not taught or suggested any solutions and, thus, solutions to these problems have long eluded those skilled in the art.

DISCLOSURE OF THE INVENTION

An integrated circuit package system includes: connecting an integrated circuit die and external interconnects; forming an encapsulation over the integrated circuit die and a portion of the external interconnects; and forming an isolation hole between the external interconnects and into a side of the encapsulation exposing the external interconnects.

Certain embodiments of the invention have other aspects in addition to or in place of those mentioned above. The aspects will become apparent to those skilled in the art from a reading of the following detailed description when taken with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a bottom view of an integrated circuit package system in a first embodiment of the present invention;

FIG. 2 is a cross-sectional view of the integrated circuit package system along line 2--2 of FIG. 1;

FIG. 3 is a bottom view of a portion of a lead frame in an intermediate step for manufacturing the integrated circuit package system of FIG. 1;

FIG. 4 is a cross-sectional view of the structure of FIG. 3 along a line 4--4;

FIG. 5 is a bottom view of the structure of FIG. 3 in a connecting step;

FIG. 6 is a cross-sectional view of the structure of FIG. 5 along a line 6--6;

FIG. 7A and 7B are ~~more detailed~~exemplary cross-sectional views ~~of a portion of FIG. 6~~ of the structure of FIG. 5 along the section line 7--7;

FIG. 8 is a bottom view of the structure of FIG. 5 in an isolating step;

FIG. 9 is a cross-sectional view of the structure of FIG. 8 along a line 9--9;

FIG. 10A and 10B are ~~more~~exemplary detailed cross-sectional views of ~~a portion of FIG. 9~~ the structure of FIG. 8 along the section line 10--10;

FIG. 11 is a bottom view of a lead frame in a second embodiment of the present

invention; and

elements. The term "processing" as used herein includes deposition of material, patterning, exposure, development, etching, cleaning, molding, and/or removal of the material or as required in forming a described structure. The term "system" as used herein means and refers to the method and to the apparatus of the present invention in accordance with the context in which the term is used.

Referring now to FIG. 1, therein is shown a bottom view of an integrated circuit package system 100 in a first embodiment of the present invention. The bottom view depicts isolation holes 102 within an encapsulation 104, such as epoxy mold compound. As an example, each of the isolation holes 102 electrically isolates external interconnects 106, such as terminal pads, adjacent to each of the isolation holes 102. In this example, each of the isolation holes 102 isolates the external interconnects 106 included in a first row 108, a second row 110, and a third row 112 of the external interconnects 106, wherein the external interconnects 106 are in a staggered configuration. The first row 108 is adjacent to a boundary 114 of the integrated circuit package system 100. The third row 112 is between the second row 110 and a die-attach paddle 116. The second row 110 is between the first row 108 and the third row 112.

For illustrative purposes, the integrated circuit package system 100 is shown as a quad flat non-leaded (QFN) package with the external interconnects 106 as terminal pads, although it is understood that the integrated circuit package system 100 may be a different type of package with different types of the external interconnects 106. For example, the integrated circuit package system 100 may be a quad flat package (QFP) type with the external interconnects 106 as leads extending from the encapsulation 104. Also for illustrative purposes, the integrated circuit package system 100 is shown with the die-attach paddle 116, although it is understood that the encapsulation 104 may not expose the die-attach paddle 116 or the integrated circuit package system 100 may not have the die-attach paddle 116.

Referring now to FIG. 2, therein is shown a cross-sectional view of the integrated circuit package system 100 along line 2--2 of FIG. 1. The cross-sectional view depicts the isolation holes 102, which are shown behind the external interconnects 106 in this cross-sectional view, with dotted lines isolating different rows of the external interconnects 106. In this example, the isolation holes 102 separate the first row 108 and the third row 112 of the external interconnects 106.

An integrated circuit die 218 is over the die-attach paddle 116. Internal

interconnects 220, such as bond wires or ribbon bond wires, connect the integrated circuit die 218 and the external interconnects 106. The encapsulation 104 covers the integrated circuit die 218 and partially covering the die-attach paddle 116 and the external interconnects 106. In this example, the external interconnects 106 and the die-attach paddle 116 are shown as coplanar.

Referring now to FIG. 3, therein is a bottom view of a portion of a lead frame 302 in an intermediate step for manufacturing the integrated circuit package system 100 of FIG. 1. As an example, the lead frame 302 includes the die-attach paddle 116 surrounded by dam bars 304. First radiating structures 306 extend from the dam bars 304 towards the die-attach paddle 116. Second radiating structures 308 extend the die-attach paddle 116 towards the dam bars 304. The first radiating structures 306 and the second radiating structures 308 alternate in position along each of the dam bars 304 and are horizontally offset from the die-attach paddle 116 or the integrated circuit die 218.

Each of the first radiating structures 306 includes a first extension 310, a first common portion 312, and first radiating interconnects 314. The first extension 310 is between the dam bars 304 and the first common portion 312. The first radiating interconnects 314 extend radiating from the first common portion 312. There can be at least three of the first radiating interconnects 314 radiating or extending from the first common portion 312. The first radiating interconnects 314 can include the external interconnects 106 at an end of ~~and~~ radiating tiebars 315 of the first radiating interconnects 314. An opposite end of each of radiating tiebars 315 of the first radiating interconnects 314 faces away from the external interconnects 106. The opposite end of each of the radiating tiebars 315 extends or radiates from the first common portion 312. The radiating tiebars 315 can connect the external interconnects 106 to the common portion 312. The first radiating interconnects 314 occupy the first row 108, the second row 110, and the third row 112.

Each of the second radiating structures 308 includes a second extension 316, a second common portion 318, and second radiating interconnects 320. The second extension 316 is between the die-attach paddle 116 and the second common portion 318. The second radiating interconnects 320 extend radiating from the second common portion 318. The second radiating interconnects 320 occupy the first row 108,

the second row 110, and the third row 112.

As another example, the first radiating interconnects 314 may not be connected to the dam bars 304 with the first extension 310. A third extension 322, depicted as dotted lines, may connect the first radiating interconnects 314 with the die-attach paddle 116, wherein the third extension 322 attaches to one of the first radiating interconnects 314 adjacent to the die-attach paddle 116.

Yet another example, the second radiating interconnects 320 may not be connected to the die-attach paddle 116 with the second extension 316. A fourth extension 324, depicted as dotted lines, may connect the second radiating interconnects

of FIG. 5 along a line 6--6. The internal interconnects 220 connect the integrated circuit die 218 and the first radiating interconnects 314. The internal interconnects 220 also connect the integrated circuit die 218 and the second radiating interconnects 320.

Referring now to FIG. 7A and 7B, therein are shown ~~more detailed~~ exemplary cross-sectional views of ~~a portion of FIG. 6~~ the structure of FIG. 5 along the section line 7--7. The ~~more detailed~~exemplary cross-sectional view depicts, as an example, one of the first radiating structures 306. The first common portion 312 is between the first radiating interconnects 314. The first radiating structures 306 are depicted in this example, but the more detailed cross-sectional view may have represented the second radiating structures 308 of FIG. 3.

Shown in FIG. 7A, a first side 702 of the first radiating structures 306 is planar such that the first common portion 312 and the first radiating interconnects 314 are coplanar along the first side 702. Shown in FIG. 7B, as an example, a second side 704 of the first radiating structures 306 includes an indent 706 approximately at the first common portion 312. The second side 704 in FIG. 7B is at the same relative side as the first side 702 in FIG. 7A.

Referring now to FIG. 8, therein is shown a bottom view of the structure of FIG. 5 in an isolating step. The structure of FIG. 5 undergoes a molding process forming the encapsulation 104. The encapsulation 104 exposes the die-attach paddle 116 and the ends of both the first radiating interconnects 314 of FIG. 5 and the second radiating interconnects 320 of FIG. 5.

The first radiating interconnects 314 may be isolated from each other by forming the isolation holes 102 through the encapsulation 104 ~~and~~by severing the physical connection of the first radiating interconnects 314 at the first common portion 312 of FIG. 3 exposing a portion of the radiating tiebars 315 of the first radiating interconnects 314 in the isolation holes 102 and ~~forming a portion of~~isolating the external interconnects 106. The isolation holes 102 may be formed in a number of ways. For example, the isolation holes 102 may be formed with chemical etching with a stencil (not shown), drilling, or lasing. The second radiating interconnects 320 may also be isolated from each other by forming the isolation holes through the encapsulation 104 and severing the physical connection at the second common portion 318 of FIG. 3 forming the remaining portion of the external interconnects 106.

For illustrative purposes, the isolation holes 102 are shown over all the first radiating structures 306 of FIG. 5 and the second radiating structures 308 of FIG. 5, although it is understood that the isolation holes 102 may be formed to a portion of the

Referring now to FIG. 10A and 10B, therein are shown ~~more detailed~~exemplary cross-sectional views of ~~a portion of FIG. 9~~ the structure of FIG. 8 along the section line 10--10. The ~~more detailed~~exemplary cross-sectional view depicts, as an example, one of the first radiating structures 306 of FIG. 3. Shown in FIG. 10A, the first common portion 312 of FIG. 7A has been removed between the first radiating interconnects 314 of FIG. 7A leaving one of the isolation holes 102 between the external interconnects 106. Similarly shown in FIG. 10B, the first common portion 312 of FIG. 7B has been removed between the first radiating interconnects 314 of FIG. 7B leaving one of the isolation holes 102 between the external interconnects 106. In FIG. 10B, the isolation holes 102 do not traverse the height of the external interconnects 106 such that the encapsulation 104 is also between the external interconnects 106. The first radiating structures 306 are depicted in this example, but the more detailed cross-sectional view may have represented the second radiating structures 308 of FIG. 3.

Referring now to FIG. 11, therein is shown a bottom view of a lead frame 1102 in a second embodiment of the present invention. The lead frame 1102 may be used for forming an embodiment of the integrated circuit package system 100 of FIG. 1. As an example, the lead frame 1102 includes a die-attach paddle 1116 surrounded by dam bars 1104. Tie bars 1106 are between the corners of the dam bars 1104 and corners of the die-attach paddle 1116.

Radiating structures 1108 extend from the dam bars 1104 towards the die-attach paddle 1116. Each of the radiating structures 1108 includes an extension 1110, a common portion 1112, and radiating interconnects 1114. The extension 1110 is between the dam bars 1104 and the common portion 1112. The radiating interconnects 1114 extend radiating from the common portion 1112. Terminal pads 1118 at the ends of the radiating interconnects 1114 are formed in a configuration such that the terminal pads 1118 radiate out from the common portion 1112.

The number and angles of the radiating interconnects 1114 may vary. The length of the extension 1110 and the radiating interconnects 1114 may vary. The size of the die-attach paddle 1116 may vary. The configuration of the terminal pads 1118 may vary, such as parallel to the borders of the integrated circuit package system 100, as an example, or may be formed in a round configuration. The exposed shape and size of the terminal pads 1118 may vary.

Referring now to FIG. 12, therein is shown a flow chart of an integrated circuit

What is claimed is:

1. An integrated circuit package system comprising:
connecting an integrated circuit die and external interconnects;
forming an encapsulation over the integrated circuit die and a portion of the external interconnects; and
forming an isolation hole between the external interconnects and into a side of the encapsulation exposing the external interconnects.

2. The system as claimed in claim 1 wherein connecting the integrated circuit die and the external interconnects includes connecting the external interconnects radiating from the isolation hole.

3. The system as claimed in claim 1 wherein forming the encapsulation over the integrated circuit die and the portion of the external interconnects includes forming the encapsulation between the external interconnects and over the isolation hole.

4. The system as claimed in claim 1 wherein connecting the integrated circuit die and the external interconnects includes connecting the external interconnects parallel to borders of the encapsulation.

5. The system as claimed in claim 1 further comprising providing a die-attach paddle with the integrated circuit die thereover.

6. An integrated circuit package system comprising:
mounting an integrated circuit die over a die-attach paddle;
connecting the integrated circuit die and external interconnects;
forming an encapsulation over the integrated circuit die, a portion of the external interconnects, and over a portion of the die-attach paddle; and
forming an isolation hole between the external interconnects and into a side of the encapsulation exposing the external interconnects.

7. The system as claimed in claim 6 wherein forming the isolation hole between the external interconnects and into the encapsulation includes forming the isolation hole adjacent to a boundary of the encapsulation.

8. The system as claimed in claim 6 wherein forming the isolation hole between the external interconnects and into the encapsulation includes forming

~~the isolation hole adjacent to the die-attach paddle.~~

~~9. The system as claimed in claim 6 wherein connecting the integrated circuit die and the external interconnects includes connecting multiple rows of the external interconnects in a staggered configuration with the integrated circuit die.~~

~~10. The system as claimed in claim 6 wherein forming the encapsulation includes exposing the die attach paddle.~~

~~11.~~1. An integrated circuit package system comprising:

a die-attach paddle;

an integrated circuit die over the die-attach paddle ;

~~external~~ at least one radiating structure having at least three radiating interconnects ~~interconnects connected with the integrated circuit die~~; and

an encapsulation having an isolation hole horizontally offset from the die-attach paddle and~~, having an isolation hole,~~ over the integrated circuit die and the radiating structure; and~~a portion of the external interconnects with the isolation hole between the external interconnects and into a side of the encapsulation exposing the external interconnects.~~ wherein:

each of the three radiating interconnects includes:

a radiating tiebar,

an external interconnect connected to an end of the radiating tiebar and electrically to the integrated circuit die, and

a portion of an opposite end of each of the radiating tiebars, facing away from the external interconnect, having an orientation characteristic of extending from the isolation hole, and exposed by the isolation hole isolating the external interconnects from each other.

~~12.~~2. The system as claimed in claim 1~~1~~ wherein the external interconnects are in a radiating configuration from the isolation hole.

~~13.~~3. The system as claimed in claim 1~~1~~ wherein the encapsulation is between the external interconnects and over the isolation hole.

~~14.~~4. The system as claimed in claim 1~~1~~ wherein the external interconnects are parallel to borders of the encapsulation.

~~15. The system as claimed in claim 11 further comprising a die attach paddle with the integrated circuit die thereover.~~

~~16.~~ 5. ~~The~~ The system as claimed in claim 1~~1~~ ~~further comprising:~~

~~a die attach paddle with the integrated circuit die thereover; and~~

wherein:

the encapsulation is over a portion of the die-attach paddle.

~~17.~~ 6.The system as claimed in claim ~~16~~5 wherein the isolation hole is adjacent to a boundary of the encapsulation.

~~18.~~ 7.The system as claimed in claim ~~16~~5 wherein the isolation hole is adjacent to the die-attach paddle.

~~19.~~ 8.The system as claimed in claim ~~16~~5 wherein the external interconnects connected with the integrated circuit die includes multiple rows of the external interconnects in a staggered configuration connected with the integrated circuit die.

~~20.~~ 9.The system as claimed in claim ~~16~~5 wherein the die-attach paddle is exposed from the encapsulation.