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Executed this February 16, 2016.

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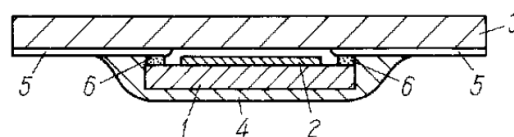
(54) [Title of Invention] Imaging Equipment and its Method of Manufacture

(57) [Abstract]

[Purpose] To present imaging equipment and its method of manufacture having a package structure that can be less expensive and thinner.

[Structure] Wires (5) are provided on one surface of a transparent plate (3), the inner edges of the wires are aligned in locations that surround the center portion of the transparent plate (3), and their outer edges are aligned along the long sides of the transparent plate (3) to form terminals that are connected to the outside. An imaging element (1) is electrically connected to the inner edges of the wires by bump electrodes (6) and a conductive adhesive (not shown in the figure), and its light-receiving surface is fixed so as to face the transparent plate (3). A filter (2) is deposited on the light-receiving surface of the imaging element (1). A sealing resin (4) such as an epoxy resin or a silicone resin covers the imaging element (1) from its rear side and around its periphery, so that the space between the light-receiving surface of the imaging element (1) and the transparent plate (3) is sealed.

1 Imaging Element
 3 Transparent Plate (Plate-Shaped Body)
 4 Sealing Resin (Sealing Means)
 5 Wires (Conductive Patterns)
 6 Bump Electrodes (Electrodes)



[Claims]

[Claim 1] Imaging equipment that has a plate-shaped body with a light-transmitting portion at least in its center portion, multiple conductive patterns that are formed on one surface of the plate-shaped body, an imaging element whose terminals are electrically connected to the inner edges of the conductive patterns and whose light-receiving surface is fixed so as to face the plate-shaped body, and a sealing means for sealing the space between the plate-shaped body and the light-receiving surface of the imaging element.

[Claim 2] Imaging equipment that has a base with a window in its central portion, multiple conductors that are provided to the base surface such that one end of each extends inside the window and the other end extends outside the base, a plate-shaped body that is attached to the base and has a light-transmitting portion at least in the center portion, an imaging element whose electrodes are connected to the inner edges of the conductors and whose light-receiving surface is fixed within the window so as to face the plate-shaped body, and a sealing means for sealing the space between the plate-shaped body and the light-receiving surface of the imaging element.

[Claim 3] Imaging equipment as in Claim 2 such that one portion of the adhesive that joins the base and the plate-shaped body extends toward the central portion of the plate-shaped body to form a flare-prevention layer.

[Claim 4] A manufacturing method for imaging equipment that has a procedure for preparing a structure that has a plate-shaped body with a light-transmitting portion at least in its center portion and multiple conductive patterns that are formed on one surface of the plate-shaped body, a procedure for connecting the electrodes of an imaging element to the inner edges of the conductive patterns and for fixing the light-receiving surface of the imaging element so as to face the plate-shaped body, and a sealing procedure for sealing the space between the plate-shaped body and the light-receiving surface of the imaging element.

[Claim 5] A manufacturing method for imaging equipment that has a procedure for preparing a structure that has a base with a window in its central portion, multiple conductors that are provided to the base surface such that one end of each extends inside the window and the other end extends to the periphery of the base or outside it, and a plate-shaped body that is attached to the base and has a light-transmitting portion at least in the center portion; a procedure for connecting the electrodes of an imaging element to the inner edges of the conductors and for fixing the light-receiving surface of the imaging element within the window so as to face the plate-shaped body; and a sealing procedure for sealing the space between the light-receiving surface of the imaging element and the plate-shaped body.

[Claim 6] Imaging equipment as in Claim 1, Claim 2, or Claim 3 such that the electrodes of the imaging element are two-stage protrusion electrodes.

[Detailed Description of the Invention]

[0001]

[Industrial Field of Application] This invention is related to imaging equipment that is used, for example, in video cameras, and to its manufacturing method.

[0002]

[Prior Art] Figure 5 is a cross-section of imaging equipment of prior art. In Figure 5, (20) is the base, (21) is the imaging element, (22) are the leads, (23) are the wires, (24) is the filter, (25) is the flare-prevention plate, and (26) is the transparent plate.

[0003] In a central concave portion of the base (20), which is made of a multi-layer ceramic, the imaging element (21) such as a CCD is fixed, and the electrodes and leads (22) of the imaging element (21) are connected by the wires (23). The filter (24) is deposited on the light-receiving surface of the imaging element (21). The flare-prevention plate (25) is provided at the middle stage of the central concave portion of the base (20), and is covered and sealed by the transparent plate (26).

[0004] As a manufacturing method of prior art, the imaging element (21) such as a CCD is fixed to the central concave portion of the base (20), which is made of a multi-layer ceramic, and the electrodes and leads (22) of the imaging element (21) are connected with the wires (23). The filter (24) is deposited on the light-receiving surface of the imaging element (21), and the flare-prevention plate (25) is provided to the

middle stage of the central concave portion of the base (20). Then the transparent plate (26) is attached to the base (20) around its edge portion to form a closed structure.

[0005]

[Problems that the Invention is to Solve] In the imaging equipment of prior art as described above, from the viewpoint of cost, the multi-layer ceramic that is used for the base and the flare-prevention plate are expensive, so it is difficult to reduce the cost. Also, since it is a structure in which the imaging element is contained within the concave portion of the base, there is a limit to how thin the imaging equipment can be after it is complete. Also, in the manufacturing method of prior art the processes after the imaging element has been fixed to the base are long and complicated, which not only is a hindrance to shortening the lead time after completion of the diffusion process but also, if a defect occurs in these processes, then it is necessary to discard even the imaging element, which is not defective and has already been mounted, so there is a great loss when discarding defective products.

[0006] The purpose of the present invention is to present imaging equipment, and its manufacturing method, that solves these problems, so that it is less expensive and can be made thinner.

[0007]

[Means for Solving the Problems] In order to achieve the above purpose, the imaging equipment of the first invention has a plate-shaped body with a transparent portion at least in its center portion, multiple conductive patterns that are formed on one surface of the plate-shaped body, an imaging element whose terminals are electrically connected to the inner edges of the conductive patterns and whose light-receiving surface is fixed so as to face the plate-shaped body, and a sealing means that is provided so as to seal the space between the plate-shaped body and the light-receiving surface of the imaging element.

[0008] And the imaging equipment of the second invention has a base with a window in its central portion, multiple conductors that are provided to the base surface such that one end of each extends inside the window and the other end extends outside the base, a plate-shaped body that is attached to the base and has a transparent portion at least in the center portion, an imaging element whose electrodes are connected to the inner edges of the conductors and whose light-receiving surface is held within the window so as to face the plate-shaped body, and a sealing means for sealing the space between the plate-shaped body and the light-receiving surface of the imaging element.

[0009] Also, for the imaging equipment of the third invention, in the imaging equipment of the second invention one portion of the adhesive that joins the base and the plate-shaped body extends toward the central portion of the plate-shaped body to form a flare-prevention layer.

[0010] Or, the manufacturing method for imaging equipment of the fourth invention has a procedure for preparing a structure that has a plate-shaped body with a light-transmitting portion at least in its center portion and multiple conductive patterns that are formed on one surface of the plate-shaped body, a procedure for connecting the electrodes of an imaging element to the inner edges of the conductive patterns and for fixing the light-receiving surface of the imaging element so as to face the plate-shaped body, and a sealing procedure for sealing the space between the plate-shaped body and the light-receiving surface of the imaging element.

[0011] The manufacturing method for imaging equipment of the fifth invention has a procedure for preparing a structure that has a base with a window in its central portion, multiple conductors that are provided to the base surface such that one end of each extends inside the window and the other end extends to the periphery of the base or outside it, and a plate-shaped body that is attached to the base and has a light-transmitting portion at least in the center portion; a procedure for connecting the electrodes of an imaging element to the inner edges of the conductors and for fixing the light-receiving surface of the imaging element within the window so as to face the plate-shaped body; and a sealing procedure for sealing the space between the light-receiving surface of the imaging element and the plate-shaped body.

[0012]

[Operation of the Invention] According to this configuration a base with an expensive multi-layered structure is unnecessary and, in addition to trying to reduce cost, the base does not require depth to contain the imaging element, so a thinner imaging element can also be implemented. Also, not just are a die bond process and a wire bond process unnecessary, but also the process after the fixing of the imaging element is short, so that it is possible to try to shorten the lead time and minimize the loss due to discard when a defect occurs.

[0013]

[Working Examples] Figure 1 is a cross-section of a working example of the first invention and Figure 2 is its plane view. Figure 1 is the cross-section at the location of X-Y in Figure 2. In both figures, (1) is the imaging element, (2) is the filter, (3) is the transparent plate, (4) is the sealing resin, (5) are the wires, and (6) are the bump electrodes. On one surface of the transparent plate (3), which is formed of glass with a thickness from 1 mm to 2 mm, the wires (5) are provided as multiple conductive patterns that are formed as vapor-deposited metal or by screen printing. The inner edges of the wires are aligned at positions that surround the central portion of the transparent plate (3), and their outer edges are aligned along the long sides of the transparent plate (3) to form terminals that are connected to the outside. The outer edges of the wires are not covered by the sealing resin (4). Two-stage protrusion bump electrodes may be provided to these connection terminals. The imaging element (1) is electrically connected to the inner edges of the wires (5) by the bump electrodes (6) and a conductive adhesive (not shown in the figures), and its light-receiving surface is fixed so as to face the transparent plate (3). On the surface of the imaging element (1) the bump electrodes (6) are formed of metal materials by a plating method or a stud bump method, and they may first be transferred to predetermined positions of the wires (5). Bump electrodes that are formed by the stud bump method have a two-stage protruding shape comprising a base portion that is a crushed ball and a protruding portion that is formed by folding back a wire that extends from the base portion. If this type of electrode is used then it is possible to form an electrode that has a greater height than a bump electrode with the shape of prior art. In the equipment of this working example, if two-stage protrusion electrodes are used as the bump electrodes (6), then it is possible to make the gap between the transparent plate (3) and the surface of the imaging element (1) sufficiently wide so that the filter (2) can be provided with an allowance. Also, from its shape, a two-stage protrusion electrode functions to mitigate impact, absorbing mechanical impact when connecting to the wires (5) so that the transparent plate and imaging element are not damaged. The connection between the bump electrodes and the wires may be by direct crimping or they may be attached through a conductive adhesive. A conductive adhesive would be applied by batch transfer. The filter (2) is deposited on the light-receiving surface of the imaging element (1). The sealing resin (4) such as an epoxy resin or a silicone resin covers the imaging element (1) from its rear side and around its periphery, so that nitrogen gas, which is an inert gas, is sealed in the space between the light-receiving surface of the imaging element (1) and the transparent plate (3), and the space is closed. The structure of the equipment of this working example has the advantage that the wires (5) that are formed of conductor patterns also serve as external leads, so that it is not necessary to separately provide external leads, and therefore thinner equipment can be implemented.

[0014] A preferable method of manufacturing the equipment of this working example is to first prepare a structure in which the wires (5) are

formed on the transparent plate (3), then clean the structure, and then connect the imaging element (1), to which the bump electrodes (6) and filter (2) are provided, to the inner edges of the wires (5). Then, in a nitrogen gas atmosphere, a sealing resin (4) such as an epoxy resin or a silicone resin is used to cover the imaging element (1) from the rear side and around its periphery, and the space between the light-receiving surface of the imaging element (1) and the transparent plate (3) is sealed.

[0015] According to this manufacturing method the process after connecting the imaging element is just the sealing process, so the lead time after the completion of the so-called diffusion process is shortened, and there are few occurrences of process defects after connecting the imaging element, so there is little discarding of semi-finished products including the imaging element as defective products, and therefore the loss due to the occurrence of defects is minimized. Also, the space near the surface of the imaging element (1) is filled with nitrogen gas, which is an inert gas, so that degradation of the element due to oxidation or moisture absorbance does not occur.

[0016] Figure 3 is a cross-section of the imaging equipment in a working example of the second invention. In the figure, (7) is the base, (8) are the leads, and (9) is the adhesive. The base (7), which is made of a one-layer ceramic, has in its middle portion a rectangular window of a size that can contain the imaging element (1), and multiple leads (8) are formed on one surface. The leads (8) are formed from conductors of an iron alloy, for example, and the inner edge of each one protrudes into the window of the base (7). In order to increase the bondability of the protruding portion with the bump electrodes (6), for example, if the bump electrodes (6) are metal then it is preferable to perform tin plating of the surfaces of the leads (8). The other edges of the leads (8) extend outside the base (7) and bend downward along the side surfaces of the base (7) to become external leads. The imaging element (1) is electrically connected to the inner edges of the leads (8) by the bump electrodes (6), and its light-receiving surface is fixed within the window of the base (7) so as to face the transparent plate (3). The electrical connection between the inner edges of the leads (8) and the bump electrodes (6) may be batch bonding by thermocompression bonding. The bump electrodes (6) may first be formed on the surface of the imaging element (1) by a plating method or a stud bump method, and may first be transferred to predetermined positions of the leads (8). Bump electrodes that are formed by the stud bump method have a two-stage protrusion shape comprising a base portion that is a crushed ball and a protruding portion that folds back a wire that extends from the base portion. If this type of electrode is used then it is possible to form an electrode with a greater height than a bump electrode with the shape of prior art. In the equipment of this working example, if two-stage protrusion electrodes are used as the bump electrodes (6), then it is possible to make the gap between the transparent plate (3) and the surface of the imaging element (1) sufficiently wide so that the filter (2) can be provided with an allowance. Also, from its shape, a two-stage protrusion electrode functions to mitigate impact, absorbing mechanical impact when connecting to the wires (5) so that the wire and imaging element are not damaged.

[0017] According to the structure of this working example the imaging element (1) is connected to the inner edges of the leads (8) that protrude into a hollow space within the window of the base (7), so the stress during the hardening of the sealing resin (4) can be absorbed by the flexibility of the leads (8).

[0018] The filter (2) is deposited on the light-receiving surface of the imaging element (1). The imaging element (1) is covered by the sealing resin (4) such as an epoxy resin or a silicone resin from its rear side and around its periphery, so that the space between the light-receiving surface of the imaging element (1) and the transparent plate (3) is sealed and has nitrogen gas inserted into it.

[0019] A preferable method of manufacturing the equipment of this working example is to first prepare a structure comprising the base (7), leads (8), adhesive (9), and transparent plate (3), then clean the structure, and then connect the imaging element (1), to which the bump electrodes (6) and filter (2) are provided, to the inner edges of the leads (8). Then, in a nitrogen gas atmosphere, a sealing resin (4) such as an epoxy resin or a silicone resin may cover the imaging element (1) from the rear side and around its periphery, and the space between the light-receiving surface of the imaging element (1) and the transparent plate (3) is sealed. According to this manufacturing method the process after connecting the imaging element is just the sealing process, so the lead time after the completion of the so-called diffusion process is shortened, and there are few occurrences of process defects after connecting the imaging element, so there is little discarding of semi-finished products including the imaging element as defective products, and therefore the loss due to the occurrence of defects is minimized. Also, the space near the surface of the imaging element (1) is filled with nitrogen gas, which is an inert gas, so that degradation of the element due to oxidation or moisture absorbance does not occur. Also, a base (7) made of a one-layer ceramic is used, so the imaging equipment can be implemented less expensively than a structure of prior art that uses a base made of a multi-layer ceramic.

[0020] Figure 4 is a cross-section of imaging equipment of a working example of the third invention. In the figure, (10) is the flare-prevention layer. The base (7), which is made of a one-layer ceramic, has a window in the center of it, and multiple leads (8) are formed on one surface. The inner edge of each lead (8) protrudes into the window of the base (7). The imaging element (1) is electrically connected to the inner edges of the leads (8) by the bump electrodes (6), and its light-receiving surface is fixed within the window of the base (7) so as to face the transparent plate (3). The electrical connection between the inner edges of the leads (8) and the bump electrodes (6) may be batch bonding by thermocompression bonding. The bump electrodes (6) may first be formed on the surface of the imaging element (1) by a plating method or a stud bump method, and may first be transferred to predetermined positions of the leads (8). Bump electrodes that are formed by the stud bump method have a two-stage protrusion shape comprising a base portion that is a crushed ball and a protruding portion that folds back a wire that extends from the base portion. If this type of electrode is used then it is possible to form an electrode with a greater height than a bump electrode with the shape of prior art. In the equipment of this working example, if two-stage protrusion electrodes are used as the bump electrodes (6), then it is possible to make the gap between the transparent plate (3) and the surface of the imaging element (1) sufficiently wide so that the filter (2) can be provided with an allowance. Also, from its shape, a two-stage protrusion electrode functions to mitigate impact, absorbing mechanical impact when connecting to the wires (5) so that the wires and imaging element are not damaged. The other edges of the leads (8) extend outside the base (7) and bend downward along the side surfaces of the base (7) to become external leads.

[0021] The filter (2) is deposited on the light-receiving surface of the imaging element (1). A sealing resin (4) such as an epoxy resin or a silicone resin covers the imaging element (1) from the rear side and around its periphery, so that the space between the light-receiving surface of the imaging element (1) and the transparent plate (3) is sealed, and it is filled with nitrogen gas.

[0022] The basic structure of this invention is common with the example shown in Figure 3, but the characteristic of this invention is that one

portion of the adhesive (9) that joins the base (7) and the transparent plate (3) extends on the adhesive surface of the transparent plate (3) toward the central portion of the transparent plate (3) and forms a flare-prevention layer (10). The flare-prevention layer (10) is provided only at a portion that does not interfere with light that is perpendicularly incident onto the effective pixel region of the imaging element (1). The adhesive (9) may use a blackened epoxy resin to confer the ability to block and/or absorb light. As a result of this type of structure it is not necessary to separately provide a member for flare prevention and, in addition to reducing cost, imaging equipment that is thin and has excellent flare resistance can be implemented. Also, a base (7) made of a one-layer ceramic is used, so the imaging equipment can be implemented less expensively than a structure of prior art that uses a base made of a multi-layer ceramic.

[0023] According to the structure of this working example the imaging element (1) is connected to the inner edges of the leads (8) that protrude into the hollow space within the window of the base (7), so that the stress during the hardening of the sealing resin (4) can be absorbed by the flexibility of the leads (8).

[0024] The stud bump method in each of these working examples is described in detail, for example, in Disclosed Patent S63-304587 [1988].

[0025] In each of these working examples a glass plate that is fully transparent is used as the plate-shaped body, but it is also possible to use a plate-shaped object where only the center portion that transmits light that is incident onto the effective pixel region of the imaging element is formed of a transparent material.

[0026] In the working examples shown in Figure 3 and Figure 4 the lead-out portions of the leads (8) bend downward along the side surfaces of the base (7), which is the so-called dual inline type of lead shape, but the lead shape can also be a flat package shape (gull wing type).

[0027]

[Effects of the Invention] As explained in detail above, according to the imaging equipment of this invention and its manufacturing method, a base with an expensive multi-layer structure becomes unnecessary and, in addition to trying to reduce cost, it is unnecessary for the base to have a depth for containing the imaging element, so a thinner imaging element can also be implemented. The process after fixing the imaging element is shorter, and in addition to trying to shorten the lead time it is also possible to minimize the loss due to discard when a defect occurs.

[Brief Explanation of the Figures]

[Figure 1] Cross-section that shows equipment of a working example of this invention.

[Figure 2] Plane view that shows equipment of a working example of this invention.

[Figure 3] Cross-section that shows equipment of a working example of this invention.

[Figure 4] Cross-section that shows equipment of a working example of this invention.

[Figure 5] Cross-section that shows equipment that is an example of prior art.

[Explanation of Reference Numerals]

1 Imaging Element

3 Transparent Plate (Plate-Shaped Body)

4 Sealing Resin (Sealing Means)

5 Wires

6

Bump

Electrodes

Figure 1

- 1 Imaging Element
- 3 Transparent Plate (Plate-Shaped Body)
- 4 Sealing Resin (Sealing Means)
- 5 Wires (Conductive Patterns)
- 6 Bump Electrodes (Electrodes)

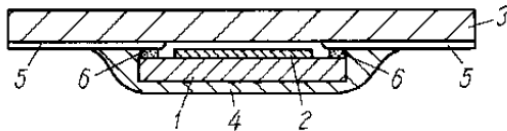


Figure 3

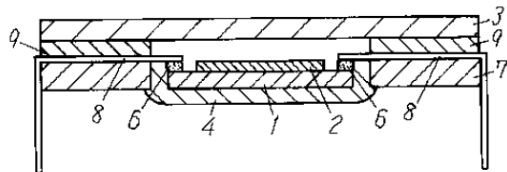


Figure 4

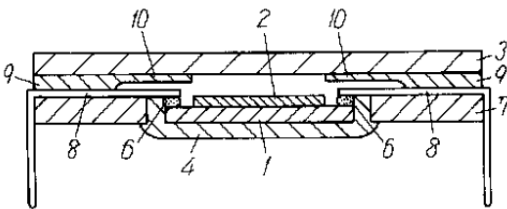


Figure 2

