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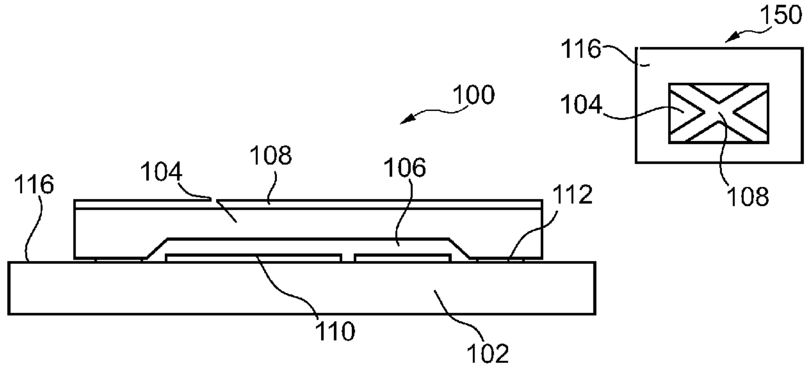

Fig. 1

(57) Abstract: An integrated component (100) comprising a substrate (102), a cap (104) formed on the substrate (102) to enclose a cavity (106) with a surface of the substrate (102), and a reinforcement structure (108) for reinforcing the cap (104) and extending from a central portion of the cap (104) along the cap (104).

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AN INTEGRATED COMPONENT AND A METHOD OF MANUFACTURING AN INTEGRATED COMPONENT

FIELD OF THE INVENTION

The invention relates to an integrated component.

Moreover, the invention relates to a method of manufacturing an integrated component.

BACKGROUND OF THE INVENTION

Microelectromechanical systems (MEMS) may be denoted as devices manufactured by a technology of a very small dimension, and merges at the nano-scale into nanoelectromechanical systems (NEMS). MEMS are also referred to as micro machines. MEMS may particularly be made up of components between 1 to 100 micrometers in size. A MEMS device may comprise a central unit that processes data such as a microprocessor and several components that interact with the outside such as micro sensors.

Capping of MEMS maybe performed for the purpose of protecting components thereof, for instance mechanically movable components.

US 2002/0001874 discloses an apparatus for enclosing logic chips which includes a substrate upon which a logic chip is mounted and a mold cap disposed upon the substrate and covering the logic chip. The mold cap includes at least one extension of sufficient size and shape to provide structural support to a section of the substrate.

JP 2007184815 discloses a MEMS resonator with a high Q value for reducing an energy loss in spite of a provision of MEMS structures located on one and the same board and whose natural frequencies differ from each other. In a MEMS resonator, positions being nodes of vibration of both-end free beams are cross-connected in linkage by connection parts and the MEMS structure wherein positions being nodes of vibration of both-end free beams are cross-connected in linkage by connection parts. The MEMS structures are multiply and annularly formed on the same plane of a board, the connection parts and the connection parts of the MEMS structures are connected by support beams, and the connection parts and a base part of the board are connected by support beams, the MEMS structures respectively have the different natural frequencies (resonance frequencies), and either of the MEMS structures is selectively driven.

US 4,132,570 discloses a support for a solar cell array which includes means for positioning the solar cells and limiting the relative movement of the cells. Integral rib stiffeners are provided as well as at least one integral junction box. The support further includes a perimeter skirt which may be used for connecting modules having the support to each other or to a mounting standard.

However, the mechanical robustness of integrated devices may still be not strong enough.

OBJECT AND SUMMARY OF THE INVENTION

It is an object of the invention to provide an integrated component which has a sufficient mechanical robustness.

In order to achieve the object defined above, an integrated component and a method of manufacturing an integrated component according to the independent claims are provided.

According to an exemplary embodiment of the invention, an integrated component (for instance a monolithically integrated component) is provided which comprises a substrate (which may have a main surface), a cap formed on the substrate (for instance on the main surface) and a cavity that is enclosed by the cap and a surface of the substrate (for instance with a portion of the main surface) of the substrate, and a reinforcement structure extending from a central portion of the cap along the cap (for instance having one or more arms extending towards a portion of a perimeter of the cap).

According to another exemplary embodiment of the invention, a method of manufacturing an integrated component is provided, wherein the method comprises forming a cap on a substrate to enclose a cavity with a surface of the substrate and forming a reinforcement structure for reinforcing the cap and extending from a central portion of the cap along the cap.

The term "central portion of the cap" may particularly denote that the reinforcement structure is not exclusively located along a boundary of a cap, but at least partially spaced with a sufficient distance from this boundary to thereby support specifically a portion of the cap arranged remotely from the boundary. Such a central portion may be specifically prone to mechanical damage, for instance during an encapsulation procedure for encapsulating the cap for instance with an epoxy resin. In a plan view onto the substrate and the cap, at least a part of the reinforcement structure may be arranged in a center of gravity of the cap. In a circular shape of the cap, the central portion may include (or may be at least close to) the center of the circle.

The term "component" may particularly denote any structure, member or apparatus which fulfils any mechanic, electric, magnetic and/or electronic functionality. This means that electric, magnetic and/or electromagnetic signals may be applied to and/or generated by the integrated component during regular use or a mechanic behaviour of the component may contribute to its function.

The term "integrated" may particularly denote that at least a part, particularly the entire, component may be formed into one whole. The term "integrated" may particularly denote that the component is monolithically integrated, that is to say is constituted on and/or in a common substrate, for example using a microtechnology such as semiconductor technology.

The term "cap" may particularly denote a cover element which can be placed onto a for instance planar (or curved) surface portion of the substrate and which accommodates a void or hollow space together with the surface portion of the substrate covered by the cap. This hollow space may be delimited partially by a for instance curved inner surface portion of the cap.

The term "substrate" may be used to define generally the elements for layers that underlie and/or overlie a layer or portions of interest. Also, the substrate may be any other base on which a layer is formed, for example a semiconductor wafer such as a silicon wafer or silicon chip. Substrates from other materials such as plastic, glass, ceramics, etc. are possible as well.

The term "diagonal" may particularly denote a line joining two non-consecutive vertices or corners of a structure of a polygonal shape (for instance in a plan view) or a polyhedron shape. A polygon may be denoted as a geometrical structure that is bounded by a closed path composed of a finite sequence of straight line segments. These segments may be called its edges or sides, and the points where two edges meet may be denoted as the polygon's vertices or corners. Examples for polygons are a rectangle (particularly a square), a pentagon, a hexagon, etc.

The term "MEMS" may particularly denote a microelectromechanical structure. For instance, an electrical signal modified may result in a specific motion of a movable component of the microelectromechanical structure (MEMS), or vice versa.

According to an exemplary embodiment of the invention, a specifically robust protection against mechanical damage is provided for a member having a cavity which is shielded against external influence by a cap. In this context, the present inventors have surprisingly recognized that the provision of a reinforcement structure which is arranged close to a geometric or mass center of the cap (for instance aligned along a diagonal or basically along a diagonal of a polygonal shape of a cap in a plan view) makes the cap robust against mechanical damage for instance during a moulding procedure in which an encapsulation is formed to cover the cap. During such a moulding procedure, high mechanical stress may act on the cap. A reinforcement structure having one or more pillars or arms extending from a central portion of the cap for instance towards vertices of a polygon can be manufactured easily with low effort and do not significantly influence an interior of the cavity (which can accommodate immovable element or the like).

According to an exemplary embodiment, a system may be provided to enhance the reliability and robustness of capped MEMS devices. Such a system may comprise a MEMS device comprising a cap, and a support structure provided and arranged to support the cap, wherein the support structure may be oriented along a diagonal or a diameter of the cap. For instance, the support structure may have a cross-like shaped base. A cap with a central support may be manufactured with reasonable effort, for instance by using an anisotropic etching technique, for example by performing a heated potassium hydroxide (KOH) etch. Advantageously, such architecture may enhance reliability and robustness of the integrated component, which may for instance be configured as a capped MEMS device.

During a moulding procedure, a MEMS cap may be exposed to high pressures. Hence, an exemplary embodiment provides a supporting structure for the cap. An embodiment of the invention provides a central pillar of a cross-shaped design, whose arms extend along the diagonals of the cap for improved supporting strength. Such a structure may be etched using KOH, which also makes possible the manufacture of an upside down pyramid-like structure for even better strength. A centrally positioned pillar with supporting arms may extend along one or more diagonals of a hexagon, along one or more diameters of a circle or along one or more axes (such as a major axis and/or a minor axis) of an ellipse. Embodiments may allow to save space by fabricating a centrally positioned pillar in the shape of an upside down pyramid. In an embodiment, a simple, diagonally aligned, cross-shaped pillar may be provided to increase the supporting strength by using for instance diagonals or diameters.

Next, further exemplary embodiments of the integrated component will be explained. However, these embodiments also apply to the method of manufacturing an integrated component.

The cap may be formed with a polygonal shape in a plan view (for instance onto the main surface) on the substrate. The reinforcement structure may extend partially or entirely along a diagonal of the polygonal shape of the cap. With such an embodiment with a diagonally extending reinforcement beam to strengthen a polygonally shaped cap, a particularly robust configuration may be obtained to protect a polygonal cap which is particularly susceptible to mechanical damage during the application of stress in a direction corresponding to the diagonals. Upon moulding an encapsulation onto such a cap, pressure values of 80 bar and more may be exerted on diagonals of for instance a rectangle.

In another embodiment, the cap may be formed with a circular or an elliptic or an oval shape in a plan view. In case of a circular shape, a reinforcement structure may extend partially or entirely along a diameter of the circle and may particularly traverse the center of the circle. In an elliptic configuration, the mechanical stress may have a maximum value along the line segment that passes through the foci and terminates on the ellipse, which is also called the major axis. The major axis is the longest segment that can be obtained by joining two points on the ellipse. In an embodiment, the reinforcement structure may extend along the major axis and may include a center of gravity of the ellipse.

The reinforcement structure may be integrally formed with the cap. Such an embodiment, in which the reinforcement structure and the cap are made of the same material, may be formed on the basis of a single body, which may be manufactured with low effort and provides for a very stable mechanical configuration.

Alternatively, the reinforcement structure and the cap may be configured as two separate structures that may be connected to one another. In such an embodiment, the cap can be optimized specifically for cap purposes, and the reinforcement structure can be optimized specifically regarding the reinforcement properties such as mechanical robustness. Furthermore, the manufacture procedures for manufacturing the reinforcement structure and the cap may be separated.

The reinforcement structure may be arranged at a surface of the cap within the cavity. In such an embodiment, an external surrounding of the cap remains completely uninfluenced from the mechanical strengthening and no topography at an outer surface of the cap occurs which might result from the reinforcement structure.

The reinforcement structure may alternatively be arranged at a surface of the cap outside of the cavity, that is opposing the cavity relative to the orientation of the cap. In such an embodiment, the arrangement of the reinforcement structure outside of the cap allows for an easy manufacture (using a simple deposition and/or etching procedure) and at the same time maintains the sealed cavity completely uninfluenced so that no mechanical obstacles for a movable element within the cavity are present.

The reinforcement structure may be cross-shaped (compare Fig. 3, for instance). The inventors have surprisingly recognized that such a centrally arranged crossover structure which has arms extending or pointing or directing towards or even up to corners of a polygon provides for a specifically stable arrangement. Such a cross geometry may be easily manufactured with etching procedures and provides for a robust protection against mechanical damage.

A preferred embodiment relates to an upside-down pyramid shape of the reinforcement structure. In other words, an envelope of the reinforcement structure may have a pyramid geometry. However, etching or other appropriate conditioning may remove portions of this pyramid to provide a strut or web-like configuration with arms extending towards corners of the polygonal cap. Such an upside-down pyramid shape of the reinforcement structure may have the shape of a cross when being looked at from above.

A functional element may be arranged within the cavity. Such a functional element may provide any desired electric and/or mechanic function within the cap for protecting the functional element.

A movable element may be arranged within the cavity. Such a movable element may be, for instance, an electromechanic switch having a cantilever beam with a conductive pad at the cantilever and a further a conductive pad on a surface opposing the conductive pad on the cantilever. Upon applying an attracting electric voltage between the two conductive pads, the beam may be forced to bend towards the surface which may allow to selectively close an electric connection between two electrodes located on the cantilever and on the opposing surface so that an electromechanic switch function can be provided. However, other movable elements such as movable sensor probes, micro engines, mills, mixing arrangements, etc. are possible as well.

The integrated component may further comprise a sealing element arranged between the substrate and the cap to thereby form a hermetically sealed cavity. Such a cavity may be gas-tight, for instance air-tight, or liquid-tight, for instance waterproof. Thus, such an arrangement may also be used for systems using fluids such as gases and/or liquids within the cavity or requiring the reliable absence of such fluids within the cavity. Hence, in an embodiment, the cavity may be evacuated. The sealing element may for instance be a sealing ring or annulus arranged along a perimeter of the cap to seal the boundary area between cap and substrate. Such a sealing may also be achieved by a sealing adhesive applied between substrate and cap.

The integrated component may comprise an encapsulation structure covering the cap. Such an encapsulation structure may be formed by moulding to encapsulate the surrounding of the cap. Due to the presence of the reinforcement structure pointing towards corners of a polygonal cap or more generally towards a boundary of the cap adjacent the substrate, the formation of the encapsulating structure by moulding or the like which may introduce high pressure and thus mechanical stress will not negatively influence an interior of the cap and will keep the functionality of the integrated component uninfluenced.

The substrate may be a semiconductor substrate. Hence, the integrated component may be monolithically integrated in semiconductor technology. For example, such a semiconductor substrate may be a silicon substrate (such as an SOI substrate or a pure crystalline silicon substrate), a germanium substrate, a group Ill-group V semiconductor substrate or a gallium-arsenide substrate.

For example, the integrated component may be an actuator, a microelectromechanical structure, a microstructure, a nanostructure, a controller or a switch (such as an RF switch). The integrated component is particularly suitable for all applications in which movable elements are involved, since the provision of the cavity and the protection against breakage of the cavity ensure the proper operation and motion of the movable elements within the cavity.

In an embodiment in which the integrated component is adapted as a microelectromechanical structure (MEMS), examples for such a MEMS are accelerometers in modern cars for a large number of purposes including airbag deployment in collisions, and accelerometers in consumer electronics devices such as game controllers, personal media players, cell phones or digital cameras. An other field of applications are MEMS gyroscopes used in modern cars and other applications to detect yaw (for instance to deploy a roll over bar or trigger dynamic stability control). Still another field of application are pressure sensors (for instance car tire pressure sensors, and disposable blood pressure sensors). Such MEMS may also be employed in displays having on its surface a large number of micro mirrors. Other embodiments employ the integrated component in optical switching technology which is used for switching technology and alignment for data communications. Other applications relate to biological applications in medical and health related technologies, for instance Lab-On-Chip, biosensors, chemosensors. Moreover, MEMS may be used in interferometric modulator displays in consumer electronics (for instance displays for mobile devices) to create interferometric modulation. Another example for a MEMS is an RF (radio frequency) switch, for instance based on a movable membrane or a movable cantilever beam. For all these applications, a cap reinforcement may allow to improve the robustness.

Next, further exemplary embodiments of the method will be explained. However, these embodiments also apply to the integrated component.

The reinforcement structure may be formed by anisotropic etching. The term "anisotropic etching" may particularly denote etching which involves different etch rates in different directions in a material. Anisotropic etching may be promoted by a corresponding selection of the etched material (for instance different etching rates along different crystalline axes) and/or by the chosen etching procedure. For example, a layer may be applied on the cap and this layer may be patterned by an anisotropic etching procedure to form the aligned reinforcement structure. This may allow defining the exact geometry of the formed structure. In an alternative embodiment, in which the cap and the reinforcement structure are integrally formed, the cap may be provided with a larger thickness and may be etched to form a reinforced structure in a surface thereof.

It has turned out to be particularly advantageous that the reinforcement structure is formed by anisotropic etching using heated potassium hydroxide as an etchant (KOH etch). With this procedure, it is has turned out to be possible to manufacture even upside-down shaped pyramidal pillar like reinforcement structures.

For any method step, any conventional procedure as known from semiconductor technology may be implemented. Forming layers or components may include deposition techniques like CVD (chemical vapour deposition), PECVD (plasma enhanced chemical vapour deposition), ALD (atomic layer deposition), or sputtering. Removing layers or components may include etching techniques like wet etching, vapour etching, etc., as well as patterning techniques like optical lithography, UV lithography, electron beam lithography, etc.

Embodiments of the invention are not bound to specific materials, so that many different materials may be used. For conductive structures, it may be possible to use metallization structures, suicide structures or polysilicon structures. For semiconductor regions or components, crystalline silicon may be used. For insulating portions, silicon oxide or silicon nitride may be used.

The structure may be formed on a purely crystalline silicon wafer or on an SOI wafer (Silicon On Insulator).

Any process technologies like CMOS, BIPOLAR, BICMOS may be implemented.

The aspects defined above and further aspects of the invention are apparent from the examples of embodiment to be described hereinafter and are explained with reference to these examples of embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in more detail hereinafter with reference to examples of embodiment but to which the invention is not limited.

Fig. 1 and Fig. 2 show integrated components according to exemplary embodiments of the invention.

Fig. 3 to Fig. 7 show plan views of caps provided with reinforcement structures according to exemplary embodiments of the invention towards a main surface of a substrate.

DESCRIPTION OF EMBODIMENTS

The illustration in the drawing is schematical. In different drawings, similar or identical elements are provided with the same reference signs.

In the following, some basic recognitions of the present inventors will be mentioned based on which exemplary embodiments of systems for enhancing the reliability and robustness of capped MEMS devices have been developed.

Exemplary embodiments relate to Micro-Electro-Mechanical Systems (MEMS) or any other electronic and/or mechanic devices comprising a hermetic cavity in it. One gist of this invention is to enhance the reliability and robustness of capped MEMS devices by using a centrally located support extending or directing towards a cap boundary, for instance a crossover shaped support in a cavity.

A MEMS device may comprise a MEMS die, a cap and a seal. For MEMS devices, hermetic cavities may be advantageous to allow the movement of moving parts within a cavity. In order to protect the devices from mechanical and environmental damage, the capped MEMS devices may be encapsulated or packaged with epoxy moulding compound, or sometimes the MEMS devices are needed to be packaged with other components or devices to form a System-in-Package (SiP). However, packaging of the capped MEMS device presents thermomechanical reliability challenges, because MEMS devices with cavities are vulnerable to the packaging loads subjected to it, especially the moulding pressure during the transfer moulding process. Under the moulding pressure, the inside surface of the cap undergoes high tensile stress. Such moulding pressure may cause reliability issues including the cracking of the cap and the MEMS die, and excessive deflection of the cap as well, which may have adversely impact on the electric performance of the MEMS.

In order to decrease the stress level and deflection in the cap, the use of local supports for the cap (for instance at a center thereof) may be advantageous. The design of such a support should consider that under the moulding pressure, the distribution pattern of the stress and deformation at the cap is such that the area with the highest stress level and highest deflection is always along a diagonal direction or along a diameter of the cap.

Embodiments of the invention provide a method to enhance the reliability and the robustness of the MEMS devices by using a specific support structure. Advantageously, a cross-like shape of the support may be used, which may be oriented along the diagonal of the cap. In this way, the structure can reduce the tensile stress and deflection of the cap significantly.

The cap with such a central support can be manufactured by using an anisotropic etching technique, for example heated potassium hydroxide (KOH) etch. An advantage of an anisotropic etching is that it is possible to create an upside down pyramid-like structure for the support that can be particularly appropriate, from mechanical point of view, for the robustness of the MEMS device.

Fig. 1 illustrates a capped MEMS device 100 according to an exemplary embodiment of the invention, including a cap 104 and a seal 112.

Fig. 1 shows the MEMS component 100 in a cross-sectional view, that is in a direction perpendicular to a main surface 116 of a silicon substrate 102 on which the individual components of the MEMS device 100 are located.

Fig. 1 shows the silicon substrate 102 and the cap 104 which is formed or bonded on the silicon substrate 102 with a rectangular shape in a plan view 150 (that is in a view onto the main surface 116 of the substrate 102. A cavity or hollow volume 106 is formed respectively enclosed by the cap 104 and a surface of the substrate 102; that is to say the cavity in this case is delimited by a portion of the main surface 116 of the silicon substrate 102 and an inner surface of the cap 104. A reinforcement structure 108 is provided on the cap 104 and externally of the cavity 106 such that a mechanical reinforcement the cap 104 is achieved.

As can be taken from the plan view 150, the reinforcement structure 108 for reinforcing the cap 104 extends with a cross shape from a central portion of the cap 104 along the two diagonals of the rectangular cap 104.

In the embodiment of Fig. 1 the reinforcement structure 108 is deposited on an exterior surface of the cap 104. It is arranged at an external surface of the cap 104, that is to say outside of the cavity 106. As can be taken from the plan view 150, the reinforcement structure 108 is cross-shaped and has legs extending from a center of gravity of the plan view of the cap 104 up to the corners of the rectangular cap 104.

Within the cavity 106, a MEM circuit 110 including a moving part is accommodated to freely move within the hollow space 106 of the cap 104. Moreover, a sealing ring 112 is arranged to hermetically seal the cavity 106 with regard to a surrounding medium.

In the following, referring to Fig. 2, a capped MEMS device 200 with a cavity internal reinforcement structure 108 according to another exemplary embodiment of the invention will be explained.

As can be taken from Fig. 2, a MEMS die 102 or substrate is fastened using a die attach 204 on an additional substrate 206. The reinforcement structure 108 which may be realized with a cross-shape as in Fig. 1 is now arranged within the cavity 106. Moreover, an epoxy moulding compound 202 is provided as an encapsulation structure covering an external surface of the cap 104. Due to the provision of the reinforcement structure 108, the cap 104 is mechanically protected during deposition of the epoxy moulding component 202 which may involve the application of significant mechanical stress.

Fig. 3 shows a plan view 300 of a cross-shaped support 108 according to another exemplary embodiment of the invention having legs extending towards but not up to corners of the rectangular cap 104.

Fig. 4 shows another embodiment of the invention in which the reinforcement structure 108 is a single diagonal beam extending from one corner of the rectangular cap 104 to another opposing corner of the rectangular cap 104.

Fig. 5 shows a further embodiment of a reinforcement structure 108, which comprises four legs pointing towards but not up to corners of the rectangular cap 104 and additionally comprising four beams extending towards median lines of the rectangle 104.

Fig. 6 shows a plan view 600 of a hexagonal cap 104 with a star-shaped reinforcement structure 108 having legs extending towards all six corners of the hexagon 104. Thus, the reinforcement structure 108 is configured as a central pillar or post having six legs forming the star-like structure 108.

Fig. 7 shows a plan view 700 of an elliptic cap 104 with a beam and pillar shaped reinforcement structure 108. The reinforcement structure 108 comprises a central pillar portion 702 and a beam portion 704, the latter extending along a major axis 706 of the ellipse 104.

Finally, it should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be capable of designing many alternative embodiments without departing from the scope of the invention as defined by the appended claims. In the claims, any reference signs placed in parentheses shall not be construed as limiting the claims. The word "comprising" and "comprises", and the like, does not exclude the presence of elements or steps other than those listed in any claim or the specification as a whole. The singular reference of an element does not exclude the plural reference of such elements and vice-versa. In a device claim enumerating several means, several of these means may be embodied by one and the same item of software or hardware. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

CLAIMS:

1. An integrated component (100), the integrated component (100) comprising
a substrate (102);
a cap (104) arranged on the substrate (102);
a cavity (106) that is enclosed by the cap (104) and a surface of the substrate (102);
a reinforcement structure (108) extending from a central portion of the cap (104) along the cap (104).

2. The integrated component (100) according to claim 1,
wherein the cap (104) is formed with a polygonal shape in a plan view on the substrate (102) and the reinforcement structure (108) extends along one or more diagonals of the polygonal shape of the cap (104).

3. The integrated component (700) according to claim 1,
wherein the cap (104) is formed with a circular or elliptic shape in a plan view on the substrate (102), and the reinforcement structure (108) extends along a diameter of the circular shape of the cap (104) or extends at least along a major axis (706) of the elliptic shape of the cap (104).

4. The integrated component (100) according to claim 1,
wherein the reinforcement structure (108) is integrally formed with the cap (104).

5. The integrated component (100) according to claim 1,
wherein the reinforcement structure (108) and the cap (104) are configured as separate structures.

6. The integrated component (100) according to claim 1,
wherein the reinforcement structure (108) is arranged at a surface of the cap

(104) within the cavity (106).

7. The integrated component (100) according to claim 1, wherein the reinforcement structure (108) is arranged at a surface of the cap (104) outside of the cavity (106).

8. The integrated component (100) according to claim 1, wherein the reinforcement structure (108) is arranged as a support or pillar between a surface of the cap (104) within the cavity (106) and the substrate (102).

9. The integrated component (100) according to claim 1, wherein the reinforcement structure (108) is cross-shaped.

10. The integrated component (100) according to claim 1, wherein the reinforcement structure (108) is shaped as an upside-down pyramid.

11. The integrated component (100) according to claim 1, comprising a functional element (110) arranged within the cavity (106), particularly a movable element (110) arranged within the cavity (106), more particularly a movable element (110) freely movable within a hollow space of the cavity (106).

12. The integrated component (100) according to claim 1, comprising a sealing element (112) arranged between the substrate (102) and the cap (104) to thereby form a hermetically sealed cavity (106).

13. The integrated component (200) according to claim 1, comprising an encapsulation structure (202) at least partially covering the cap (104).

14. The integrated component (100) according to claim 1, wherein the substrate (102) is a semiconductor substrate, particularly one of the group consisting of a group IV semiconductor substrate, a silicon substrate, a germanium

substrate, a group Ill-group V semiconductor substrate, and a GaAs substrate.

15. The integrated component (100) according to claim 1, adapted as one of the group consisting of an actuator, a resonator, a microelectromechanical structure, a microstructure, a nanostructure, a controller, and a switch.

16. A method of manufacturing an integrated component (100), the method comprising

forming a cap (104) on a substrate (102) to enclose a cavity (106) with a surface of the substrate (102);

forming a reinforcement structure (108) for reinforcing the cap (104) and extending from a central portion of the cap (104) along the cap (104).

17. The method according to claim 16, comprising forming the reinforcement structure (108) by anisotropic etching.

18. The method according to claim 16, comprising forming the reinforcement structure (108) by anisotropic etching using heated potassium hydroxide as an etchant.

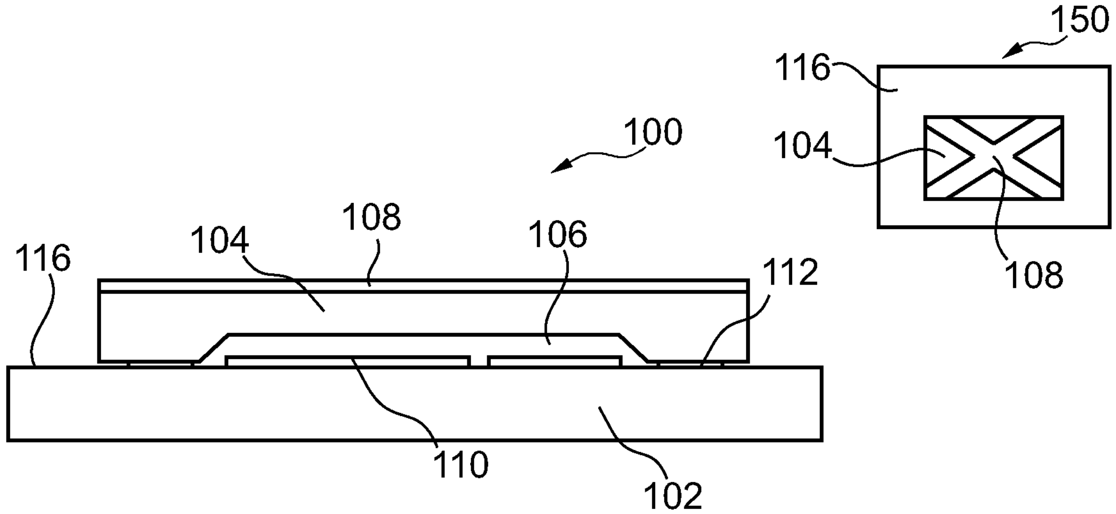

Fig. 1

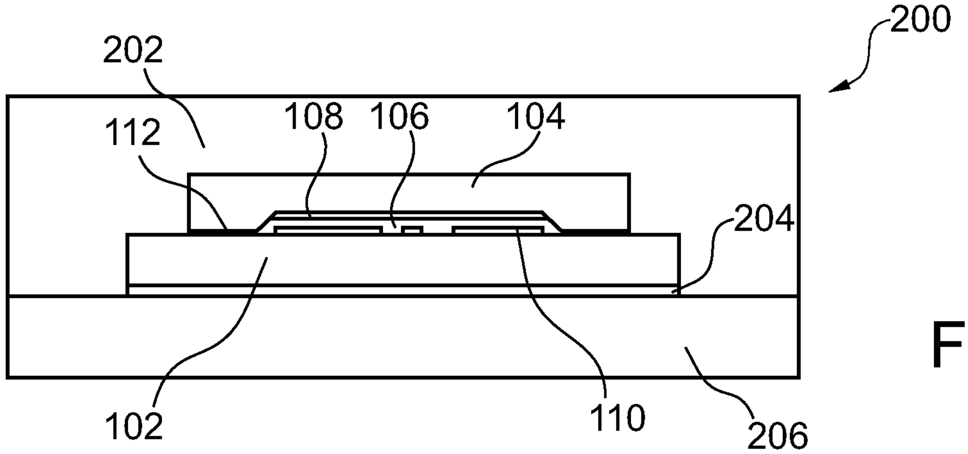

Fig. 2

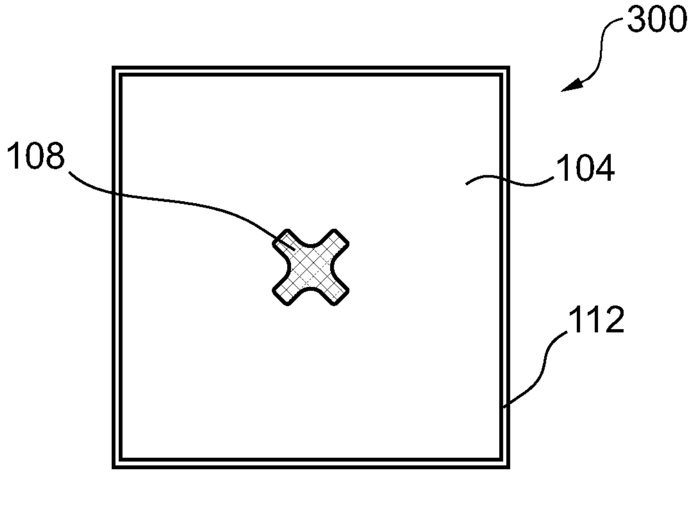

Fig. 3

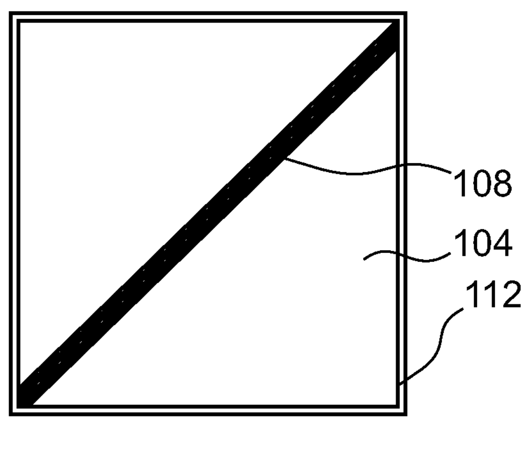

Fig. 4

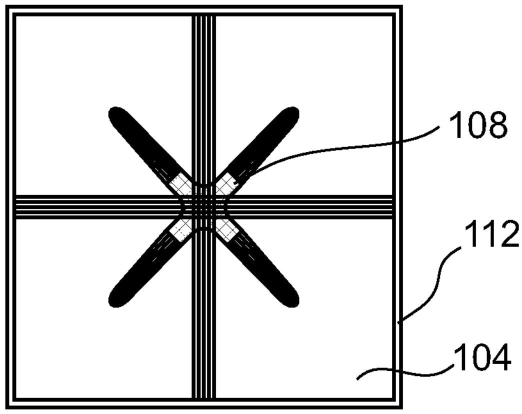

Fig. 5

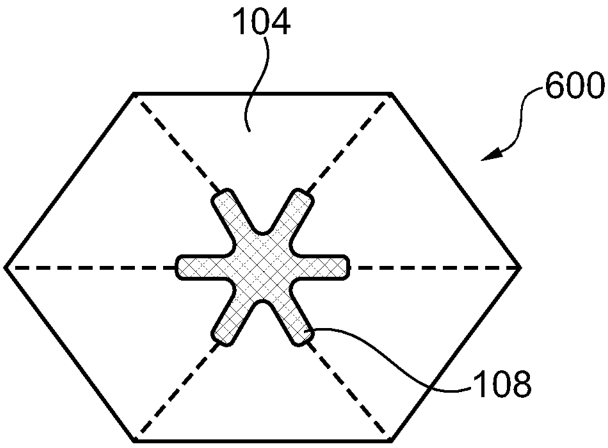

Fig. 6

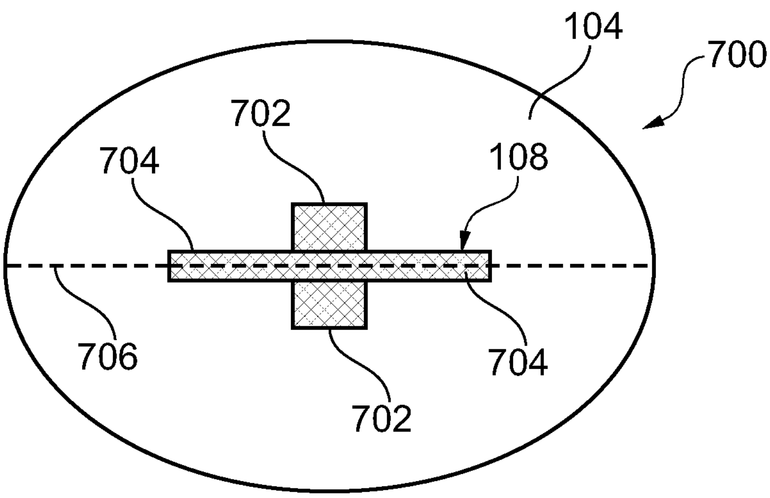

Fig. 7