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(54) Process for Producing a Solid-State Image Pickup Device

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Specification

1. Title of the Invention

Process for producing a solid-state image pickup device

2. Claims

A process for producing a solid-state image pickup device characterized by comprising: placing a solid-state image sensor in the recess of a housing for securing a solid-state image sensor so that the image pickup face opposes the light entrance hole formed at the bottom of said recess; capturing the image of an alignment marking prepositioned at a prescribed location in relation to said housing using said solid-state image sensor; displaying the image of said alignment marking on a display device using the signals from said solid-state image sensor; aligning said image with a reference position preset on said display device in relation to said housing by moving said solid-state image sensor; and securing said solid-state image sensor to said housing by facedown bonding said solid-state image sensor to the terminals of the housing.

3. Detailed explanation of the Invention
(Field of the Invention)

The present invention relates to processes for producing semiconductor devices, particularly to processes for producing solid-state image pickup devices.

(Background Art)

FIG. 1 is a plan view of a conventional solid-state image pickup device, and FIG. 2 is a sectional view of the device. The semiconductor chip used as the solid-state image pickup device shown in the figures is mounted within a housing as follows. A semiconductor chip 1 is aligned with a housing 2 by inserting the semiconductor chip 1 in the recess 2a of the housing 2, and abutting the semiconductor chip 1 against the alignment guides 2₁, 2₂, and 2₃, which project into the recess 2a, followed by securing the semiconductor chip 1 at the bottom of the recess 2a of the housing 2 using a mounting medium 3. Then, electrodes 1a of the semiconductor chip 1 and the metalized pattern 5 formed on the stepped section 4 of the recess 2a of the housing 2 are connected by wire bonding. A light transmitting glass 6 is then secured to the housing so as to seal the recess 2a of the housing 2. The semiconductor chip 1 is thus mounted within the housing 2.

(Problems with the Prior Art)

(1) In producing a solid-state image pickup device, the surface of the semiconductor chip 1 must be free of dust and dirt, and the light transmitting glass 4 must be free of dust and scratches. Methods for removing dust and dirt on the image pickup face of the semiconductor chip 1 include ① inspecting the appearance of the semiconductor chip 1 and cleaning and removing the dust and dirt attached thereto, and ② inserting the semiconductor chip 1 in the housing 2 and bonding thereto, followed by operating the semiconductor chip 1, and cleaning the dust and dirt off of the semiconductor chip 1 while observing the output image. The former reduces the efficiency, and the latter is subjected to restrictions in terms of cleaning methods because the bonding step has been completed. The appearance of the light transmitting glass 6 must also be inspected prior to cleaning, which also reduces the efficiency. Moreover, once the semiconductor chip 1 is secured to the housing 2 and the light transmitting glass 6 secured to the housing 2, it is no longer possible to remove the dust on the inner side of the light transmitting glass 6.

(2) Since the solid-state image pickup device is used in combination with a lens system, the semiconductor chip 1 must be highly accurately aligned with the housing 2. For this purpose, the alignment guides 2_1 , 2_2 , and 2_3 are provided in the recess 2a of the housing 2 against which the edges of the semiconductor chip 1 are abutted. At this point, an appropriate holding tool, such as a tweezer, must be used to grasp the edge of the semiconductor chip 1. This reduces the efficiency as well as making the semiconductor chip 1 more vulnerable to scratches.

(Object of the Invention)

The present invention was created taking the above problems into consideration, and aims to achieve a process for producing a solid-state image pickup device which enables high precision alignment of the semiconductor chip with the housing, and finding the dust and dirt on the image pickup face of the semiconductor chip and the light transmitting glass surface before they are secured to the housing.

(Summary of the Invention)

The present invention is a process for producing a solid-state image pickup device characterized by comprising: placing a solid-state image sensor in the recess of a housing for securing a solid-state image sensor so that the image pickup face opposes the light

entrance hole formed at the bottom of said recess; capturing the image of an alignment marking prepositioned at a prescribed location in relation to said housing using said solid-state image sensor; displaying the image of said alignment marking on a display device using the signals from said solid-state image sensor; aligning said image with a reference position preset on said display device in relation to said housing by moving said solid-state image sensor; and securing said solid-state image sensor to said housing by facedown bonding said solid-state image sensor to the terminals of the housing.

(Example of the Invention)

FIG. 3 is a plan view of the main section of the production equipment for the solid-state image pickup device for carrying out the invention, and FIG. 4 is a front view showing a partial sectional view of the device. As shown in the figures, the recess 7a formed in the housing 7 has a stepped section 8, and a through hole 9 for light entry created in the central section at its bottom. On the bottom face of the recess 7a, moreover, a metalized pattern 10 is formed to serve as the terminals for the housing, and the solder bumps 11 for facedown bonding are formed on the metalized pattern 10 (the metalized pattern 10 is connected to the leads (not shown) disposed on the housing 7). Reference numeral 12 denotes a semiconductor chip serving as a solid-state image sensor, and electrodes 12a are formed in the peripheral section on the image pickup face thereof. The semiconductor chip 12 is placed on the solder bumps 11 so that the electrodes 12a in the peripheral section thereof come into contact with the solder bumps 11. Reference numeral 13 denotes a light transmitting glass fused to the lower face of the housing 7 so as to plug the through hole 9, reference numeral 14 denotes a sealing plate for closing the recess 7a by being fitted to the stepped section 8 of the recess 7a of the housing 7. Reference numeral 15 denotes a display device having a CRT, 16 denotes a drive circuit for operating the semiconductor chip 12, and 17 denotes a signal processing circuit for displaying the image captured by the semiconductor chip 12 onto the display device 15.

As shown in FIG. 3, 18 denotes a pair of mounting racks disposed in parallel, which are movable so as to move closer together or move apart in the horizontal direction, as well as moving up and down. The pair

of mounting racks 18 each has a stepped section 18a in the section that faces one another.

Using an appropriate holding means (not shown), the housing 7 is placed on the stepped sections 18a of the pair of mounting racks 18.

Reference numeral 19 denotes a stop disposed at one end of the stepped section 18a of each mounting rack 18, and 20 denotes a pressing means disposed at the inner side of the pair of mounting racks 18 at the other end so as to be movable in the lengthwise direction of the mounting racks 18. The housing 7 placed on the pair of mounting racks 18 is pressed against the stops 19 by the pressing means 20, and is held between the pair of mounting racks 18 by moving them closer together. The housing 7 is thus positioned and secured at a prescribed position.

A carrier 21 is disposed under the pair of mounting racks 18 in close proximity thereto. The carrier 21 is adapted to be movable in the lengthwise direction of the mounting racks 18. The carrier 21 has recesses 21a for fitting and placing the light transmitting glass 13 formed at prescribed intervals in the lengthwise direction, and a through hole 22 is created in the central section of each recess 21a. An adhesive is applied to the peripheral section of the upper face of the light transmitting glass 13 placed on the carrier 21. The movement of the carrier 21 is controlled by an appropriate drive means (not shown) to position a recess 21a directly under the housing 7 which has been positioned and secured on the pair of mounting racks 18. Accordingly, by lowering the pair of mounting racks 18 holding the housing 7 on which a semiconductor chip 12 is positioned and secured, the housing 7 is placed on the light transmitting glass on the carrier 21 positioned directly under the pair of mounting racks 18 so as to close the through hole 9.

Above the pair of mounting racks 18, there are provided a vacuum suction holding means (not shown) for holding and placing the semiconductor chip 12 on the stepped section 7a of the housing 7 positioned and secured on the pair of mounting racks 18, and a heating means (not shown) for facedown bonding.

Reference numeral 23 denotes a lens disposed directly under the pair of mounting racks 18 and below the carrier 21 in close proximity, 24 denotes a transparent marking plate disposed under the lens 23, and 25 denotes a lamp disposed under the marking plate 24.

FIG. 5 is a plan view of the marking plate 24, on which a cross-shaped marking 24a is provided as shown in the figure. The center of the lens 23 and the center of the marking 24a are positioned along the line that passes orthogonally through the center of the housing 7 positioned and secured on the pair of mounting racks 18. The positions of the lens 23 and the marking 24a are adjusted so that an image of the marking 24a is formed on the image pickup face of the semiconductor chip 12 placed on the solder bumps 11 of the housing 7. By shining the light from the lamp 25 against the marking plate 24, the shadow of the marking 24a is clearly projected on the image pickup face of the semiconductor chip 12 via the lens 23, the through hole 22 of the carrier 21, and the light transmitting glass 13.

The production steps of the solid-state image pickup device constructed as above will be explained next. First, a housing 7 is positioned and secured on the pair of mounting racks 18 by placing the housing 7 on the pair of mounting racks 18, pressing it against the stops 19 using the pressing means 20, and squeezing it between the pair of mounting racks 18.

Next, a semiconductor chip 12 held by a vacuum suction holding means (not shown) is placed on the solder bumps 11 in the recess 7a of the housing 7 placed at the prescribed position described above so that its electrodes 12a come into contact with the solder bumps 11.

Then, the semiconductor chip 12 is operated by the drive circuit 16 via the leads (not shown) disposed on the housing 7 to display the image captured by the semiconductor chip 12 on the CRT screen of the display device 15. One example of a CRT screen of the display device 15 is shown in FIG. 6(a).

As shown in FIG. 6(a), reference numeral 15a denotes a reference marking on the CRT screen of the display device 15 which has been preset in relation to the housing 7 positioned and secured on the pair of mounting racks 18, and 26 denotes the image of the marking 24a displayed on the CRT screen. The semiconductor chip 12 placed on the solder bumps 11 is moved so that the image 26 is aligned with the reference marking 15a (see FIG. 5(b)). At this time, any dust or dirt present on the semiconductor chip 12 will be displayed on the CRT screen of the display device 15. If this occurs, the semiconductor chip 12 is replaced.

Then, the electrodes 12a of the semiconductor chip 12 and the metalized pattern 10 are facedown bonded using the heating means for facedown bonding to secure the semiconductor chip 12 to the housing 7.

The pair of mounting racks 18 is then lowered to place the housing 7 on the light transmitting glass 13 on the carrier 21. This adheres (tacks) the light transmitting glass 13 to the lower face of the housing 7. At this time, any dirt or the like present on the light transmitting glass 13 will be displayed on the CRT screen of the display device 15. If this occurs, the carrier 21 is moved and the light transmitting glass replaced.

Then, the housing 7 is released from the pair of mounting racks 18 and the pressing means 20, and the carrier 21 is moved. Once outside the pair of mounting racks 18, the semiconductor chip 12 is secured, and the housing 7 and the light transmitting glass 13 adhered thereto are removed from the carrier 21 using an appropriate holding means (not shown). The light transmitting glass 13 is then fused to the housing 7, and the stepped section 8 of the recess 7a is closed with a sealing plate 14 to thus produce the solid-state image pickup device.

(Effect of the Invention)

As explained above, according to present invention, the solid-state image sensor can be highly precisely aligned with the housing prior to securing the solid-state image sensor to the housing, as well as detecting the dust or dirt on the image pickup face of the image sensor and the light transmitting glass surface prior to securing them to the housing.

4. Brief Explanation of the Drawings

FIG. 1 is a plan view of a conventional solid-state image pickup device, and FIG. 2 is a sectional view of the device. FIG. 3 is a plan view of the main section of the production equipment for the solid-state image pickup device for carrying out the invention, and FIG. 4 is a front view showing a partial sectional view of the device. FIG. 5 is a plan view of a marking plate, and FIGS. 6(a) and (b) show the CRT screen of a display device.

7 --- housing, 7a --- recess, 9 --- through hole,
12 --- semiconductor chip, 15 --- display device,
15a --- reference marking, 24a --- marking

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FIG. 1

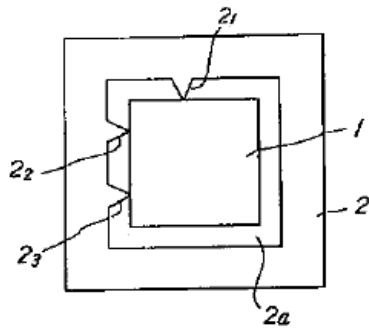


FIG. 2

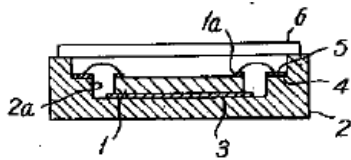


FIG. 3

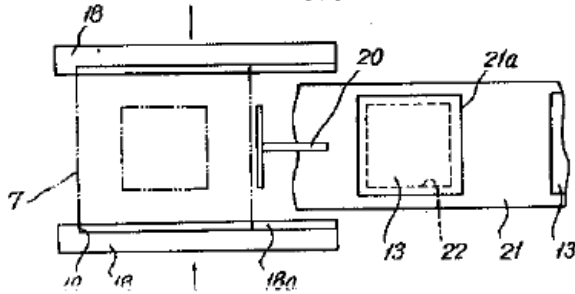


FIG. 4

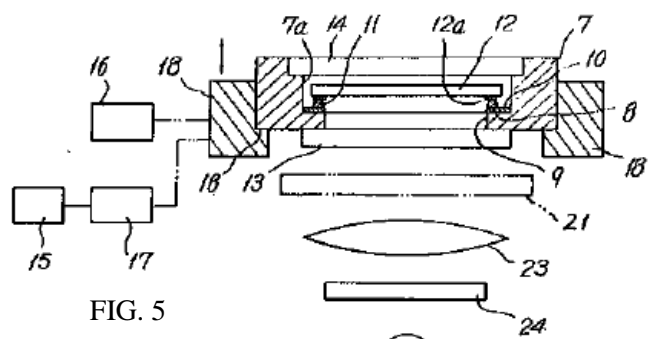


FIG. 5

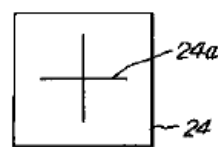
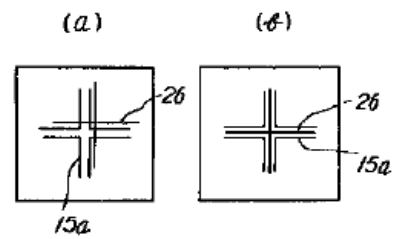


FIG. 6





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I, Asami Isomichi, hereby declare:

1. I am a Japanese language translator.
2. I have over 25 years experience translating technical, legal, and business documents from Japanese to English, and from English to Japanese.
3. I certify that the English translation of the document identified below is a true and correct translation, to the best of my knowledge and ability, of the original Japanese document:

- Japanese Unexamined Patent Application Publication No. S59-225560

I hereby certify under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed this 3rd day of March, 2016.

By: _____

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