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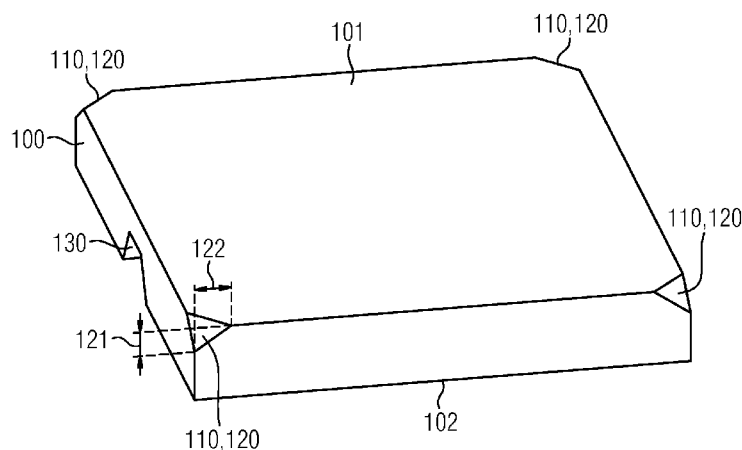
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(54) Title: A WINDOW FOR COVERING AN OPTOELECTRONIC SEMICONDUCTOR CHIP, A PANEL COMPRISING A PLURALITY OF WINDOWS, A METHOD FOR PRODUCING WINDOWS AND AN OPTOELECTRONIC SEMICONDUCTOR DEVICE

FIG 1



(57) Abstract: A window for covering an optoelectronic semiconductor chip comprises an upper face. The upper face comprises a polygonal shape. At least one of the corners of the upper face is chamfered.



Description

A window for covering an optoelectronic semiconductor chip, a panel comprising a plurality of windows, a method for producing windows and an optoelectronic semiconductor device

The present invention relates to a window for covering an optoelectronic semiconductor chip according to claim 1, an optoelectronic semiconductor device according to claim 6, a panel according to claim 7 and a method for producing a window according to claim 13.

Optoelectronic semiconductor devices comprising a glass window covering one or more optoelectronic semiconductor chips are known in the state of the art. Such windows are easily damageable.

It is an object of the present invention to provide a window for covering an optoelectronic semiconductor chip. This objective is achieved by a window according to claim 1. It is a further object of the present invention to provide an optoelectronic semiconductor device. This objective is achieved by an optoelectronic semiconductor device according to claim 6. It is a further object of the present invention to provide a panel designed for being divided into a plurality of windows. This objective is achieved by a panel according to claim 7. It is a further object of the present invention to provide a method for producing a window for covering an optoelectronic semiconductor chip. This objective is achieved by a method according to claim 13. Various embodiments are disclosed in the dependent claims.

A window for covering an optoelectronic semiconductor chip comprises an upper face, the upper face comprising a polygonal shape. At least one of the corners of the upper face is chamfered.

The chamfer at the corner of the upper face of this window advantageously reduces a risk of damage of this window. Sharp corners are particularly vulnerable to chipping. Chamfering the corner reduces this risk considerably. This reduces the risk of a degradation of optical properties of the window and a risk of potential problems during handling of the window. The reduced risk of damage of the window may result in an increased yield in the production of such windows and a production of optoelectronic semiconductor devices comprising these windows.

In an embodiment of the window the upper face comprises a rectangular shape. Advantageously, this allows the window for being used for producing an optoelectronic semiconductor device comprising a rectangular shape.

In an embodiment of the window all corners of the upper face are chamfered. Advantageously, this reduces a risk of damage at all corners of the upper face of the window.

In an embodiment of the window the window comprises a recess for receiving an optoelectronic semiconductor chip at a lower face of the window. Advantageously, this allows the window to partially or fully enclose an optoelectronic semiconductor chip, providing a protective cover for the optoelectronic semiconductor chip.

In an embodiment of the window the window comprises a glass. Advantageously, this allows the window to comprise a high optical transparency. Furthermore, this allows for a cost-efficient production of the window.

An optoelectronic semiconductor device comprises an optoelectronic semiconductor chip and a window of the aforementioned kind. The window covers the optoelectronic semiconductor chip.

Advantageously, the window of this optoelectronic semiconductor device provides protection for the optoelectronic semiconductor chip. The chamfer at the corner of the upper face of the window reduces a risk of the window getting damaged.

5

A panel designed for being divided along separation lines into a plurality of windows for covering optoelectronic semiconductor chips comprises an upper face. The upper face of the panel comprises a plurality of holes arranged on the separation lines.

10

Advantageously, the holes arranged on the separation lines at the upper face of this panel automatically create chamfers at corners of the upper faces of the windows when the panel is separated into the windows along the separation lines. The chamfers at the corners of the windows reduce the risk of the windows getting damaged.

15

In an embodiment of the panel each hole is arranged at an intersection of two separation lines. At the intersection of separation lines, corners of the windows are formed when the panel is divided into the windows along the separation lines. Advantageously, a hole arranged at an intersection of two separation lines may simultaneously create chamfers at several windows adjoining the intersection of the two separation lines when the panel is divided into the windows along the separation lines.

20

25

In an embodiment of the panel each hole comprises a pyramidal shape. Advantageously, a pyramidal shape of a hole may comprise a flat face oriented towards each window adjoining said hole, allowing for a creation of flat chamfers.

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In an embodiment of the panel each hole comprises a depth between 100 μm and 80% of a thickness of the panel. Advantageously, holes of this depth have proven to create chamfers which can remarkably reduce a risk of a damage of a window.

35

In an embodiment of the panel the holes are arranged in a rectangular grid pattern. Each hole comprises a rectangular opening at the upper face of the panel. The four corners of each opening of each hole are oriented towards the four nearest neighbouring holes of the respective hole. Advantageously this panel allows for creating rectangular windows with rectangular upper faces with chamfers at each corner of each upper face.

10 In an embodiment of the panel two opposing corners of the opening of each hole are spaced apart by 300 μm to 1000 μm . Advantageously, holes of such diameter can create chamfers which remarkably reduce a risk of the window getting damaged.

15 A method for producing a window for covering an optoelectronic semiconductor chip comprises steps for providing a panel, creating a plurality of holes at an upper face of the panel, and dividing the panel along separation lines to obtain a plurality of windows. The separation lines extend through the
20 holes.

This method allows for producing windows which comprise chamfers at their upper faces. These chamfers may reduce the risk of the windows getting damaged by chipping. The reduced risk
25 of the windows getting damaged may increase a yield of this method for producing windows.

In an embodiment of the method two separation lines intersect at the position of each hole. Advantageously, this results in
30 chamfers being created at corners of the upper faces of the windows.

In an embodiment of the method the holes are created by etching. Advantageously, this allows for a simple and cost-
35 efficient creation of the holes. A particular advantage of this method is that a plurality of holes can be created simultaneously.

In an embodiment of the method the panel is divided by sawing. Advantageously, this allows for an easy and cost-efficient division of the panel.

5 The accompanying drawings are included in order to provide a further understanding of the present invention and are incorporated into and constitute a part of the specification. The drawings illustrate embodiments of the present invention and together with the description serve to explain the principles
10 of the invention. Other embodiments of the present invention and many of the intended advantages of the present invention will be readily appreciated as they will be better understood by reference to the following detailed description. The elements of the drawings are not to scale with regard to each
15 other.

Fig. 1 shows a schematic perspective view of a window;

Fig. 2 shows a schematic transparent top view of the window;
20

Fig. 3 shows a sectional side view of an optoelectronic semiconductor device comprising the window;

Fig. 4 shows a schematic transparent top view of a panel;
25

Fig. 5 shows a schematic top view of a hole arranged at an upper face of the panel; and

Fig. 6 shows a schematic sectional side view of the panel.
30

Fig. 1 shows a schematic perspective view of a window 100. The window 100 is designed for covering an optoelectronic semiconductor chip of an optoelectronic device. Fig. 2 shows a schematic transparent top view of the window 100.
35

The window 100 comprises an optically transparent material. The window 100 may for example comprise a glass or a plastic material.

The window 100 comprises an upper face 101 and an opposed lower face 102. The upper face 101 and the lower face 102 each comprise a rectangular shape. In other embodiments, however, the upper face 101 and the lower face 102 may comprise a triangular or another polygonal shape.

The rectangular upper face 101 comprises four corners 110. Each of the four corners 110 comprises a chamfer 120, such that the tip of the respective corner 110 is removed. Each of the chamfers 120 is arranged at an angle with respect to the upper face 101 of the window 100.

In alternative embodiments of the window 100, chamfers 120 are arranged at only one, two or three corners 110 of the upper face 101.

The chamfers 120 protect the corners 110 of the window 100 against an accidental and uncontrolled chipping of the corners 110 which might damage the window 100.

Each chamfer 120 comprises a depth 121 measured from the upper face 101 in a direction perpendicular to the upper face 101. The depth 121 may for example be between 100 μm and 80% of a thickness of the windows 100.

Each chamfer 120 comprises a length 122 measured from the removed tip of the respective corner 110 of the window 100 along an edge of the upper face 101. The length 122 may for example be between 150 μm and 500 μm .

The window 100 comprises a recess 130 at the lower face 102. The recess 130 is provided for receiving an optoelectronic semiconductor chip of an optoelectronic device. In alternative embodiments of the window, the recess 130 may be omitted.

Fig. 3 shows a schematic sectional drawing of an optoelectronic semiconductor device 200. The optoelectronic semiconductor device 200 may be a light emitting device.

5 The optoelectronic semiconductor device 200 comprises a carrier 220 and an optoelectronic semiconductor chip 210 arranged on the carrier 220. The optoelectronic semiconductor chip 210 may be designed for emitting electromagnetic radiation, for example visible light. The optoelectronic semiconductor
10 ductor chip 210 may be a light emitting diode (LED) chip.

The optoelectronic semiconductor device 200 furthermore comprises the window 100 described above with reference to Figs. 1 and 2. The window 100 is arranged on the carrier 220 such
15 that the lower face 102 of the window 100 is oriented towards the carrier 220. The optoelectronic semiconductor chip 210 of the optoelectronic semiconductor device 200 is arranged in the recess 130 of the window 100. Consequently, the window 100 covers the optoelectronic semiconductor chip 210 of the
20 optoelectronic semiconductor device 200. An air gap may be arranged between the optoelectronic semiconductor chip 210 and the window 100.

Fig. 4 shows a schematic transparent top view of a part of a
25 panel 300. The panel 300 is a semifinished product for the production of a plurality of windows 100. The panel 300 is designed for being divided into a plurality of windows 100 along separation lines 310. The panel 300 can for example be divided along the separation lines 310 by sawing.

30

The panel 300 comprises an optically transparent material, for example a glass or a plastic material.

The panel 300 comprises an upper face 301 and an opposed lower face 302. The upper faces 101 of the windows 100 formed
35 out of the panel 300 are formed out of the upper face 301 of the panel 300. The lower faces 102 of the windows 100 formed

out of the panel 300 are formed out of the lower face 302 of the panel 300.

In the panel 300 the rectangular windows 100 are arranged in a rectangular grid pattern and are integrally connected. In the case that the upper faces 101 of the windows 100 are not rectangular, the windows 100 may be arranged in another regular pattern in the panel 300.

The separation lines 310, along which the panel 300 will be divided into the individual windows 100, are straight lines. The separation lines 310 intersect at intersections 315. In the embodiment depicted in Fig. 4, the separation lines 310 intersect at right angles at the intersections 315.

When the panel 300 is divided into the windows 100 along the separation lines 310, the corners 110 of the windows 100 are formed at the intersections 315 of the separation lines 310.

The upper face 301 of the panel 300 comprises a plurality of holes 320 arranged on the separation lines 310. Each hole 320 is arranged at an intersection 315 of two separation lines 310. Consequently, the holes 320 are arranged in a rectangular grid pattern in the embodiment depicted in Fig. 4.

Fig. 5 shows a schematic magnified top view of one hole 320 arranged at the upper face 301 of the panel 300. Fig. 6 shows a schematic sectional drawing of one of the holes 320 arranged at the upper face 301 of the panel 300.

Each hole 320 comprises an opening 330 at the upper face 301 of the panel 300. Each hole 320 extends into the panel 300 by a depth 321, measured in a direction perpendicular to the upper face 301 of the panel 300. The depth 321 may for example be between 100 μm and 80% of a thickness of the panel 300.

The openings 330 of the holes 320 comprise a rectangular shape with four corners 340. The corners 340 and the edges of

the openings 330 of the holes 320 may be rounded due to manufacturing tolerances.

The four corners 340 of each opening 330 of each hole 320 are oriented towards the four nearest neighboring holes 320 of the respective hole 320. This means that the corners 340 of the openings 330 of the holes 320 are arranged on the separation lines 310.

Each two opposing corners 340 of the opening 330 of each hole 320 are spaced apart by a distance 341 which may for example be between 300 μm and 1000 μm .

In other embodiments the openings 330 of the holes 320 may comprise other shapes than rectangular shapes. In the case that the upper faces 101 of the windows 100 comprise a triangular shape, the openings 330 of the holes 320 may for example also comprise triangular shapes.

The holes 320 arranged at the upper face 301 of the panel 300 comprise pyramidal shapes. Each hole 320 narrows from its opening 330 at the upper face 301 of the panel 300 towards a single point arranged at the bottom of the respective hole 320 inside the panel 300. The pyramidal shapes of the holes 320 may be rounded due to manufacturing tolerances.

In order to produce a window 100 as depicted in Fig. 1, first the panel 300 is provided without the holes 320 at the upper face 301.

In a consecutive step, the holes 320 are created at the upper face 301 of the panel 300. The holes 320 may for example be created by etching.

Afterwards, the panel 300 is divided along the separation lines 310 to obtain a plurality of windows 100. The panel 300 may for example be divided by sawing.

The separation lines 310, along which the panel 300 is divided, extend through the holes 320. Since each hole 320 is arranged at an intersection 315 of two separation lines 310, each hole 320 is divided into four parts upon dividing the panel 300. Each of the faces of each hole 320 forms one chamfer 120 at one corner 110 of one of the windows 100 adjoining the intersection 315 at which the respective hole 320 is arranged.

While the invention has been described in detail with reference to specific embodiments thereof, it will be apparent to one of ordinary skill in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof. Accordingly, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Reference numbers

	100	window
	101	upper face
5	102	lower face
	110	corner
	120	chamfer
	121	depth
	122	length
10	130	recess
	200	optoelectronic semiconductor device
	210	optoelectronic semiconductor chip
	220	carrier
15		
	300	panel
	301	upper face
	302	lower face
	310	separation line
20	315	intersection
	320	hole
	321	depth
	330	opening
	340	corner
25	341	distance

Claims

1. A window (100)
for covering an optoelectronic semiconductor chip (210),
5 the window (100) comprising an upper face (101),
the upper face (101) comprising a polygonal shape,
wherein at least one of the corners (110) of the upper
face (101) is chamfered.
- 10 2. The window (100) of claim 1,
wherein the upper face (101) comprises a rectangular
shape.
3. The window (100) of any one of the previous claims,
15 wherein all corners (110) of the upper face (101) are
chamfered.
4. The window (100) of any one of the previous claims,
wherein the window (100) comprises a recess (130) for re-
20 ceiving an optoelectronic semiconductor chip (210) at a
lower face (102).
5. The window (100) of any one of the previous claims,
wherein the window (100) comprises a glass.
25
6. An optoelectronic semiconductor device (200)
comprising an optoelectronic semiconductor chip (210) and
a window (100) according to any one of the previous
claims,
30 wherein the window covers (100) the optoelectronic semi-
conductor chip (210).
7. A panel (300)
designed for being divided along separation lines (310)
35 into a plurality of windows (100) for covering optoelec-
tronic semiconductor chips (210),
wherein an upper face (301) of the panel (300) comprises

a plurality of holes (320) arranged on the separation lines (310).

8. The panel (300) of claim 7,

5 wherein each hole (320) is arranged at an intersection (315) of two separation lines (310).

9. The panel (300) of any one of claims 7 and 8,

wherein each hole (320) comprises a pyramidal shape.

10

10. The panel (300) of any one of claims 7 to 9,

wherein each hole (320) comprises a depth (321) between 100 μm and 80% of a thickness of the panel (300).

15 11. The panel (300) of any one of claims 7 to 10,

wherein the holes (320) are arranged in a rectangular grid pattern,

wherein each hole (320) comprises a rectangular opening (330) at the upper face (301) of the panel (300),

20

wherein the four corners (340) of each opening (330) of each hole (320) are oriented towards the four nearest neighbouring holes (320) of the respective hole (320).

12. The panel (300) of claim 11,

25

wherein two opposing corners (340) of the opening (330) of each hole (320) are spaced apart by 300 μm to 1000 μm .

13. A method for producing a window (100) for covering an optoelectronic semiconductor chip (210),

30

the method comprising the following steps:

- providing a panel (300);

- creating a plurality of holes (320) at an upper face (301) of the panel (300);

- dividing the panel (300) along separation lines (310)

35

to obtain a plurality of windows (100),

wherein the separation lines (310) extend through the holes (320).

14.The method of claim 13,
wherein at the position of each hole (320) two separation
lines (310) intersect.

5 15.The method of any one of claims 13 and 14,
wherein the holes (320) are created by etching.

16.The method of any one of claims 13 to 15,
wherein the panel (300) is divided by sawing.

FIG 1

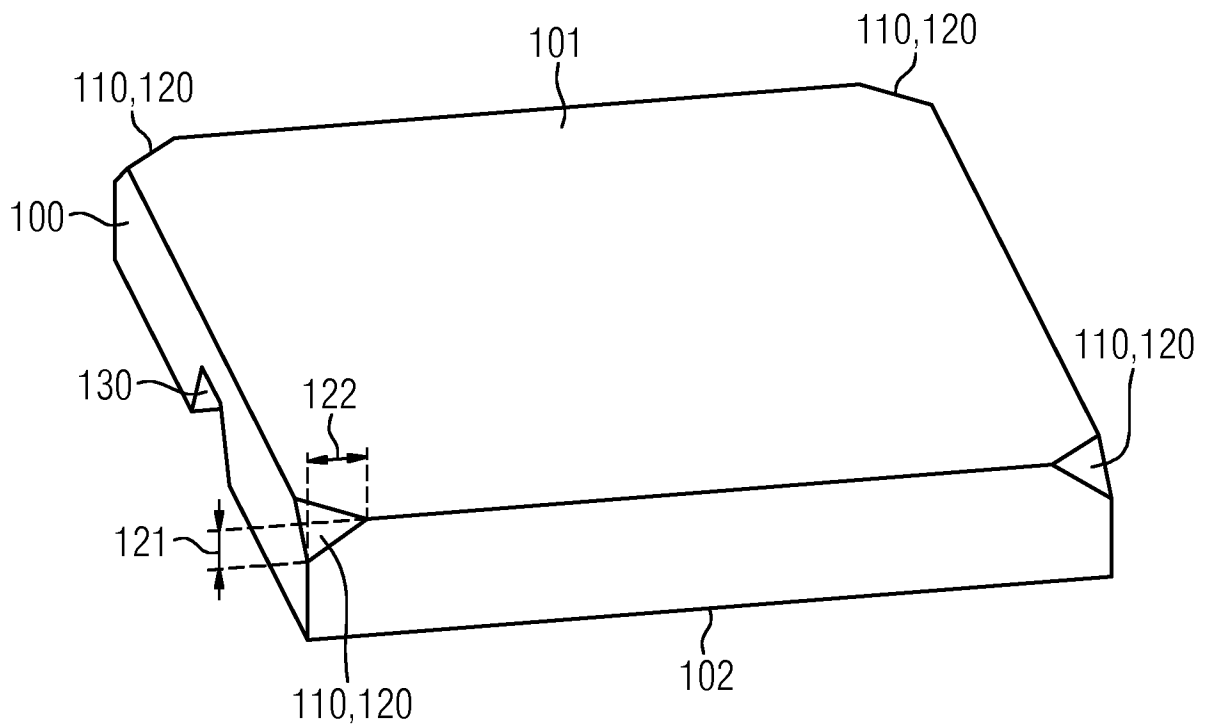


FIG 2

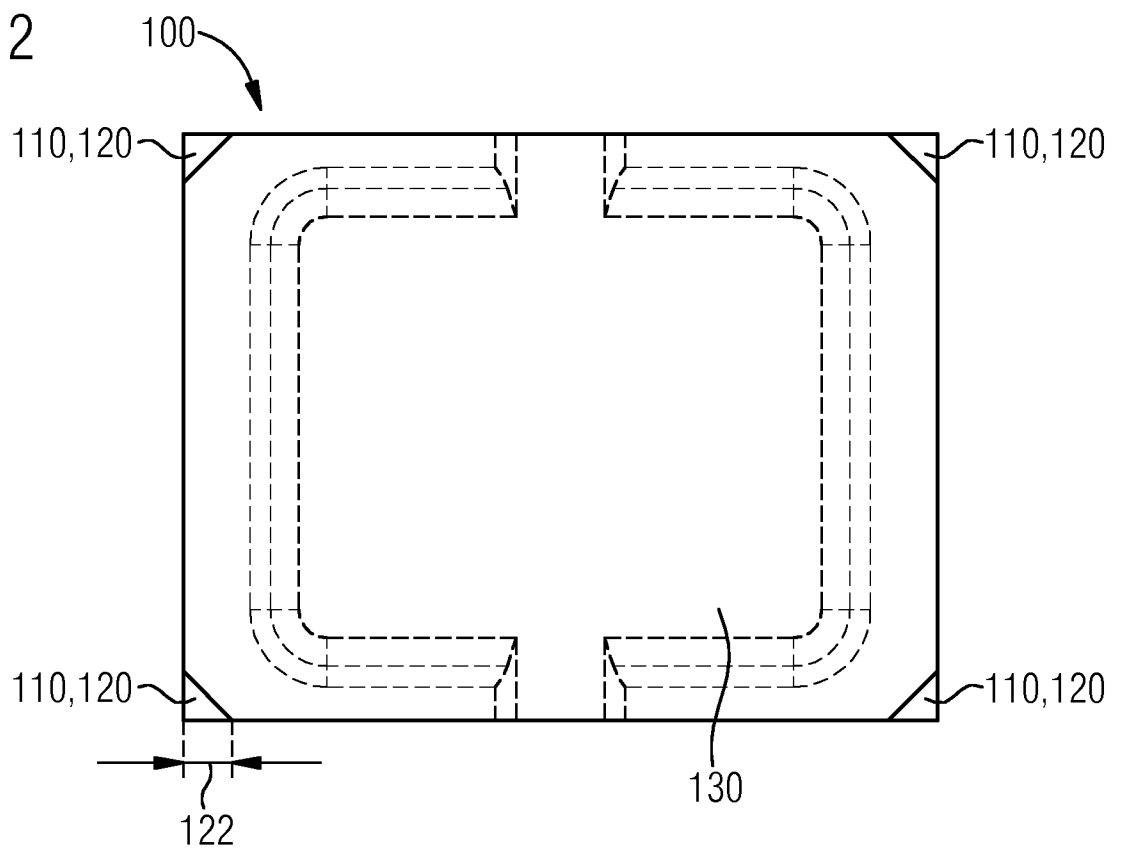


FIG 3

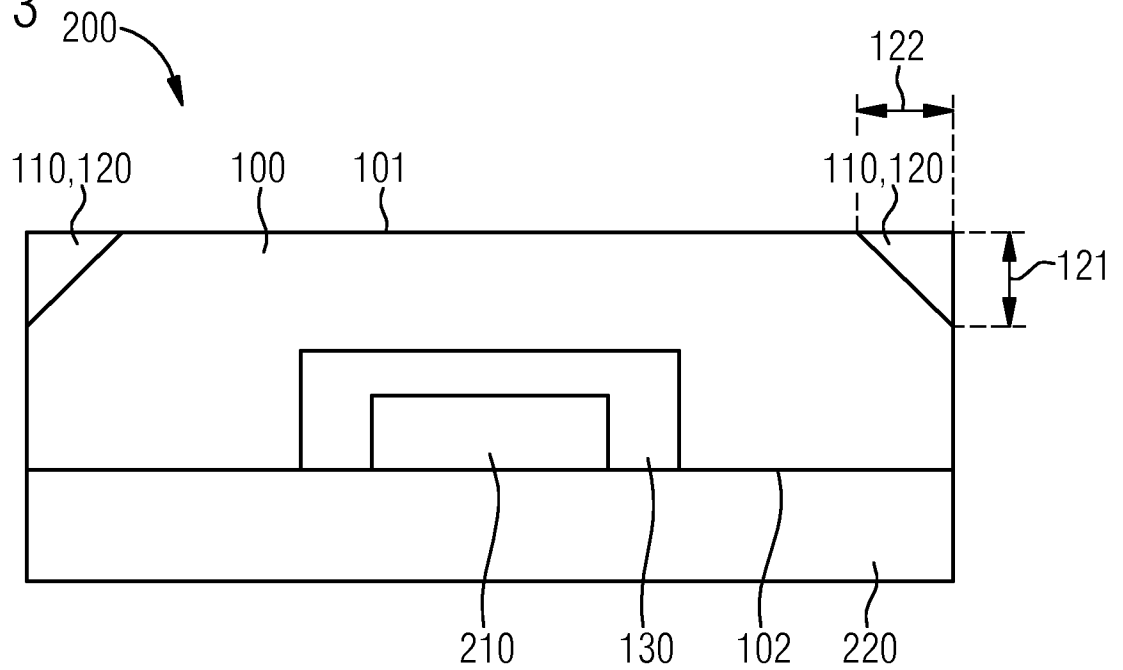
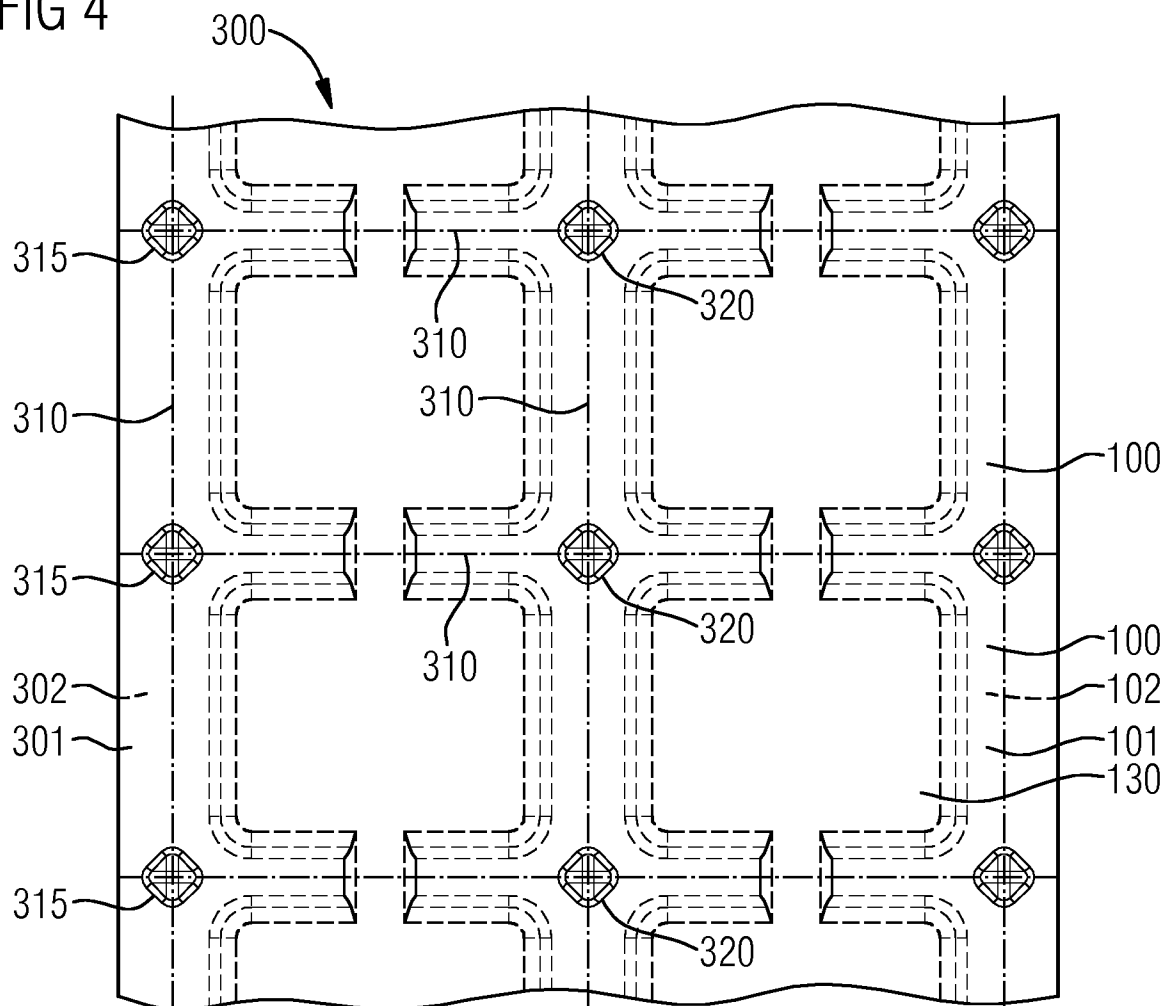


FIG 4



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/055833

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01L33/58
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 2008/150087 A1 (FAROOQ MUKTA G [US] ET AL) 26 June 2008 (2008-06-26) the whole document -----	7,13
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Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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