Method for producing a component, and component

The invention relates to a method for producing a component, in particular, a micro-mechanical, micro-electromechanical (MEMS) or rather micro-opto-electro-mechanical (MOEMS) component, as well as to such a component.

To keep environmental impacts such as humidity and contaminations (e.g. dust) on micro-electromechanical (MEMS) components and micro-opto-electro-mechanical components (MOEMS), respectively as low as possible, active structures of such components are frequently encapsulated hermetically. In this connection, in particular, mobile structures, optical structures or structures, which equally include mobile and optical components (e.g. mobile mirrors), are to be understood by "active structure". The term "active area" designates the area or rather the volume of the component, in which the active structure lies or rather moves. The hermetically sealed encapsulation can furthermore be used to set a certain internal pressure in the region of the active structures, which is particularly advantageous for components whose functioning depends on a defined internal pressure, such as acceleration sensors and gyroscopes (rotation rate sensors), for example.

In order to be able to produce as cost-effective as possible, MEMS and MOEMS components, respectively are generally produced at the wafer level. Joining processes to be frequently conducted can be effected on the basis of direct bonding processes as well as anodic bonding processes.

Leading out electrical contacts from the hermetically sealed region of the component to contact certain parts of the component (e.g. to contact the active structure) is difficult to realize from a manufacturing point of view. Various possibilities come into consideration: The electrical contacts can, for example, be realized by lateral running semiconductor layers having a low layer resistance produced by means of implantation and diffusion processes, respectively. Furthermore, realization is possible by means of structured conductive layers covered with a planarized passivation layer.

Alternatively, the electrical contacts can be led out of the component in the form of a plurality of vertically running through connections. The contacts can each be produced via a wire, which is led through an opening or a hole in a cover of the component and connected to the part of the component to be contacted. However, in the case of large aspect ratios of the opening, i.e. in the case of large ratios of the depth of the opening to the lateral surface of the opening, difficulties regarding the realization and durability of the contact may arise. According to another possibility, a contact can be created in an opening or a hole in a cover of the component by depositing an electrically conductive layer or an electrically conductive material filling the opening. This can, in particular, in the case of high aspect ratios of the opening,

result in difficulties when realizing the contact, for example, through holes in the filling or not continuously deposited layers, and require a high material expense regarding the material to be filled or additional processing steps.

Another problem can arise during the process of connecting the cover of the component to the other layers of the component. If the aforementioned openings are already existent prior to the joining process and not filled with a conductive material, then the joining area, which is available for connecting the cover to the other layers, is reduced. If the existing openings are already filled with conductive material, then restrictions for the parameters of the joining process (for example, temperature and pressure) can follow therefrom. In both cases, the quality of the connection can decrease, and the production of the hermetically sealed region of the component cannot be guaranteed.

Embodiments of the invention provide a method for producing a component, in particular, a micro-mechanical, micro-electromechanical or micro-opto-electro-mechanical component, as well as such a component, by which an electrical contact to parts of the component can be realized.

According to a first aspect of the present invention, there is provided a method for producing a component, including: the step of creating a first layer composite, which comprises a first substrate made of an electrically conductive material and at least one trench filled with an insulating material, which extends outwards from a first surface of the first substrate, wherein a first region of the first substrate is electrically insulated laterally from other regions of the first substrate by the at least one trench on the first surface, the step of creating a second layer composite, which comprises the first layer composite and a structure layer, which comprises an active structure of the component and which is electrically conductive at least in a first region, wherein the first region of the structure layer adjoins the first surface of the first substrate in the first region of the first substrate, and is connected thereto in an electrically conductive manner, and the step of creating a first electrically conductive contact face on a second surface of the first substrate, wherein the second surface is located opposite the first surface, and wherein the first contact face is arranged in the first region of the first substrate, wherein the first region of the first substrate is electrically insulated laterally from other regions of the first substrate by the at least one trench on the second surface, wherein during the step of creating the first layer composite, a first depression is created in the first surface of the first substrate, wherein the first depression has a depth smaller than the thickness of the first substrate, and wherein the first region of the first substrate is located outside of the first depression, and a second region of the first substrate is arranged within the first depression, wherein the second region of the first substrate is electrically insulated laterally from other regions of the first substrate by the at least one trench on the first surface of the first substrate, and wherein during the step of creating the second layer composite, at least a part of the active structure is arranged within the first depression at a distance to the first substrate, and a second electrically conductive contact face is created on the second surface of the first substrate, wherein the second contact face is arranged in the second region of the first substrate, and wherein the second region of the first substrate is electrically insulated

laterally from other regions of the first substrate by the at least one trench on the second surface, characterized in that the first layer composite comprises at least two trenches filled with insulating material, at least two second regions of the first substrate are arranged within the first depression, and at least two second contact faces are created on the second surface of the first substrate, wherein every second contact face is arranged in one of the second regions of the first substrate.

According to an embodiment of the method for producing a component, a first depression can be created in the first surface of the first substrate during the creation of the first layer composite, wherein the depth of the first depression is smaller than the thickness of the first substrate. The first region of the first substrate is arranged outside of the first depression. Within the first depression a second region of the first substrate can be arranged, which is electrically insulated laterally from other regions of the first substrate by the at least one trench on the first surface of the first substrate. During the creation of the second layer composite, at least a part of the active structure is arranged within the first depression at a distance to the first substrate. Furthermore, a second electrically conductive contact face is created on the second surface of the first substrate, wherein the second contact face is arranged in the second region of the first substrate, and wherein the second region of the first substrate is electrically insulated laterally from other regions of the first substrate by the at least one trench on the second surface of the first substrate.

According to an embodiment, the first layer composite comprises at least two trenches filled with insulating material, and at least two second regions of the first substrate are arranged with the first depression. At least two second contact faces are created on the second surface of the first substrate, wherein every second contact face is arranged in one of the second regions of the first substrate.

According to an embodiment, the first layer composite can comprise the first substrate and the at least one trench only, wherein the at least one trench in the first substrate extends to the second surface of the first substrate prior to creating the second layer composite.

According to another embodiment, the at least one trench in the first layer composite initially extends to a depth, which is smaller than the thickness of the first layer composite, prior to creating the second layer composite. After the creation of the second layer composite and prior to the creation of the first contact face, the thickness of the first layer composite from a first surface of the first layer composite to the depth of the at least one trench is reduced. The first surface of the first layer composite is the surface of the first layer composite, which is located opposite the first surface of the first substrate.

According to a further embodiment, the second layer composite can furthermore comprise a third layer composite, which adjoins the substrate layer on the side opposite the first layer composite and comprises a second substrate.

If the second layer composite comprises a third layer composite, then the second layer composite can, according to a first embodiment, be created in that initially the structure layer is applied to the first surface of the first substrate, and, thereafter, the structure layer applied to the first layer composite is connected to the third layer composite. According to another embodiment, the second layer composite can be created in that initially the structure layer is applied to the third layer composite, and, thereafter, the structure layer applied to the third layer composite is connected to the first layer composite.

According to an embodiment, the third layer composite can comprise a cover layer conductive at least in one region, which is arranged on a first surface of the second substrate. The first surface of the second substrate is the surface of the second substrate facing the structure layer. A second depression can be created in a first surface of the cover layer, wherein the first surface of the cover layer is the surface of the cover layer facing the structure layer. The depth of the second depression is smaller than the thickness of the cover layer. During the creation of the second layer composite, the conductive region of the cover layer is arranged in an adjoining manner to the first region of the structure layer and a second region of the structure layer. The first region of the structure layer is arranged outside of the active structure, whereas the second region of the structure layer is arranged within the active structure and is electrically conductive. The second depression and at least one part of the active structure are arranged so that the lateral position of the second depression corresponds to the lateral position of the at least one part of the active structure. The cover layer thereby forms a conductor path bridge, which connects the second region of the structure layer to the first region of the structure layer.

According to an embodiment, the structure layer and the layer of the third layer composite facing the structure layer can consist of the same material.

According to a further embodiment, the first substrate and the structure layer can consist of the same material.

In case that the layers to be connected to each other during the creation of the second layer composite, i.e. the first substrate and the structure layer, and, where applicable, the layer of the third layer composite facing the structure layer, consist of the same material, particularly suited methods for connecting those layers can be used, for example, bonding processes. For example, the layers can consist of a semiconductor material, in particular, silicon.

According to a second aspect of the present invention, there is provided a component including: a first layer composite, which comprises a first substrate made of an electrically conductive material and at least one trench filled with an insulating material, which extends outwards from a first surface of the first substrate to a second surface of the first substrate, wherein the second surface is located opposite the first

surface, and wherein a first region of the first substrate is electrically insulated laterally from other regions of the first substrate by the at least one trench, a structure layer, which comprises an active structure of the component and which is electrically conductive at least in a first region, wherein the first region of the structure layer adjoins the first surface of the first substrate in the first region of the first substrate, and is connected to the first region of the first substrate in an electrically conductive manner, and an electrically conductive contact face is arranged on the second surface of the first substrate, wherein the first contact face is arranged in the first region of the first substrate, wherein a first depression is formed in the first surface of the first substrate, wherein the first depression has a depth smaller than the thickness of the first substrate, and wherein the first region of the first substrate is arranged outside of the first depression, and a second region of the first substrate is arranged within the first depression, wherein the second region of the first substrate is electrically insulated laterally from other regions of the first substrate by the at least one trench, at least a part of the active structure is arranged within the first depression at a distance to the first substrate, and a second electrically conductive contact face is arranged on the second surface of the first substrate, wherein the second contact face is arranged in the second region of the first substrate, characterized in that the first layer composite comprises at least two trenches filled with insulating material, at least two second regions of the first substrate are arranged within the first depression, and at least two second contact faces are arranged on the second surface of the first substrate, wherein every second contact face is arranged in one of the second regions of the first substrate.

According to an embodiment, a first depression is formed in the first surface of the first substrate, which has a depth smaller than the thickness of the first substrate. The first region of the first substrate is arranged outside of the first depression, while a second region of the first substrate can be arranged within the first depression, wherein the second region of the first substrate is electrically insulated laterally from other regions of the first substrate by the at least one trench. At least a part of the active structure is arranged within the first depression at a distance to the first substrate. The component furthermore comprises a second electrically conductive contact face on the second surface of the first substrate, wherein the second contact face is arranged in the second region of the first substrate.

According to an embodiment, the first layer composite comprises at least two trenches filled with insulating material. At least two second regions of the first substrate are arranged within the first depression, and at least two second contact faces are arranged on the second surface of the first substrate, wherein every second contact face is arranged in one of the second regions of the first substrate.

According to an embodiment, the component can furthermore comprise a third layer composite, which adjoins the structure layer on the side opposite the first layer composite and comprises a second substrate. The first layer composite, the structure