carrier. In addition to the label area, the wafer carrier has an area for a RF ID tag 65 (Also show in Figure 5) to be inserted into the wafer carrier housing. This area is of the part is marked to identify the location of the RF ID to aid in scanning for the RF ID and eliminate the need to scan all the sides of the carrier to locate the RF ID.

The inner rib walls are formed in the top housing provide flexible wall segments that are bent with when the top housing 50 is inserted onto the bottom housing 100. In this preferred arrangement, there are four vertical ribs and each vertical rib has two flexible walls. When the walls are flexed, the walls push radially inward or concentrically into the center of the wafer carrier to reduce the inside diameter of the central cavity and to clamp the wafers 20-22, wafer separators and or space rings 25. This is shown and described in more detail in the Figures 2-6 of this application.

FIG. 2 shows a top view of the bottom housing with the ribs 110, 111, 112 and 113 all having two each flexible walls. The flexible wall is better shown with FIG. 3 that shows a perspective view of the rib with two flexible wall segments 122 and 123 on rib 110. Each flexible wall 122 and 123 has an associated boss, 124 and 125 respectively, that is pushed upon by a mating rib located in the top housing. As the top housing is pushed down onto the bottom housing, the bosses 124 and 125 are pushed towards the center of the wafer carrier.

The walls 122 and 123 will flex on the outer restrained portion of the rib 110 and bends into the center of the wafer carrier. Because there are eight flexible walls located around the wafer carrier the walls all will move inward in unison to push in on the wafer from all directions to clamp the wafer into the center of the wafer carrier. Moving all of the walls together further prevents damage to the wafers because they are not being pushed in only one direction and when the top housing is removed the

FIG 6 shows a perspective cut away view of the flexible wall 123 on rib 110 of the bottom housing 100 and the ramped engagement rib 143 on the top housing. The top housing 50 is pushed down onto the bottom housing 100 until the locking tab or latch 70 engages and locks into the notch 75 in the top housing 50. To separate the two housings the locking tab or latch 70 is pushed out of the notch 75 and the housings can be pulled apart. As the housings are pulled apart the engagement rib 143 slides off of the boss 125 such that flexible wall 123 springs back away thereby releasing the wafers. In this figure, an insert or pad 127 is shown on the inside of the flexible wall. The pad 127 can be an inserted, over molded or integrated into or from the wall. This pad 127 is preferably an elastomeric and provides an additional cushion to the wafer as well as increasing the coefficient of friction of the flexible wall to grip the silicon wafers, or spacers. It should be noted that the location of this cushion or pad 127 is not placed at the hinge end or directly behind where a boss 125 would exist. The location of the cushion or pad 127 is paced between these two locations to allow the flexible wall to bend at the point of contact with the wafer(s). Because the point of contact is between the hinge location and the boss location the flexible wall provides additional flexing to further cushion the wafers. The cushions, pads or flexible inserts 127 can be embedded onto or into the flexible wall. The insert is a flexible or resilient inserts, whether separate pieces or over molded onto the walls, using a resilient materials. The wall may include holes or slots for insertion and retention of the insert. In this Figure, the living hinge area 128 is shown where the wall is thinned to allow for flexing. The living hinge is a hinge that is formed from the wall material where the wall material is unsupported on three sides. Pressure on the end of the free end of the hinge allows the wall to bend. The wall is thinned at location 128 to allows for easier flexing or hinging at a more localized area of the wall.

A radial support for the wafer ring 129 is also shown to support the lowermost wafer ring.

Thus, exemplary arrangements 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 scope of the appended claims.