TAPE CARRIER AND MANUFACTURING METHOD OF TAPE CARRIER TYPE SEMICONDUCTOR DEVICE

FIELD OF THE INVENTION

The present invention relates to a tape carrier type semiconductor device composed of a flexible printed board and a semiconductor element bonded and mounted thereon, and a method of manufacturing the same.

BACKGROUND OF THE INVENTION

In packing semiconductor elements into an electronic circuit, a TAB (Tape Automated Bonding) technique has been known, by which a tape carrier type semiconductor device is obtained by bonding and mounting a semiconductor element on a flexible printed board (so-called tape carrier).

Tape carrier type semiconductor devices obtained by the TAB technique include a COF (Chip On FPC (Flexible

Printed Circuit)), a TCP (Tape Carrier Package), etc. In case of the COF, the tape carrier is bonded to the semiconductor element electrode and a wiring pattern on the bonded portion is backed with a tape carrier material. On the other hand, in case of the TCP, the tape carrier material is bonded to the semiconductor element electrode and a through-hole is provided in the bonded portion where the semiconductor element is mounted. Further, a top end of a wiring pattern called an inner lead which protrudes to form a cantilever is bonded to the semiconductor element electrode.

The tape carrier type semiconductor devices are mainly used as a liquid crystal driver, a thermal head printer, etc.

The tape carrier type semiconductor device is completed in the following manner. That is, identical wiring patterns are formed successively on a lengthy tape (tape carrier material) at regular intervals in a single direction with respect to a direction in which the tape is fed, and semiconductor elements are mounted at specific positions of the wiring patterns. Then, the tape carrier type semiconductor device is completed when punched out individually from the lengthy tape. Thus, the tape carrier type semiconductor devices formed on the tape carrier are designed along a single direction with

respect to a direction in which the tape is fed. In case that the tape carrier type semiconductor device thus completed is used for a liquid crystal panel, for example, it is connected to the liquid crystal panel at one side end, and to the printed board or the like at the other side end.

Because the tape carrier type semiconductor device is flexible, it is designed on the provision that it will be bent when mounted, and therefore, given with high design flexibility. Thus, in case that a layout of the tape carrier type semiconductor devices is designed on a lengthy tape carrier, each tape carrier type semiconductor device is not necessarily a rectangle, which is a shape the area of the tape carrier is utilized efficiently, and can be of an L-shape, a T-shape, a triangular shape, etc.

However, when the tape carrier type semiconductor devices of arbitrary shapes are aligned in a single direction as has been discussed, a useless area which is not used in manufacturing the tape carrier type semiconductor devices is formed on the tape carrier. For example, in case that COFs 51 of a shape shown in Figure 11(a) are aligned on the tape carrier, then a conventional layout is as the one shown in Figure 11(b). That is, in this case, a useless area (indicated by

diagonal lines) 52 is formed on the tape carrier.

When the manufacturing procedure and used materials of the tape carrier are concerned, the tape carrier is manufactured in the form of a lengthy tape from reel to reel, and therefore, the cost thereof increases in proportion to the tape area. Thus, even if some areas of the tape carrier are not used in manufacturing the tape carrier semiconductor devices, the cost wasted on such areas is included in the manufacturing cost. Therefore, the manufacturing cost of the tape carrier type semiconductor devices increases as the areas which are not used in manufacturing the same increases. The useless areas may be reduced by designing the tape carrier type semiconductor devices in a shape with which the tape carrier is utilized efficiently (for example, rectangles). However, this is not preferable, because the design flexibility given to the tape carrier type semiconductor devices as benefits will be lost.

Japanese Laid-open Utility Model No. 82852/1994 (Japanese Official Gazette *Jitsukaihei No. 6-82852*, publishing date: November 25, 1994) discloses a technique for aligning the semiconductor device TABs in more than one row in the width direction of the tape carrier as a method of minimizing unused areas on the tape carrier and conducting an electrical test on more than one TAB

simultaneously. However, the above publication does not solve the problem that useless areas are readily formed on the tape area if the tape carrier type semiconductor devices are of arbitrary shapes, because each TAB is aligned in one specific direction with respect to a direction in which the tape is fed, and each TAB is of a rectangular shape with which the tape area can be utilized efficiently.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to save the manufacturing cost of the tape carrier type semiconductor devices by increasing the number manufactured out of a tape carrier of a certain length without losing the benefits that they can be designed in arbitrary shapes.

In order to fulfill the above and other objects, a tape carrier of the present invention is a tape carrier used for a tape carrier type semiconductor device comprising a lengthy tape carrier and a semiconductor element bonded and mounted thereon, on which wiring patterns of the tape carrier type semiconductor device are successively formed, in which:

wiring patterns of an identical shape are aligned in more than one direction with respect to a direction in

which the tape carrier is fed in a layout such that increases a utilized area of the tape carrier.

Also, a tape carrier type semiconductor device of the present invention is manufactured by:

bonding and mounting a semiconductor element on a specific position of each wiring pattern on a tape carrier on which wiring patterns of an identical shape are aligned in more than one direction with respect to a direction in which the tape carrier is fed in a layout such that increases a utilized area of the tape carrier; and

punching out tape carrier type semiconductor devices, each having the wiring pattern and the semiconductor element bonded and mounted thereon, from the tape carrier.

Also, a manufacturing method of a tape carrier type semiconductor device of the present invention includes:

a first step of bonding and mounting a semiconductor element on a specific position of each wiring pattern on a tape carrier on which wiring patterns of an identical shape are aligned in more than one direction with respect to a direction in which the tape carrier is fed in a layout such that increases a utilized area of the tape carrier; and

a second step of punching out tape carrier type

semiconductor devices, each having the wiring pattern and the semiconductor element bonded and mounted thereon, from the tape carrier, so that individual tape carrier type semiconductor devices are manufactured.

According to the above tape carrier, tape carrier type semiconductor device, and manufacturing method of the tape carrier type semiconductor device, by aligning the wiring patterns of the identical shape in more than one direction with respect to a direction in which the tape carrier is fed in a layout such that increases a utilized area of the tape carrier, useless areas which have no contribution in forming the tape carrier type semiconductor devices on the tape carrier can be reduced compared with a conventional arrangement in which all the wiring patterns are formed and aligned on the tape carrier along the same direction.

Consequently, from the tape carrier of a specific length, more tape carrier type semiconductor devices can be manufactured compared with the conventional method, thereby making it possible to save the manufacturing cost of the tape carrier type semiconductor devices significantly.

Further, in order to fulfill the above and other objects, a tape carrier of the present invention is a tape carrier used for a tape carrier type semiconductor

device comprising a lengthy tape carrier and a semiconductor element bonded and mounted thereon, on which wiring patterns of the tape carrier type semiconductor device are successively formed, in which:

wiring patterns of more than one kind each having a different shape are aligned in a layout such that increases a utilized area of the tape carrier.

Also, a tape carrier type semiconductor device of the present invention is manufactured by:

bonding and mounting a semiconductor element on a specific position of each wiring pattern on a tape carrier on which wiring patterns of more than one kind each having a different shape are aligned in a layout such that increases a utilized area of the tape carrier; and

punching out tape carrier type semiconductor devices, each having the wiring pattern and the semiconductor element bonded and mounted thereon, from the tape carrier.

In order to fulfill the above and other objects, a method of manufacturing a tape carrier type semiconductor device of the present invention includes:

a first step of bonding and mounting a semiconductor element on a specific position of each wiring pattern on a tape carrier on which wiring patterns of more than one

kind each having a different shape are aligned in a layout such that increases a utilized area of the tape carrier; and

a second step of punching out tape carrier type semiconductor devices, each having the wiring pattern and the semiconductor element bonded and mounted thereon, from the tape carrier, so that individual tape carrier type semiconductor devices are manufactured.

According to the above tape carrier, tape carrier type semiconductor device, and manufacturing method of the tape carrier type semiconductor device, in case that the wiring patterns of more than one kind each having a different shape are aligned on the same tape carrier, these wiring patterns of more than one kind can be aligned in a layout such that increases a utilized area of the tape carrier by making an optimal combination. Thus, useless areas which have no contribution in forming the tape carrier type semiconductor devices on the tape carrier can be reduced compared with the conventional arrangement in which the wiring patterns of the same kind are aligned along the same direction.

Consequently, from the tape carrier of a specific length, more tape carrier type semiconductor devices can be manufactured compared with the conventional method, thereby making it possible to save the manufacturing cost

of the tape carrier type semiconductor devices significantly.

Further, in case that the tape carrier type semiconductor devices of more than one kind are manufactured, these tape carrier type semiconductor devices can be manufactured simultaneously on a single kind of tape carrier. Thus, the arrangements of the present invention are suitable in manufacturing the devices of many kinds with a small number of each.

Here, the wiring patterns of more than one kind each having a different shape include mirror symmetrical wiring patterns.

For a fuller understanding of the nature and advantages of the invention, reference should be made to the ensuing detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1(a) and 1(b) are views depicting an arrangement in accordance with Embodiment 1 of the present invention; Figure 1(a) is a plan view showing the shape of a COF to be manufactured; and Figure 1(b) is a plan view showing the pattern layout of the COFs on a lengthy tape carrier.

Figure 2 is a cross section showing an arrangement

of the COF when a triple-layer tape carrier is used.

Figure 3 is a cross section showing an arrangement of the COF when a double-layer tape carrier is used.

Figures 4(a) through 4(c) are views detailing a manufacturing procedure of the COF.

Figures 5(a) through 5(c) are views explaining a part of another manufacturing procedure of the COF.

Figures 6(a) and 6(b) are views explaining a part of still another manufacturing procedure of the COF.

Figures 7(a) through 7(c) are views depicting an arrangement in accordance with Embodiment 2 of the present invention; Figure 7(a) is a plan view showing the shape of a COF to be manufactured; Figure 7(b) is a plan view showing the pattern layout of the COFs on a lengthy tape carrier; and Figure 7(c) is a plan view showing a conventional pattern layout of the COFs on a lengthy tape carrier.

Figure 8 is a view depicting an arrangement in accordance with Embodiment 3 of the present invention, and shows a plan view illustrating a pattern layout of COFs of more than one kind on a lengthy tape carrier.

Figure 9 is a view depicting an arrangement in accordance with Embodiment 4 of the present invention, and shows a cross section depicting an arrangement of a COF when a semiconductor element and a tape carrier are

bonded to each other through an anisotropic conductive bonding film.

Figure 10 is a view depicting an arrangement in accordance with Embodiment 4 of the present invention, and shows a cross section depicting an arrangement of a COF when a semiconductor element and a tape carrier are bonded to each other through an anisotropic conductive bonding paste.

Figures 11(a) and 11(b) are views depicting a conventional arrangement; Figure 11(a) is a plan view showing the shape of a COF to be manufactured; and Figure 11(b) is a plan view showing a conventional pattern layout of the COFs on a lengthy tape carrier.

DESCRIPTION OF THE EMBODIMENTS

The following description will describe embodiments of the present invention. The tape carrier type semiconductor devices of the present invention include COFs, TCPs, etc., and because substantially the same functional effect can be attained whether the present invention is applied to the COFs or TCPs, the kinds of the tape carrier type semiconductor devices of the present invention are not especially limited. It should be appreciated, however, that because the COFs are not shaped in rectangles in many cases in comparison with the

TCPs, the present invention can be more appreciated with the COFs. Thus, in the following explanation, the COFs are used as examples of the tape carrier type semiconductor devices. The COFs are not precisely defined, and those mounted on the tape and those punched out individually from the tape are both referred to as the COFs.

(Embodiment 1)

Figures 1(a) and 1(b) show the shape of the COF of the present embodiment and the layout of the COF patterns on the tape carrier, respectively.

A COF 1 is of the shape shown in Figure 1(a), which is identical with the shape of the COF 51 shown in Figure 11(a). The COF 1 is composed of a flexible printed board on which a wiring pattern has been formed, and a semiconductor element (indicated by black-paint) 2 bonded and mounted thereon. The wiring pattern is generally composed of an inner lead connected to the electrode of the semiconductor element 2 and an outer lead connected to an external circuit. In Figure 1(a), the inner lead is omitted for ease of explanation.

In case that the COFs 1 are designed in a layout so as to be aligned on the tape carrier in accordance with the method of the present embodiment, adjacent COF

patterns 1a and 1b are positioned on the tape carrier in such a manner that one is turned by 180 degrees with respect to the other. When punched out from the tape carrier, the COFs 1 of the identical shape can be obtained from the COF patterns 1a and 1b.

According to the present embodiment, by aligning the COFs 1 of the same shape on the tape carrier in different directions, more COFs can be mounted on the tape carrier along its lengthwise direction in comparison with the conventional arrangement by which the COFs are mounted in a single direction, thereby utilizing the tape area more efficiently. This will be discussed more in detail with reference to a comparison between Figures 1(b) and 11(b).

According to the conventional arrangement shown in Figure 11(b), a useless area 52 is formed as all the COFs 51 are aligned in a single direction, and three COFs 51 are manufactured out of the tape carrier of a specific length L. On the other hand, according to the arrangement of the present embodiment shown in Figure 1(b), a useless area 3 is formed as well, but it is quite small compared with the useless area 52, and four COFs 1 are manufactured out of the tape carrier of the same length L. In other words, out of the tape carrier of the length L, four COFs are manufactured in the present embodiment whereas three COFs are manufactured in the

conventional arrangement. This means, if the same number of COFs are to be manufactured, the tape carrier can be saved by 25% in length in the present embodiment in comparison with the conventional arrangement. Thus, the arrangement of the present embodiment can save the manufacturing cost of the COFs significantly.

Next, Figure 2 shows a cross section of the COF 1. In case that a triple-layer tape is used as the tape carrier, the semiconductor element 2 is bonded onto the tape carrier 4 at a specific position, and a space formed between the tape carrier 4 and semiconductor element 2 is filled with sealing resin 5.

The tape carrier 4 is composed of an insulating material (tape carrier material) 6 made of polyimide, and a copper foil pattern (wiring pattern) 8 layered thereon through a bonding agent 7 having a thickness of 5-15 μm. The thickness of the insulating material 6 is 75 μm (typical thickness of an ordinary TCP), 40 μm, or 25 μm. The thickness of 40 μm or 25 μm is preferable to fully exploit the flexibility of the COF given as benefits. Also, a protruding electrode (generally referred to as bump) 9 is formed at an external outlet electrode of the semiconductor element 2. Tinning or gilding is applied to the copper foil pattern 8 and protruding electrode 9 when necessary, and in the present embodiment, tinning is

applied to the copper foil pattern 8 and gilding is applied to the protruding electrode 9.

When the semiconductor element 2 is bonded to the tape carrier 4, the semiconductor element 2 and tape carrier 4 are positioned in such a manner that the electrode forming surface of the former opposes the pattern surface of the latter, and heat and pressure are applied for a predetermined time from either the back surface of the electrode forming surface of the semiconductor element 2 or the back surface of the pattern surface of the tape carrier 4, whereby the protruding electrode 9 of the semiconductor element 2 is connected to the copper foil pattern 8 of the tape carrier 4. In other words, in the present embodiment, the copper foil pattern 8 is tinned and the protruding electrode 9 is gilt, and the plating materials form alloy as heat and pressure are applied. Consequently, the protruding electrode 9 is connected to the copper foil pattern 8 by Au-Sn alloy.

After the protruding electrode 9 is connected to the copper foil pattern 8, a space formed between the tape carrier 4 and semiconductor element 2 is filled with the sealing resin 5. The sealing resin 5 is filled in the space to enhance moisture resistance and mechanical strength. In addition, an insulating material called

solder resist is applied entirely except for an external connection terminal (that is, outer lead) of the tape carrier 4 to prevent short-circuit caused when an conductive foreign substance is placed directly on the pattern.

The COF shown in Figure 2 is composed of a triple-layer tape carrier 4; however, a COF composed of a double-layer tape carrier 10 as shown in Figure 3 may be used as well. The tape carrier 10 does not require the bonding agent 7 and the copper foil pattern 8 is directly formed on the insulating material 6.

Next, the following will describe the manufacturing procedure of the COF of the present embodiment with reference to Figures 4(a) through 4(c).

Initially, the tape carrier 4 is manufactured in the manufacturing procedure of the tape carrier shown in Figure 4(a). When the pattern is designed, the layout on the tape carrier 4 must be designed in such a manner that the useless areas 3 (see Figure 1(b)) are minimized, that is, as many COFs 1 as possible are manufactured out of the tape carrier 4 of a specific length. It should be appreciated, however, that the tape carrier is manufactured in the conventional manner and no additional steps are required.

Then, in the ILB (Inner Lead Bonding) step shown in

Figure 4(b), the semiconductor element 2 is bonded to a specific position of the wiring pattern formed in the manufacturing procedure of the tape carrier 4. Here, the semiconductor element 2 is picked up from the semiconductor wafer and aligned to a specific position on the tape carrier 4, and heat and pressure are applied by a device called an inner lead bonder, whereby the semiconductor element 2 is bonded to the tape carrier 4. In the ILB step, the wiring patterns are formed on the tape carrier 4 in different directions with respect to the direction in which the tape is fed. Accordingly, the alignment position of each semiconductor element 2 should be matched with the alignment direction of their respective wiring patterns, but only mechanism such that can rotate the picked-up semiconductor element 2 at arbitrary angles has to be provided and no further equipment is required. The ILB step discussed above corresponds to a first step set forth in claims below.

The ILB step is followed by a resin applying step and an electrical testing step, and in the following punching step shown in Figure 4(C), the COFs 1 formed successively on the tape carrier 4 are punched out individually. This punching step is conducted by using a punching mold. In the punching step, the direction along which each COF 1 is punched out also has to be

matched with the alignment direction of their respective wiring patterns, but here again, only mechanism such that can rotate the punching mold at arbitrary angles has to be provided. Here, the punching step corresponds to a second step set forth in claims below.

The COF 1 thus completed constitutes an a module structure when the external connection terminal (outlead) is connected to another circuit board in an OLB (Outer Lead Bonding) step. For example, in case that the COF 1 is used as the driver of the liquid crystal display, the COF 1 is connected to the liquid crystal panel and the like, thereby forming a liquid crystal module. Also, chip components including a resistor, a capacitor, an LED (Liquid Crystal Display), etc. can be mounted on the tape carrier 4. Consequently, the tape carrier 4 can form a module structure which also serves as a circuit board, thereby utilizing a space in the module more efficiently.

In the manufacturing method of the COF shown in Figures 4(a) through 4(c), in the IBL step and punching step, a method of rotating the pick-up mechanism of the semiconductor element 2 and punching mold was explained as a means to match the alignment direction of the semiconductor elements 2 and the punching-out direction of the COFs 1 with the direction of the wiring pattern. The following will explain another manufacturing method

of the COFs with reference to Figures 5(a) through 5(c) and Figures 6(a) and 6(b).

The tape carrier manufacturing step in Figure 5(a) is identical with the step in Figure 4(a).

In the ILB step shown in Figures 5(b) and 5(c), more than one kind of semiconductor elements are mounted sequentially on the same tape carrier 4 by using more than one pick-up mechanism when picking up the semiconductor elements 2 from the semiconductor wafer and positioning the same to the specific positions on the tape carrier 4. In the present embodiment, two kinds of COFs 1a and 1b having opposite alignment directions are formed on the tape carrier 4, and accordingly, two pick-up mechanisms are provided. When punched out, the COFs 1a and 1b form identical COFs, but at this point, the COFs having different alignment directions on the tape carrier are deemed as different kinds.

As shown in Figure 5(b), the semiconductor element 2a is mounted on the wiring pattern which will become the COF 1a by one pick-up mechanism, and as shown in Figure 5(c), the semiconductor element 2b is mounted on the wiring pattern which will become the COF 1b by the other pick-up mechanism. As was in the step of Figure 4(b), the semiconductor elements 2a and 2b mounted on the tape carrier 4 are bonded to the same by means of heating and

pressurization by the inner lead bonder. The positional relation between the adjacent COFs 1a and 1b is constant in the layout on the tape carrier 4. That is, when the COFs 1a (COFs 1b) alone are concerned, the alignment direction and intervals on the tape carrier 4 are constant. Hence, it is by no means difficult to mount the semiconductor element 2a onto each COF 1a by using one pick-up mechanism.

Further, the ILB step may be conducted with the conventional facility. To be more specific, more than one kind of semiconductor elements are mounted on the same tape carrier 4 by feeding the tape carrier 4 more than once into a bonding device composed of the pick-up mechanism and inner lead bonder. In case of the present embodiment, the step of Figure 5(b) is conducted in the first feeding, and the step of Figure 5(c) is conducted in the second feeding.

The ILB step is followed by the resin applying step and electrical testing step. Then, in the following punching step of Figures 6(a) and 6(b), as was in the ILB step, two kinds of COFs 1 are punched out from the same tape carrier 4 with two kinds of punching molds by feeding the tape carrier 4 once into two punching devices or feeding the tape carrier 4 into one punching device twice. To be more specific, as shown in Figure 6(a), the

COFs 1a are punched out by the first punching device (or in the first feeding), and as shown in Figure 6(b), the COFs 1b are punched out by the second punching device (or in the second feeding). Alternatively, a punching mold which can simultaneously punch out two kinds of COFs 1 may be employed in the punching step.

(Embodiment 2)

Figures 7(a) through 7(c) show another embodiment of the present invention.

A COF 11 of the present embodiment is of the shape shown in Figure 7(a), and used in the liquid crystal module. In the liquid crystal module, more than one COF is mounted at both ends of the liquid crystal panel, and in such a case, drivers each composed of mirror symmetrical COFs are mounted respectively at the top and bottom (right and left) of the liquid crystal panel. The arrangement of the present embodiment is particularly effective in manufacturing the mirror symmetrical COFs.

According to the arrangement of the present embodiment, as shown in Figure 7(b), the COFs 11a which are of the same shape as that of the COF 11 of Figure 7(a) and COFs 11b which are mirror symmetrical with respect to the COFs 11a are aligned alternately on the same tape carrier 4. The COFs 11b are positioned where

the COFs 11a are reversed from left to right and turned by 90 degrees counter clockwise in the drawing. The semiconductor elements 12a are bonded to the COFs 11a, and the semiconductor elements 12b are bonded to the COFs 11b. The semiconductor elements 12a and 12b are rotated by 90 degrees to match with the COFs 11a and 11b on the tape carrier 4.

As has been discussed, in the present embodiment, two kinds of COFs 11a and 11b which are mirror symmetrical with respect to each other are aligned on the tape carrier 4 in the directions such that minimizes the useless areas of the tape carrier 4. Accordingly, more COFs can be mounted on the tape carrier 4 along its lengthwise direction, thereby utilizing the tape area efficiently.

Conventionally, the COFs 11a and 11b have to be manufactured out of different tape carriers. Figure 7(c) shows the tape carrier on which the COFs 11a are formed in accordance with the conventional manufacturing method.

According to the arrangement of the present embodiment shown in Figure 7(b), six COFs 11a and 11b are manufactured in total from the tape carrier 4 with the length shown in the drawing. In contrast, according to the conventional arrangement shown in Figure 7(c), only five COFs 11a are manufactured from the tape carrier of

the same length as that shown in Figure 7(b). Thus, according to the arrangement of the present embodiment, more COFs can be obtained from the tape carrier of the same length in comparison with the conventional method, and the manufacturing cost of the COFs can be saved significantly.

Further, when two kinds of COFs are manufactured, only one kind of tape carrier is necessary, because two kinds of COFs can be manufactured simultaneously on the same tape carrier.

In the manufacturing procedure of the COFs 11a and 11b, the semiconductor elements 12a and 12b respectively bonded to the COFs 11a and 11b are not necessarily the same (that is, the semiconductor elements 12a and 12b are generally designed so as to function mirror symmetrically). In this case, the bonding is not conducted by merely providing mechanism which can rotate the picked-up semiconductor elements 12a and 12b at arbitrary angles as shown in Figure 4(b) in Embodiment 1.

Thus, in the ILB step of the present embodiment, as were in the steps of Figures 5(b) and 5(c) of Embodiment 1, it is preferable to mount the semiconductor elements 12a and 12b alternately on the same tape carrier 4 by using two pick-up mechanisms, or alternatively, by feeding the tape carrier 4 twice into the bonding device

composed the pick-up mechanism and inner lead bonder. The positional relation between the adjacent COFs 11a and 11b in the layout on the tape carrier 4 is constant. That is, when the COFs 11a (COFs 11b) alone are concerned, the alignment direction and intervals on the tape carrier 4 are constant. Hence, it is by no means difficult to mount the semiconductor element 12a onto each COF 11a by using one pick-up mechanism.

The same can be said in the punching step. That is, because the same punching mold can not be used for the mirror symmetrical COFs 11a and 11b, it is preferable to use two kinds of punching molds, and feed the tape carrier 4 into two punching devices once or feed the tape carrier 4 into one punching device twice as were in the steps of Figures 6(a) and 6(b) in Embodiment 1.

(Embodiment 3)

Figure 8 shows still another embodiment of the present invention.

In the present embodiment, two kinds of COFs 13 and 14 of different shapes are aligned alternately on the same tape carrier 4. The COFs 13 and 14 are not necessarily used for the same module, and they can be used for different purposes when punched out. The COFs 13 and 14 are combined in such a manner that the pattern

area on the tape carrier 4 can be utilized most efficiently (that is, useless areas which are not used in manufacturing the COFs are minimized).

Figure 8 shows a case where two kinds of COFs are formed on the same tape carrier 4, but three or more kinds of COFs may be formed on the same tape carrier 4. In such a case, a plurality kinds of COFs are aligned in a specific order.

As has been discussed, according to the arrangement of the present embodiment, more than one kind of COFs each having a different shape are simultaneously formed on the same tape carrier. By making a combination such that minimizes the useless areas on the tape carrier, the tape area can be utilized efficiently, and the manufacturing cost of the COFs can be saved significantly.

Further, because more than one kind of COFs can be formed simultaneously on one kind of tape carrier, this method is suitable in manufacturing the devices of many kinds with a small number of each.

In the manufacturing procedure of the COFs 13 and 14, the semiconductor elements 13a and 14a bonded to the COFs 13 and 14 in the ILB step are basically of different kinds. Thus, as was in Embodiment 2, the bonding is not conducted by merely providing mechanism which can rotate

the picked-up semiconductor elements 13a and 14a at arbitrary angles as shown in Figure 4(b) in Embodiment 1.

Thus, in the ILB step of the present embodiment, as were in the steps of Figures 5(b) and 5(c) in Embodiment 1, it is preferable to mount the semiconductor elements 13a and 14a alternately on the same tape carrier 4 by using two pick-up mechanisms, or alternatively, by feeding the tape carrier 4 twice into the bonding device composed the pick-up mechanism and inner lead bonder. The positional relation between the adjacent COFs 13 and 14 in the layout on the tape carrier 4 is constant. That is, when the COFs 13 (COFs 14) alone are concerned, the alignment direction and intervals on the tape carrier 4 are constant. Hence, it is by no means difficult to mount the semiconductor element 13a onto each COF 13 by using one pick-up mechanism.

Even in case of forming three or more kinds of COFs on the same tape carrier, the positional relation between two kinds of adjacent COFs of specific kinds is constant. That is, when one specific kind of COFs alone are concerned, the alignment direction and intervals on the tape carrier 4 are constant. In other words, the COFs of the same kind are repetitively formed on the same tape carrier 4 at regular intervals.

The same can be said in the punching step. That is,

because the same punching mold can not be used for the COFs 13 and 14 of different shapes, it is preferable to use two kinds of punching molds, and feed the tape carrier 4 once into two punching devices or feed the tape carrier 4 into one punching device twice as were in the steps of Figures 6(a) and 6(b) in Embodiment 1.

(Embodiment 4)

In Embodiments 1 through 3, in the ILB step shown in Figure 2, the semiconductor element 2 and tape carrier 4 are aligned with respect to each other at the protruding electrode 9 of the former and the copper foil pattern 8 of the latter, and bonded to each other by means of heating and pressurizing by the inner lead bonder. Further, after the protruding electrode 9 is connected to the copper foil pattern 8, a space formed between the tape carrier 4 and semiconductor element 2 is filled with the sealing resin 5 to enhance moisture resistance and mechanical strength.

In contrast, in the present embodiment, the ILB step is simplified by using an anisotropic bonding agent to bond the semiconductor element and tape carrier.

According to the arrangement shown in Figure 9, the protruding electrode 9 of the semiconductor element 2 and copper foil pattern 8 of the tape carrier 10 are bonded

to each other by an anisotropic conductive bonding film 15 which is made by dispersing conductive particles 15b within an insulating bonding agent 15a. In this case, the anisotropic conductive bonding film 15 is transferred onto the copper foil pattern 8 of the tape carrier 10, and after the semiconductor element 2 is positioned over the same, a pressure is applied, whereby the protruding electrode 9 and copper foil pattern 8 are electrically connected through the conductive particles 15b.

In case that the anisotropic conductive bonding film 15 is used as has been discussed, the end portion can be also sealed by the anisotropic conductive bonding film 15 as another effect. Thus, no sealing resin is necessary and the step of filling the space with the sealing resin can be omitted, thereby making the assembling step simpler than the one in the conventional method. In other words, in case of the assembly in which the protruding electrode 9 of the semiconductor element 2 is bonded to the copper foil pattern 8 of the tape carrier 10 through the Au-Sn alloy as described in Embodiment 1, two steps are required: bonding the protruding electrode 9 to the copper foil pattern 8 in the ILB step; and sealing the bonded portion in the resin sealing step. However, if the anisotropic conductive bonding agent is used as was discussed herein, the bonding step

corresponding to the ILB step can include the sealing step, thereby making the procedure simpler.

In Figure 9, the anisotropic conductive bonding film 15 is used as the anisotropic conductive bonding agent. However, the same effect can be obtained if an anisotropic conductive bonding paste 16 is used as shown in Figure 10.

Also, Figures 9 and 10 show the case where double-layer tape carrier 10 is used. However, the structure of the tape carrier is not especially limited, and the triple-layer tape carrier 4 can be used as well. The same can be said in Embodiments 2 and 3. In other words, in Embodiment 2 or 3, the tape carrier 4 can be replaced with the double-layer tape carrier 10.

As has been discussed, a tape carrier type semiconductor device of Embodiment 1 can be manufactured by:

bonding and mounting a semiconductor element on a specific position of each wiring pattern on a tape carrier on which wiring patterns of an identical shape are aligned in more than one direction with respect to a direction in which the tape carrier is fed in a layout such that increases a utilized area of the tape carrier; and

punching out tape carrier type semiconductor

devices, each having the wiring pattern and the semiconductor element bonded and mounted thereon, from the tape carrier.

In this manner, by aligning the wiring patterns of the identical shape in more than one direction with respect to a direction in which the tape carrier is fed in a layout such that increases a utilized area of the tape carrier, useless areas which have no contribution in forming the tape carrier type semiconductor devices on the tape carrier can be reduced compared with a conventional arrangement in which all the wiring patterns are formed and aligned on the tape carrier along the same direction.

Consequently, from the tape carrier of a specific length, more tape carrier type semiconductor devices can be manufactured compared with the conventional method, thereby making it possible to save the manufacturing cost of the tape carrier type semiconductor devices significantly.

Further, a tape carrier type semiconductor device of Embodiments 2 and 3 is manufactured by:

bonding and mounting a semiconductor element on a specific position of each wiring pattern on a tape carrier on which wiring patterns of more than one kind each having a different shape are aligned in a layout

such that increases a utilized area of the tape carrier; and

punching out tape carrier type semiconductor devices, each having the wiring pattern and the semiconductor element bonded and mounted thereon, from the tape carrier.

In case that the wiring patterns of more than one kind each having a different shape are aligned on the same tape carrier, these wiring patterns of more than one kind can be aligned in a layout such that increases a utilized area of the tape carrier by making an optimal combination. Thus, useless areas which have no contribution in forming the tape carrier type semiconductor devices on the tape carrier can be reduced compared with the conventional arrangement in which the wiring patterns of the same kind are aligned along the same direction.

Consequently, from the tape carrier of a specific length, more tape carrier type semiconductor devices can be manufactured compared with the conventional method, thereby making it possible to save the manufacturing cost of the tape carrier type semiconductor devices significantly.

Further, in case that the tape carrier type semiconductor devices of more than one kind are

manufactured, these tape carrier type semiconductor devices can be manufactured simultaneously on a single kind of tape carrier. Thus, the arrangements of the present invention are suitable in manufacturing the devices of many kinds with a small number of each.

The tape carrier used for the tape carrier type semiconductor device may be arranged in such a manner that the wiring patterns are fixed onto a tape carrier material forming a basis of the tape carrier through a bonding agent. In this case, the present invention can be applied to a triple-layer tape carrier.

Alternatively, the tape carrier may be arranged in such a manner that the wiring patterns are fixed onto a tape carrier material forming a basis of the tape carrier without using any bonding agent. In this case, the present invention can be applied to a double-layer tape carrier.

The above method of manufacturing a tape carrier type semiconductor device may be arranged in such a manner that each semiconductor element is rotated in accordance with an alignment direction of the wiring pattern, and then mounted on the specific position of the wiring pattern on the tape carrier.

In other words, in case that the wiring patterns of the same shape are aligned in more than one direction

with respect to a direction in which the tape carrier is fed, the semiconductor elements mounted on the wiring patterns have to be mounted in accordance with the alignment direction of the wiring patterns. Hence, according to the above arrangement, the semiconductor elements are rotated in accordance with their respective wiring patterns and then mounted on the specific positions of the wiring patterns, thereby making it possible to mount the semiconductor elements in accordance with the alignment directions of their respective wiring patterns.

Also, the tape carrier type semiconductor device formed on the tape carrier may be arranged in such a manner so as to be punched out from the tape carrier by a punching mold which is allowed to rotate in accordance with an alignment direction of the wiring patterns.

In other words, in case that the wiring patterns of the same shape are aligned in more than one direction with respect to a direction in which the tape carrier is fed, the tape carrier type semiconductor devices on the tape carrier have to be punched out in accordance with the alignment direction of the wiring patterns. Hence, according to the above arrangement, the tape carrier type semiconductor devices on the tape carrier can be punched out in accordance with the alignment direction of the

wiring patterns.

The above manufacturing method of a tape carrier type semiconductor device may be arranged in such a manner that:

each semiconductor element is mounted on the specific position of the wiring pattern on the tape carrier by pick-up mechanisms provided in one-to-one correspondence for each kind of wiring patterns on the tape carrier; and

the semiconductor elements to be mounted on the wiring patterns of a same kind are mounted by a same pick-up mechanism.

In other words, in case that the wiring patterns of more than one kind are formed on the tape carrier simultaneously, the semiconductor elements have to be mounted on their respective wiring patterns in accordance with the kinds thereof. Hence, according to the above arrangement, the semiconductor elements can be mounted on their respective wiring patterns in accordance with the kinds thereof. Here, even when the wiring patterns are of the same shape, if the alignment directions are different, these wiring patterns are deemed as different kinds.

The manufacturing method of a tape carrier type semiconductor device may be arranged in such a manner

that each semiconductor element is mounted on the specific position of the wiring pattern on the tape carrier while the tape carrier is fed into a manufacturing device which conducts the bonding and mounting step as many times as the number of kinds of the wiring patterns on the tape carrier, and that the semiconductor elements to be mounted on the wiring patterns of a same kind are mounted in a same round of repetitive feeding of the tape carrier.

According to the above arrangement, the semiconductor elements can be mounted in accordance with the kinds of the wiring patterns.

The manufacturing method of the tape carrier type semiconductor device may be arranged in such a manner that:

tape carrier type semiconductor devices on the tape carrier are punched out from the tape carrier by as many punching molds as the number of kinds of the wiring patterns; and

the tape carrier type semiconductor devices having the wiring patterns of a same kind are punched out by a same punching mold.

In other words, in case that more than one kind of wiring patterns are formed simultaneously on the tape carrier, the tape carrier type semiconductor devices have

to be punched out from the tape carrier in accordance with the kinds (shapes) of the wiring patterns. Hence, according to the above arrangement, the tape carrier type semiconductor devices can be punched out from the tape carrier in accordance with the kinds of the wiring patterns.

In addition, the manufacturing method of a carrier type semiconductor device may be arranged in such a manner that:

the tape carrier type semiconductor devices on the tape carrier are punched out from the tape carrier by as many punching molds as the number of kinds of the wiring patterns while being fed into a device conducting the punching step as many times as the number of kinds of the wiring pattern; and

the tape carrier type semiconductor devices having the wiring patterns of a same kind are punched out by a same punching mold.

According to the above arrangement, the tape carrier type semiconductor devices can be punched out from the wiring pattern in accordance with the kinds of the wiring patterns.

The manufacturing method of a tape carrier type semiconductor device may be arranged in such a manner that the semiconductor element is bonded to the wiring

pattern on the tape carrier by forming Au-Sn alloy.

According to the above arrangement, for example, the gilt semiconductor electrode and the tinned wiring pattern are heated and pressurized and Au-Sn alloy is formed, whereby the semiconductor element and wiring pattern are bonded to each other. Thus, the conventional bonding method can be employed.

The manufacturing method of a tape carrier type semiconductor device may be arranged in such a manner that the semiconductor element is bonded to the wiring pattern on the tape carrier by means of an anisotropic conductive bonding agent.

According to the above arrangement, by bonding the semiconductor element and wiring pattern on the tape carrier by means of an anisotropic conductive bonding agent, the end portion can be sealed by the anisotropic conductive bonding agent as another effect. Thus, the sealing resin which is conventionally used to obtain the above sealing effect can be omitted. Thus, because the sealing resin filling step can be omitted, the procedure can be simpler than the conventional procedure.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such

modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

CLAIMS:

1. A tape carrier (4) used for a tape carrier type semiconductor device (1) comprising a lengthy tape carrier (4) and a semiconductor element (2) bonded and mounted thereon, on which wiring patterns of said tape carrier type semiconductor device (1) are successively formed, wherein:

wiring patterns of an identical shape are aligned in more than one direction with respect to a direction in which said tape carrier (4) is fed in a layout such that increases a utilized area of said tape carrier (4).

2. A tape carrier (4) used for a tape carrier type semiconductor device (11a, 11b) comprising a lengthy tape carrier (4) and a semiconductor element (12a, 12b) bonded and mounted thereon, on which wiring patterns of said tape carrier type semiconductor device (11a, 11b) are successively formed, wherein:

wiring patterns of more than one kind each having a different shape are aligned in a layout such that increases a utilized area of said tape carrier (4).

3. The tape carrier (4) of Claim 1 or 2, wherein said wiring patterns (8) are fixed onto a tape carrier material (6) forming a basis of said tape carrier (4)

through a bonding agent (7).

4. The tape carrier (4) of Claim 1 or 2, wherein said wiring patterns (8) are fixed onto a tape carrier material (6) forming a basis of said tape carrier (4) without using any bonding agent.

5. A tape carrier type semiconductor device (1) manufactured by:

bonding and mounting a semiconductor element (2) on a specific position of each wiring pattern on a tape carrier (4) on which wiring patterns of an identical shape are aligned in more than one direction with respect to a direction in which said tape carrier (4) is fed in a layout such that increases a utilized area of said tape carrier (4); and

punching out tape carrier type semiconductor devices (1), each comprising the wiring pattern and the semiconductor element (2) bonded and mounted thereon, from said tape carrier (4).

6. A tape carrier type semiconductor device (11a, 11b) manufactured by:

bonding and mounting a semiconductor element (12a, 12b) on a specific position of each wiring pattern on a

tape carrier (4) on which wiring patterns of more than one kind each having a different shape are aligned in a layout such that increases a utilized area of said tape carrier (4); and

punching out tape carrier type semiconductor devices (11a, 11b), each comprising the wiring pattern and the semiconductor element (12a, 12b) bonded and mounted thereon, from said tape carrier (4).

7. The tape carrier type semiconductor device (1) of Claim 5 or 6, wherein a bonded portion on said tape carrier (4) where said semiconductor element (2) is bonded and mounted is a COF backed with a tape carrier material (6).

8. The tape carrier type semiconductor device (1) of Claim 7, wherein said tape carrier material (6) is made of polyimide resin and has a thickness of 75 μm or less.

9. A method of manufacturing a tape carrier type semiconductor device (1) comprising:

a first step of bonding and mounting a semiconductor element (2) on a specific position of each wiring pattern on a tape carrier (4) on which wiring patterns of an identical shape are aligned in more than one direction

* C L M S *

with respect to a direction in which said tape carrier (4) is fed in a layout such that increases a utilized area of said tape carrier (4); and

a second step of punching out tape carrier type semiconductor devices (1), each comprising the wiring pattern and the semiconductor element (2) bonded and mounted thereon, from said tape carrier (4), so that individual tape carrier type semiconductor devices (1) are manufactured.

10. A method of manufacturing a tape carrier type semiconductor device (11a, 11b) comprising:

a first step of bonding and mounting a semiconductor element (12a, 12b) on a specific position of each wiring pattern on a tape carrier (4) on which wiring patterns of more than one kind each having a different shape are aligned in a layout such that increases a utilized area of said tape carrier (4); and

a second step of punching out tape carrier type semiconductor devices (11a, 11b), each comprising the wiring pattern and the semiconductor element (12a, 12b) bonded and mounted thereon, from said tape carrier (4), so that individual tape carrier type semiconductor devices (11a, 11b) are manufactured.

11. The method of manufacturing a tape carrier type semiconductor device (1) of Claim 9, wherein, in said first step, each semiconductor element (2) is rotated in accordance with an alignment direction of the wiring pattern, and then mounted on the specific position of the wiring pattern on said tape carrier (4).

12. The method of manufacturing a tape carrier type semiconductor device (1) of Claim 9 or 10, wherein, in said first step:

each semiconductor element (2) is mounted on the specific position of the wiring pattern on said tape carrier (4) by pick-up mechanisms provided in one-to-one correspondence for each kind of wiring patterns on said tape carrier (4); and

the semiconductor elements (2) to be mounted on the wiring patterns of a same kind are mounted by a same pick-up mechanism.

13. The method of manufacturing a tape carrier type semiconductor device (1) of Claim 9 or 10, wherein, in said first step:

each semiconductor element (2) is mounted on the specific position of the wiring pattern on said tape carrier (4) while said tape carrier (4) is fed into a

* C L M S *

manufacturing device which conducts said first step as many times as the number of kinds of the wiring patterns on said tape carrier (4); and

the semiconductor elements (2) to be mounted on the wiring patterns of a same kind are mounted in a same round of repetitive feeding of said tape carrier (4).

14. The method of manufacturing a tape carrier type semiconductor device (1) of Claim 9, wherein, in said second step:

each of the tape carrier type semiconductor devices (1) on said tape carrier (4) is punched out from said tape carrier (4) by a punching mold which is allowed to rotate in accordance with an alignment direction of the wiring patterns.

15. The method of manufacturing a tape carrier type semiconductor device (1) of Claim 9 or 10, wherein, in said second step:

the tape carrier type semiconductor devices (1) on said tape carrier (4) are punched out from said tape carrier (4) by as many punching molds as the number of kinds of the wiring patterns; and

the tape carrier type semiconductor devices (1) having the wiring patterns of a same kind are punched out

by a same punching mold.

16. The method of manufacturing a tape carrier type semiconductor device (1) of Claim 9 or 10, wherein, in said second step:

the tape carrier type semiconductor devices (1) on said tape carrier (4) are punched out from said tape carrier (4) by as many punching molds as the number of kinds of the wiring patterns while said tape carrier (4) is fed into a manufacturing device conducting said second step as many times as the number of kinds of the wiring patterns; and

the tape carrier type semiconductor devices (1) having the wiring patterns of a same kind are punched out by a same punching mold in a same round of repetitive feeding of said tape carrier (4).

17. The method of manufacturing a tape carrier type semiconductor device (1) of any of Claims 9 through 16, wherein, in said first step, the semiconductor element (2) is bonded to the wiring pattern on said tape carrier (4,10) by forming Au-Sn alloy.

18. The method of manufacturing a tape carrier type semiconductor device (1) of any of Claims 9 through 16,

wherein, in said first step, the semiconductor element (2) is bonded to the wiring pattern on said tape carrier (10) by means of an anisotropic conductive bonding agent (15, 16).

