SEMICONDUCTOR WORKPIECE CARRIERS AND METHODS FOR PROCESSING SEMICONDUCTOR WORKPIECES

TECHNICAL FIELD

The present disclosure is related to semiconductor workpiece carriers and methods for processing semiconductor workpieces.

BACKGROUND

Processors, memory devices, imagers, and other types of microelectronic devices are often manufactured on semiconductor workpieces or other types of workpieces. In a typical application, several individual dies (e.g., devices) are fabricated on a single workpiece using sophisticated and expensive equipment and processes. Individual dies generally include an integrated circuit and a plurality of bond-pads coupled to the integrated circuit. The bond-pads provide external electrical contacts on the die through which supply voltage, signals, etc., are transmitted to and from the integrated circuit. The bond-pads are usually very small, and they are arranged in an array having a fine pitch between bond-pads. The dies can also be quite delicate. As a result, after fabrication, the dies are packaged to protect the dies and to connect the bond-pads to another array of larger terminals that is easier to connect to a printed circuit board. The package can then be electrically connected to other microelectronic devices or circuits in many types of consumer or industrial electronic products.

Electronic product manufacturers are under continuous pressure to reduce the size of their products. Accordingly, microelectronic die manufacturers seek to reduce the size of the packaged dies incorporated into the electronic products. One approach to reducing the size of packaged dies is to reduce the thickness of the dies. For example, the backside of a wafer is often ground to reduce the thickness of the dies formed on the wafer. After backgrinding, the wafer is attached to a die attach film tape

and then cut to singulate the dies. The die attach film tape includes a base and an adhesive layer on the base. After singulation, the dies are removed from the base and placed on a carrier tape for temporary storage. When the dies are removed from the base, sections of the adhesive layer remain attached to corresponding dies to facilitate subsequent attachment of the dies to a substrate for packaging. Conventional carrier tapes include a base and an adhesive layer on the base. For purposes of brevity and clarity, in this section the adhesive layer of the die attach film tape that remains attached to the dies will be referred to as the die attach adhesive, and the adhesive layer of the carrier tape will be referred to as the carrier tape adhesive. The singulated dies are attached to the carrier tape with the die attach adhesive facing the carrier tape adhesive.

One drawback of conventional carrier tapes is that each die needs to be removed from the carrier tape after a relatively short time (e.g., two to three weeks) because the bond between the die attach adhesive and the carrier tape adhesive strengthens over time. If a die is stored on a carrier tape for too long, several problems may result. First, removing the die can cause delamination between the die and the die attach adhesive because the bond between the die attach adhesive and the carrier tape adhesive may be stronger than the bond between the die attach adhesive and the die. Second, an increased force is required to separate the die from the carrier tape, and the increased force can crack or otherwise damage the die. Third, sections of the carrier tape adhesive may remain attached to the die attach adhesive after the die is removed, which reduces adhesive strength of the die onto the substrate or leadframe. The may result in delamination of the die from the substrate or leadframe due to insufficient adhesion to the latter. Accordingly, there is a need to improve the processing of semiconductor workpieces.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A is a top plan view of a carrier assembly for processing semiconductor workpieces in accordance with one embodiment of the disclosure.

Figure 1B is a schematic side cross-sectional view of the carrier assembly taken generally along the line 1B-1B of Figure 1A.

Figure 2A is a top plan view of the carrier assembly with a plurality of semiconductor components attached to the replaceable carrier.

Figure 2B is a schematic side cross-sectional view of the carrier assembly and the semiconductor components taken substantially along the line 2B-2B of Figure 2A.

Figure 3 is a schematic side cross-sectional view of the carrier assembly with a semiconductor workpiece attached to the assembly.

Figure 4 is a schematic side cross-sectional view of a carrier assembly in accordance with another embodiment of the disclosure.

Figure 5 is a top plan view of a carrier assembly for processing semiconductor workpieces in accordance with another embodiment of the disclosure.

DETAILED DESCRIPTION

Specific details of several embodiments of the disclosure are described below with reference to semiconductor workpiece carriers and methods for processing semiconductor workpieces. The semiconductor workpieces include substrates upon which and/or in which microelectronic devices, micromechanical devices, data storage elements, optics, read/write components, and other features are fabricated. For example, SRAM, DRAM (e.g., DDR-SDRAM), flash-memory (e.g., NAND flash-memory), processors, imagers, and other types of devices can be constructed on semiconductor workpieces. The semiconductor workpieces can be semiconductor wafers, glass substrates, dielectric substrates, or many other types of substrates. Moreover, several other embodiments of the invention can have different configurations, components, or procedures than those described in this section. A person of ordinary skill in the art, therefore, will accordingly understand that the invention may have other embodiments with additional elements, or the invention may have other embodiments without several of the elements shown and described below with reference to Figures 1A-5.

In one embodiment shown in Figure 1A and 1B, a semiconductor workpiece carrier assembly 100 includes (a) a support structure 110 having an opening sized to receive at least a portion of a semiconductor workpiece, and (b) a replaceable carrier 130 positioned at the opening. The replaceable carrier 130 includes a base 132 and an adhesive layer 140 on the base. The base 132 has a surface, and the adhesive layer 140 covers only a section of the surface. The adhesive layer also releasably attaches the replaceable carrier to the support structure.

Figure 1A is a top plan view of a carrier assembly 100 for processing semiconductor workpieces in accordance with one embodiment of the disclosure. Figure 1B is a schematic side cross-sectional view of the carrier assembly 100 taken generally along the line 1B-1B of Figure 1A. Referring to both Figures 1A and 1B, the carrier assembly 100 is configured to temporarily support or carry a semiconductor workpiece, or a portion of such a workpiece (e.g., a microelectronic die) during and/or between processing procedures. For example, the carrier assembly 100 may support a semiconductor workpiece during a dicing procedure as illustrated below in Figure 3, or the assembly 100 may carry a plurality of microelectronic dies after a wafer reconstruction process as illustrated below in Figures 2A and 2B. In either case, after the carrier assembly 100 temporarily supports the semiconductor component(s), the component(s) can be removed from the assembly 100.

The carrier assembly 100 of the illustrated embodiment includes a support structure 110 and a replaceable carrier 130 releasably attached to the support structure 110. The support structure 110 can include a generally annular frame having an inner surface 112, an outer surface 114 opposite the inner surface 112, a first surface 116 (Figure 1B), and a second surface 118 opposite the first surface 116. The illustrated inner surface 112 defines a generally circular opening 120 sized to receive a semiconductor workpiece. In other embodiments, however, the inner surface 112 of the support structure 110 can have a different configuration. For example, the support structure may not have a generally annular shape, and/or the opening may be sized to receive only a portion of a workpiece.

The replaceable carrier 130 of the illustrated embodiment is releasably attached to the first surface 116 of the support structure 110 and extends across the opening 120. The illustrated replaceable carrier 130 includes a base 132 and an adhesive layer 140 on a portion of the base 132. The base 132 can be a generally flexible film having a first major surface 134 facing the support structure 110 and a second major surface 138 opposite the first major surface 134. The first major surface 134 has a central portion 136a and a generally annular perimeter portion 136b outboard the central portion 136a.

The adhesive layer 140 is disposed on the perimeter portion 136b of the first major surface 134 and attaches the base 132 to the support structure 110. In the illustrated embodiment, the adhesive layer 140 is not disposed on the central portion 136a of the first major surface 134 such that the central portion 136a is exposed. As a result, the central portion 136a of the first major surface 134 can provide a support surface to which a semiconductor component or workpiece can be directly attached. In other embodiments, the adhesive layer 140 can be disposed on one or more sections of the central portion 136a. In either case, the adhesive layer 140 covers only a portion of the first major surface 134 so that a section of the surface 134 is exposed.

The adhesive layer 140 enables the replaceable carrier 130 to be selectively detached from the support structure 110 so that the support structure 110 can be reused with another replaceable carrier 130. For example, in several applications, the replaceable carrier 130 may be used to support a single workpiece and, after the workpiece is detached, the carrier 130 can be decoupled from the support structure 110 and a second releasable carrier 130 can be attached to the support structure 110. In other applications, the replaceable carrier 130 may be reused with several different workpieces. In either case, the adhesive layer 140 can include a UV-curable adhesive or other suitable adhesive that can be manipulated to selectively release the replaceable carrier 130 from the support structure 110.

Figures 2A-3 illustrate different methods of processing semiconductor components and/or workpieces that utilize the carrier assembly 100 in accordance with several embodiments of the disclosure. Specifically, Figure 2A is a top plan view of the

carrier assembly 100 with a plurality of semiconductor components 150 attached to the replaceable carrier 130. Figure 2B is a schematic side cross-sectional view of the carrier assembly 100 and the semiconductor components 150 taken substantially along the line 2B-2B of Figure 2A. Referring to both Figures 2A and 2B, the individual semiconductor components 150 include a microelectronic die 151 and an adhesive 160 (Figure 2B) on the die 151. The dies 151 include an active side 152 and a backside 154 (Figure 2B) opposite the active side 152. The dies 151 can also include a plurality of terminals (e.g., bond-pads) arranged in an array on one or both of the active side 152 and the backside 154, and the dies can further have an integrated circuit (shown schematically in Figure 2B) operably coupled to the terminals. In still further embodiments, the dies can include photosensitive arrays. In the illustrated embodiment, the dies 151 have a height H_1 (Figure 2B) that is less than a height H_2 (Figure 2B) of the support structure 110. As such, the dies 151 are received completely within the opening 120 and do not project beyond the second surface 118 of the support structure 110. In other embodiments, however, the height H_1 of the dies 151 may be greater than the height H_2 of the support structure 110 such that the dies 151 project beyond the second surface 118.

The adhesive 160 can be a die attach film or other suitable coupling member for releasably attaching the backsides 154 of the dies 151 to the replaceable carrier 130. The adhesive 160 can be disposed on the backsides 154 of the dies 151 before the dies 151 are attached to the carrier assembly 100, or the adhesive 160 can be deposited on the replaceable carrier 130 and then the dies 151 can be attached to the adhesive 160. In either case, the semiconductor components 150 are attached directly to the base 132 such that the adhesive layer 140 is not positioned directly between the semiconductor components 150 and the first major surface 134 of the base 132. Rather, the adhesive 160 of the semiconductor component 150 is attached to an exposed portion of the first major surface 134. The adhesive 140 can accordingly be a first adhesive, and the adhesive 160 can be a second adhesive with different properties than the first adhesive.

In one application, the semiconductor components 150 are attached to the carrier assembly 100 as part of a wafer reconstruction process. For example, the dies 151 can be formed on a semiconductor workpiece and then the workpiece can be cut to singulate the dies 151. Before or after singulation, the individual dies 151 may be tested to detect defective dies. The known good dies 151 can be attached to the carrier assembly 100 for further testing, temporary storage, and/or further processing. The semiconductor components 150 may subsequently be detached from the carrier assembly 100 for packaging or other processing.

Several embodiments of the carrier assembly 100 illustrated in Figures 1-2B may increase the time that the assembly 100 can support semiconductor components and/or workpieces. Because the first major surface 134 of the base 132 includes an exposed section, the adhesive 160 of the semiconductor component 150 can be attached directly to the base 132 without contacting the adhesive layer 140. As a result, the adhesive 160 of the semiconductor component 150 does not bond with the adhesive layer 140 and cause many of the difficulties encountered with conventional carrier tapes. The adhesive 160 may also be selected to have a lower bonding strength than the adhesive 140 because the adhesive 160 only needs to hold a single component 150, but the adhesive 140 needs to hold weight of the base 130 and all of the components 150 to the support structure 110. Therefore, the semiconductor components 150 can remain attached to the carrier assembly 100 for an increased length of time.

Another embodiment of a releasable carrier 130 for supporting semiconductor components includes a generally flexible base having a first major surface and a second major surface opposite the first major surface. The first major surface has a first portion sized to carry at least one semiconductor component and a second portion different than the first portion. The releasable carrier 130 further includes an adhesive layer 140 disposed on the second portion of the first major surface but not on the first portion of the first major surface. In still another embodiment, a semiconductor component processing assembly includes a semiconductor component releasably coupled to the first portion of the surface of the flexible base. The carrier assembly 100 can be used in the processing of microelectronic dies by attaching the

surface has a first portion sized to carry at least one semiconductor component and a second portion different than the first portion. The releasable carrier 130 further includes an adhesive layer 140 disposed on the second portion of the first major surface but not on the first portion of the first major surface. In still another embodiment, a semiconductor component processing assembly includes a semiconductor component releasably coupled to the first portion of the surface of the flexible base. The carrier assembly 100 can be used in the processing of microelectronic dies by attaching the adhesive layer around the perimeter of the replaceable carrier to a support structure and releasably connecting a die to a base of the replaceable carrier. The support structure has an opening, and the die is positioned at least partially in the opening of the support structure and spaced apart laterally from the adhesive layer.

Another embodiment of using the carrier assembly 100 for a method of processing semiconductor components includes providing a semiconductor component having a die with a surface and a first adhesive layer on the surface. After providing the component, the method further includes releasably attaching the component to a flexible carrier with the first adhesive layer contacting a first portion of a base of the carrier. The carrier further includes a second adhesive layer on a second portion of the base but not on the first portion.

Figure 3 is a schematic side cross-sectional view of the carrier assembly 100 with a semiconductor workpiece 250 attached to the assembly 100. The illustrated semiconductor workpiece 250 includes a plurality of microelectronic dies 151, an active side 252, and a backside 254 opposite the active side 252. In other embodiments, the workpiece 250 may include other features in lieu of or in addition to the dies 151. In either case, an adhesive 260 releasably attaches the backside 254 of the workpiece 250 to the first major surface 134 of the replaceable carrier 130. The workpiece 250 is positioned such that the adhesive layer 140 of the replaceable carrier 130 is outboard and spaced laterally apart from the workpiece 250. In other embodiments, a portion of the workpiece 250 and/or the adhesive 260 may contact the adhesive layer 140.

1A-3, except that the illustrated carrier assembly 300 further includes a second replaceable carrier 330 releasably attached to the support structure 110. The second replaceable carrier 330 can be similar or identical to the first replaceable carrier 130. For example, the illustrated second replaceable carrier 330 includes a base 332 and an adhesive layer 340 on a portion of the base 332. The base 332 can be a generally flexible film having a first major surface 334 facing the support structure 110 and a second major surface 338 opposite the first surface 334. The first major surface 334 has a central portion 336a and a generally annular perimeter portion 336b outboard the central portion 336a.

In the illustrated embodiment, the adhesive layer 340 is disposed on the perimeter portion 336b of the first major surface 334 and attaches the base 332 to the second surface 118 of the support structure 110. Although the adhesive layer 340 is not disposed on the central portion 336a of the first major surface 334 in the illustrated embodiment, in other embodiments the adhesive layer 340 may cover the entire first major surface 334. In either case, the second replaceable carrier 330 can be releasably attached to the support structure 110 after the workpiece 250 is coupled to the first replaceable carrier 130. Together, the support structure 110 and the first and second replaceable carriers 130 and 330 define an enclosed chamber 390 within which the workpiece 250 is positioned. The enclosed chamber 390 accordingly protects the workpiece 250 from contaminants and/or damage.

Figure 5 is a top plan view of a carrier assembly 400 for processing semiconductor workpieces in accordance with another embodiment of the disclosure. The illustrated carrier assembly 400 is generally similar to the carrier assembly 100 described above with reference to Figures 1A and 1B. For example, the carrier assembly 400 includes a support structure 110 and a replaceable carrier 430 releasably attached to the support structure 110. The illustrated replaceable carrier 430, however, includes an adhesive layer 440 disposed on some of the central portion 136a of the first major surface 134 in addition to the perimeter portion of the first major surface 134. Specifically, the adhesive layer 440 includes a plurality of apertures 442 that expose sections of the first major surface 134. The illustrated apertures 442 have a rectangular

configuration that can correspond to the size of the semiconductor components 150 illustrated in Figures 2A and 2B. The apertures 442, for example, can be slightly larger than the semiconductor components that are to be mounted in the apertures 442. As such, the semiconductor components 150 may be placed in corresponding apertures 442 and releasably attached directly to the first major surface 134 without contacting the adhesive layer 440. In other embodiments, the apertures 442 can have a different configuration and/or size. In additional embodiments, the adhesive layer 440 can be disposed on the base 132 in a different arrangement.

From the foregoing, it will be appreciated that specific embodiments of the invention have been described herein for purposes of illustration, but that various modifications may be made without deviating from the invention. For example, many of the elements of one embodiment can be combined with other embodiments in addition to or in lieu of the elements of the other embodiments. Accordingly, the invention is not limited except as by the appended claims.

CLAIMS

I/We claim:

1. A semiconductor workpiece carrier assembly, comprising:

a support structure having an opening sized to receive at least a portion of a semiconductor workpiece; and

a replaceable carrier including a base having a surface with a section and an adhesive releasably attaching the replaceable carrier to the support structure, wherein the adhesive covers only the section of the surface.

2. The carrier assembly of claim 1 wherein:

the base comprises a flexible base;

the surface of the base includes a perimeter portion and a central portion generally aligned with the opening, and wherein the central portion is exposed and sized to carry a semiconductor component;

the adhesive layer is disposed on the perimeter portion but not the central portion;

the support structure further comprises a first side and a second side opposite the first side;

the replaceable carrier is a first replaceable carrier releasably attached to the first side; and

the assembly further comprises a second replaceable carrier releasably attached to the second side.

3. The carrier assembly of claim 1 wherein:

the surface of the base includes a perimeter portion and a central portion generally aligned with the opening; and

the adhesive is disposed on the perimeter portion but not the central portion.

4. The carrier assembly of claim 1 wherein the adhesive is disposed on only an annular portion of the surface of the base.

5. The carrier assembly of claim 1 wherein:

the section of the surface comprises a first portion; and

the surface further comprises a second, exposed portion configured to carry a semiconductor component.

6. The carrier assembly of claim 1 wherein the base comprises a flexible base.

7. The carrier assembly of claim 1 wherein:

the support structure further comprises a first side and a second side opposite the first side;

the replaceable carrier is a first replaceable carrier releasably attached to the first side; and

the assembly further comprises a second replaceable carrier releasably attached to the second side.

8. A releasable carrier for supporting semiconductor components, the releasable carrier comprising:

a generally flexible base having a first major surface and a second major surface opposite the first major surface, the first major surface having a first portion sized to carry at least one semiconductor component and a second portion different than the first portion; and

an adhesive layer disposed on the second portion of the first major surface but not on the first portion of the first major surface.

9. The releasable carrier of claim 8 wherein:

the first portion of the first major surface is exposed and has a generally circular configuration; and

the second portion of the first major surface has a generally annular configuration.

10. The releasable carrier of claim 8 wherein the first portion of the first major surface is exposed and has a generally rectangular configuration.

11. The releasable carrier of claim 8 wherein:

the first portion of the first major surface comprises a central section; and

the second portion of the first major surface comprises a perimeter section.

12. The releasable carrier of claim 8 wherein:

the first portion of the first major surface is sized to carry a first semiconductor component;

the first major surface further includes a third portion sized to carry a second semiconductor component; and

the adhesive layer is not disposed on the third portion of the first major surface.

13. A semiconductor component processing assembly, the assembly comprising:

a support structure;

a carrier releasably attached to the support structure, the carrier including a base and an adhesive layer on the base, the base having a surface

with a first portion and a second portion aligned with the support structure, wherein the adhesive layer is disposed on the second portion but is not disposed on the first portion; and

a semiconductor component releasably coupled to the first portion of the surface of the base.

14. The assembly of claim 13 wherein:

the semiconductor component comprises a microelectronic die and an adhesive on the die, the die having an active side and a backside opposite the active side; and

the adhesive is attached directly to the backside of the die and the first portion of the surface of the base.

15. The assembly of claim 13, further comprising:

a semiconductor workpiece releasably attached to the first portion of the base, the semiconductor workpiece including the semiconductor component, an active side, and a backside opposite the active side; and

an adhesive attaching the backside of the workpiece to the first portion of the surface of the base.

16. The assembly of claim 13 wherein:

the semiconductor component comprises a first semiconductor component; and

the assembly further comprises a second semiconductor component releasably attached to the first portion of the surface of the base and spaced laterally apart from the first semiconductor component.

17. The assembly of claim 13 wherein:

the support structure comprises an inner surface defining an opening;

the carrier extends across the opening; and

the semiconductor component is positioned in the opening.

18. The assembly of claim 13 wherein:

the support structure comprises an inner surface defining an opening, an outer surface opposite the inner surface, a first surface extending between the inner and outer surfaces, and a second surface opposite the first surface and extending between the inner and outer surfaces;

the carrier comprises a first carrier releasably attached to the first surface of the support structure; and

the assembly further comprises a second carrier releasably attached to the second surface of the support structure.

19. The assembly of claim 13 wherein:

the surface of the base comprises a first major surface;

the base further comprises a second major surface opposite the first major surface; and

the adhesive layer is not disposed on the second major surface.

20. A method for processing microelectronic dies, the method comprising:

attaching an adhesive layer of a replaceable carrier to a support structure having an opening; and

releasably connecting a die to a base of the replaceable carrier with the die positioned at least partially in the opening of the support structure and spaced laterally apart from the adhesive layer.

21. The method of claim 20 wherein attaching the replaceable carrier to the support structure occurs before releasably connecting the die to the replaceable carrier.

22. The method of claim 20, further comprising decoupling the die from the replaceable carrier.

23. The method of claim 20, further comprising detaching the replaceable carrier from the support structure.

24. The method of claim 20 wherein the replaceable carrier comprises a first replaceable carrier, and wherein the method further comprises:

decoupling the die from the first replaceable carrier;

detaching the first replaceable carrier from the support structure; and

releasably connecting a second replaceable carrier to the support structure in place of the first replaceable carrier.

25. The method of claim 20, further comprising releasably connecting a semiconductor workpiece to the base of the replaceable carrier with the workpiece positioned in the opening and spaced apart from the adhesive layer, the workpiece including the die.

26. The method of claim 20 wherein the die comprises a first die, and wherein the method further comprises:

releasably connecting a semiconductor workpiece to the base of the replaceable carrier with the workpiece positioned in the opening and spaced apart from the adhesive layer, the workpiece including the first die and a plurality of second dies; and

cutting the semiconductor workpiece to singulate the first and second dies while the workpiece is connected to the replaceable carrier.

27. The method of claim 20 wherein:

attaching the replaceable carrier to the support structure comprises aligning an exposed surface of the base with the opening; and

releasably connecting the die to the base comprises releasably coupling the die to the exposed surface of the base.

28. The method of claim 20 wherein:

the base comprises a surface with a first portion and a second portion;

the adhesive layer covers the second portion of the surface but not the first portion of the surface; and

attaching the adhesive layer of the replaceable carrier to the support structure comprises aligning the first portion of the surface with the opening in the support structure.

[c29] 29. The method of claim 20 wherein attaching the replaceable carrier to the support structure comprises positioning the replaceable carrier across the opening of the support structure.

30. The method of claim 20 wherein:

the replaceable carrier comprises a first replaceable carrier; and

the method further comprises releasably coupling a second replaceable carrier to the support structure with the die positioned between the first and second replaceable carriers.

31. A method for processing semiconductor components, the method comprising:

covering at least a portion of a surface of a semiconductor component including a die with a first adhesive; and

releasably attaching the component to a flexible carrier with the first adhesive contacting a first portion of a base of the carrier, wherein the carrier further comprises a second adhesive on only a second portion of the base apart from the first portion.

32. The method of claim 31, further comprising detaching the component from the flexible carrier.

33. The method of claim 31, further comprising releasably connecting the flexible carrier to a support structure before releasably attaching the component to the flexible carrier.

34. The method of claim 31 wherein:

the semiconductor component comprises a first semiconductor component; and

the method further comprises releasably attaching a second semiconductor component to the flexible carrier after releasably attaching the first component to the flexible carrier but before detaching the first component from the flexible carrier.