

FBGA and COB Package Structure for Image Sensor

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

This invention relates to a package structure, and more particularly to an image sensor package structure that can prevent the micro lens from particle contamination.

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2. Description of the Prior Art

The package can have a core made of a common material such as glass epoxy, and can have additional layers laminated onto the core.

15 These additional layers are also known as "built-up" layers. The built-up layers are typically formed from alternating layers of dielectric material and conductive material. Patterns may be built in the metal or conductive layer through various etching processes such as wet etching which are known in the art and will not be described further
20 herein. Plated through holes called vias are used to make interconnects between various layers of metal. Using these layers and vias, several layers of interconnections may be built up.

Input/Output functions are typically accomplished using metal

traces between the layers. Each trace has an impedance generated by its geometry and location on the package. Due to the manufacturing technology and material requirements, packages having built-up layers often include a number of degassing holes in the metal layers.

5 Degassing holes allow gas to be evaporated during the manufacture of the package so that bubbles do not form in the package. Traces may be routed over or under the degassing holes, or around the degassing holes, or a combination thereof. Since the traces are not in the same location on the package, and pass over varying amounts of non-metal

10 areas caused by degassing holes in the metal layers, the traces have an impedance variation, or mismatch.

A digital image technique has been wildly applied to image shooting instrument such as digital camera, image scanner, etc. The

15 conventional CMOS sensor is disposed on a circuit board. The CMOS sensor has a die secured therein. The lens seat has a focusing lens for focusing the image onto the die of the CMOS sensor. Through the lens, the image signal is sent by the die to a digital processor for converting the analog signal into digital signal. The Die of the CMOS sensor is

20 relatively sensitive to infrared ray and dust particles. If the unwanted particles are not removed from the sensor, it leads to downgrade the quality of the device. In order to achieve the purpose, the removal by manual may damage the sensitive chip. Typically, the image sensor module is formed by using a method of COB or LCC. One drawback of

the COB is lower yield rate during packaging process due to particle contamination on sensing area. Besides, the drawbacks of the LCC are higher packaging cost and lower yield rate due to particle contamination on sensing area.

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Further, micro lenses are optical components on semiconductors utilized as solid state imaging devices. One of the most important considerations in designing and manufacturing micro lenses is photosensitivity. One reason micro lens photosensitivity may be
10 reduced is that the area of each micro lens has been reduced below an optimum value. Moreover, SHELL CASE company also develops wafer level package technique, the cost of the image sensor dice packaged by the SHELL CASE is higher due to requiring two glass plate and complicate process. And, the transparency is bad due to epoxy
15 wearing out, and the potential reliability may be reduced. U.S. Patent No. 5,514,888 for ON-DIE SCREEN TYPE SOLID STATE IMAGE SENSOR AND MANUFACTURING METHOD THEREOF; issued May 7, 1996 to Yoshikazu Sano, et al. teaches a method for forming charge-coupled devices (CCDS) on a silicon substrate. A micro lens
20 array is formed over the CCD array using conventional lithography and re-flow techniques.

In view of the aforementioned, the present invention provides an improved package structure to overcome the above drawback.

SUMMARY OF THE INVENTION

Therefore, the main objective of the present invention is to provide
5 a package for image sensor, such as COB (Chip On Board) or FBGA
(Fine-pitch Ball Grid Array) package structure, without particle
contamination on micro lens and method for manufacturing the same.

Another objective of the present invention is to use the glass
10 substrate to prevent the micro lens from particle contamination.

The yet objective of the present invention is to provide a CMOS
image sensor package module structure that the package may be
directly cleaned to remove particle contamination.

15 The present invention provides a package structure. The
structure of package comprises a die having a micro lens area,
adhesive film pattern formed on the die, and a substrate adhered on
the adhesive film pattern to cover the micro lens area on the chip,
20 thereby generating an air gap therebetween.

The present invention provides another structure of package. The
structure of package comprises a printed circuit board having a
plurality of connection pads. A die is placed on the printed circuit
25 board, and the die has a plurality of bonding pads connected to the

connection pads through a plurality of bonding wires, respectively. An adhesive film pattern is formed on the chip. A plurality of solder balls are formed on the first printed circuit board. A glass substrate is adhered on the adhesive film pattern to cover a micro lens area on the chip, thereby generating an air gap therebetween.

The structure of package further comprises a protection material to substantially cover the plurality of bonding wires. The die comprises a micro lens formed there in.

The present invention provides a structure of package module. The structure of package module comprises a printed circuit board having a plurality of connection pads. A die is placed on the printed circuit board, and the die has a plurality of bonding pads connected to the connection pads through a plurality of bonding wires, respectively. An adhesive film pattern is formed on the chip. A glass substrate is adhered on the adhesive film pattern to cover a micro lens area on the chip, thereby generating an air gap therebetween. A lens holder is fixed on the printed circuit board, and the lens holder has at least one lens placed therein.

The structure of package module further comprises a protection material to substantially cover the plurality of bonding wires.

The structure of package module further comprises an IR
CART/IR filtering layer fixed within the lens holder or formed on the
glass substrate.

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BRIEF DESCRIPTION OF THE DRAWINGS

The above objects, and other features and advantages of the
present invention will become more apparent after reading the
following detailed description when taken in conjunction with the
10 drawings, in which:

FIG. 1A is a schematic diagram of a glass substrate with an
elastic film pattern according to the present invention.

FIG. 1B is a schematic diagram of a processed wafer according to
the present invention.

15 FIG. 2 is a schematic diagram of the wafer combining with the
glass according to the present invention.

Fig. 3 is a schematic diagram of an individual CMOS/CCD image
sensor die structure according to the present invention.

20 Fig. 4 is a schematic diagram of an individual FBGA (Fine-pitch
Ball Grid Array) package structure according to the present invention.

Fig. 5 is a schematic diagram of an individual COB (Chip On Board)
package nodule structure according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Some sample embodiments of the invention will now be described
5 in greater detail. Nevertheless, it should be recognized that the
present invention can be practiced in a wide range of other
embodiments besides those explicitly described, and the scope of the
present invention is expressly not limited except as specified in the
accompanying claims. Then, the components of the different elements
10 are not shown to scale. Some dimensions of the related components
are exaggerated and meaningless portions are not drawn to provide
clearer description and comprehension of the present invention. The
structure is adaptable to the FBGA (Fine-pitch Ball Grid Array) and
COB (Chip On Board) type package. The present invention benefits
15 lower cost and more simple process than the die scale package (CSP).
The CSP type package suffers higher cost issue. Further, data
processing speed of the FBGA package is far faster than conventional
TSOP (Thin Small Outline Package) for inter-connection wires design.

20 Referring first to FIG.1A, a processed wafer 100 is provided. The
processed wafer 100 bears a plurality of dice having devices formed
therein. In one example, the devices include image sensors formed
thereon. The image sensor includes CCD or CMOS sensor. An adhesive
film pattern 102 is formed on a substrate 101, shown as Fig.1B. The

material of the adhesive film pattern 102 is elastic material, such as UV type or thermal type material. In one embodiment, the elastic material comprises BCB, SINR (Siloxane polymer), epoxy, polyimides or resin. Besides, the elastic film pattern 102 may be formed by printing, coating or tapping method. The substrate 101 comprises glass or quartz. The thickness of the substrate 101 is about from 100 μ m to 200 μ m. Then, the chip-side (or device side) of the wafer 100 is attached to elastic film pattern 102 of the glass 101 to expose bonding pads 105, such as Al pads, shown as Fig.2. Therefore, a micro lens area 104 of the image sensor (not shown) in the wafer 100 is covered by the glass 101. A micro lens is generally formed on the top surfaces of image sensor. The edge of the die may be contacted with the elastic film pattern 102. Al pads 105 do not contact with the elastic film pattern 102. The processed wafer 100 bears a plurality of image sensor devices in sensing area. As know in the art, the image sensor includes an isolation layer formed over the wafer 100. A color filter layer is next formed over the isolation layer with sub-pixel areas properly aligned with active devices in the wafer 100. Another layer is generally formed over the color filter layer. There are several ways well known to those skilled in the art to proceed with the formation of a micro lens. One material found suitable for the micro lens is a mixture of melamine resin and generic novolac base resin. Subsequently, a photo resist (PR) is deposited over the glass 101. Conventional lithographic techniques are then utilized to form patterns 103 in the PR by using exposure and

development step. Those steps are performed in the die formation procedure not package.

A photoresist (PR) is patterned on the glass 101 to expose the area
5 not aligned to the image sensor area or micro lens area 104. The glass
101 is then etched by a wet etching process to remove partial glass
exposed by the PR under an area 106, thereby exposing Al pads 105
and the partial silicon die. For example, the wet etching solution is HF
or BOE, etc.. PR is then stripped. The micro lens area 104 is protected
10 by the glass 101 from particle contamination.

Referring to FIG.3, the wafer is divided to obtain a plurality of an
individual CMOS or CCD image sensor die 110. From the individual
package structure, micro lenses are formed on the top surfaces of the
15 die 110, the edge of the divided glass 111 contacts to the elastic film
pattern 112. Contact pads 113 are located at the edge of the die
110 without contacting with the elastic film pattern 112. The glass 101
is attached on the top surfaces of the die 110 through the elastic film
pattern 112. An air gap 115 is created between the die 110 and the
20 glass 111 and over the micro lens area 114.

Referring to FIG.4, it is an individual FBGA (Fine-pitch Ball Grid
Array) package. Data processing speed of the FBGA package is far
faster than conventional TSOP (Thin Small Outline Package) for

inter-connection wires design. Similar to above-mentioned, a glass 123 is attached on the top surfaces of a die 121 through the elastic film pattern 124. Contact pads 129 are formed on the top edge of the die 121 for wire bonding. The die 121 comprises CMOS sensor or CCD. Al pads 129 are connected to the connection pads 128 of a substrate 120 through a plurality of bonding wires 125, respectively. Then, a protection material or molding 126 is substantially covered the pluralities of the bonding wires 125, Al pads 129 and the connection pads 128 except the top of the glass 123 to allow the light to pass through. In one embodiment, the protection material 126 comprises compound, liquid compound, and the protection material 126 may be formed by molding or gluing method. For example, the substrate 120 comprises a plurality of solder balls 122 connecting with external devices. As the same, a micro lens may be formed on the micro lens area 127, and an air gap is created between the die 121 and the glass 123. The glass 123 may prevent the micro lens from particle containment. The user may use liquid or air flush to remove the particles on the glass 123 without damaging the micro lens.

Referring to FIG.5, it is an individual COB (Chip On Board) package module. Similar to above-mentioned, a glass 132 is attached on the top surfaces of a die 131 through the elastic film pattern 133 to expose Al pads 134 for wire bonding. The die 121 comprises CMOS sensor or CCD image sensor. Al pads 134 are connected to the

connection pads 135 of a printed circuit board 130 through a plurality of bonding wires 136, respectively. Then, a protection material 137 is substantially covered the pluralities of the bonding wires 136, Al pads 134 and the connection pads 135 except the top of the glass 132 to
5 allow the light to pass through. In one embodiment, the protection material 137 comprises compound, liquid compound, and the protection material 137 may be formed by molding or gluing method. As the same, a micro lens may be formed on the micro lens area 141, and an air gap is created between the die 131 and the glass 132. A lens
10 holder 138 is fixed on the printed circuit board 130 to hold a lens 140. A filter 139, such as an IR CART, is fixed to the lens holder 138. Alternatively, the filter 139 may comprise a filtering layer, for example IR filtering layer, formed upper or lower surface of the glass 132 to act as a filter. In one embodiment, IR filtering layer comprises TiO_2 , light
15 catalyzer. The glass 132 may prevent the micro lens from particle containment. The user may use liquid or air flush to remove the particles on the glass 132 without damaging the micro lens.

Hence, according to the present invention, the aforementioned
20 package structure has the advantages list as follow: the FBGA or COB package structure of the present invention can prevent the micro lens from particle contamination. Moreover, CMOS/CCD image sensor package module structure may be directly cleaned to remove particle contamination. The process of manufacturing of the FBGA or COB

package structure of the present invention is significantly simple.

Although specific embodiments have been illustrated and described, it will be obvious to those skilled in the art that various
5 modifications may be made without departing from what is intended to be limited solely by the appended claims.

CLAIMS

What is claimed is:

1. A FBGA (Fine-pitch Ball Grid Array) package structure, comprising:
a die formed on a substrate, said die having a micro lens area;
adhesive film pattern formed on said die; and
a transparent material adhered on said adhesive film pattern to cover said micro lens area on said chip, thereby generating an air gap therebetween;
first pads formed on said substrate and second pads formed on said die;
wires connected between said first pads and second pads;
molding material substantially covered said wires; and
solder balls attached on a under surface of said substrate.
2. The structure in claim 1, wherein said die is an image sensor.
3. The structure in claim 1, wherein material of said adhesive film pattern is elastic material, wherein said elastic material comprises UV type or thermal type material.
4. The structure in claim 1, wherein said transparent material comprises glass or quartz, wherein a thickness of said transparent material is from about 100 μ m to 200 μ m.
5. The structure in claim 1, wherein said molding material comprises

compound or liquid compound, wherein said molding material is formed by molding or gluing method.

6. A Chip On Board (COB) structure of package module, comprising:
a substrate;
a die placed on said substrate;
adhesive film pattern formed on said die;
a transparent material adhered on said adhesive film pattern to cover a micro lens area on said die, thereby generating an air gap there between;
a lens holder fixed on said substrate, said lens holder having at least one lens placed therein;
first pads formed on said substrate and second pads formed on said die;
wires connected between said first pads and second pads; and
molding material substantially covered said wires;
wherein said die has a plurality of said second pads connected to a plurality of said first pads through a plurality of said wires, respectively.

7. The structure in claim 6, wherein said die is an image sensor.

8. The structure in claim 6, wherein material of said adhesive film is elastic material, wherein said elastic material comprises UV type or thermal type material.

9. The structure in claim 6, wherein said transparent material

comprises glass or quartz, wherein a thickness of said transparent material is from about 100 μ m to 200 μ m.

10. The structure in claim 6, wherein said substrate comprises printed circuit board.

11. The structure in claim 6, wherein said molding material comprises compound or liquid compound.

12. The structure in claim 6, further comprising a filter formed within said lens holder, wherein said filter is an IR filtering layer formed on a surface of said substrate.

13. The structure in claim 12, wherein material said IR filtering layer comprises TiO_2 , light catalyzer, wherein said filter is IR filter fixed within said lens holder.