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(54) **OPTOELECTRONIC COMPONENTS AND METHOD FOR PRODUCING AN OPTOELECTRONIC COMPONENT**

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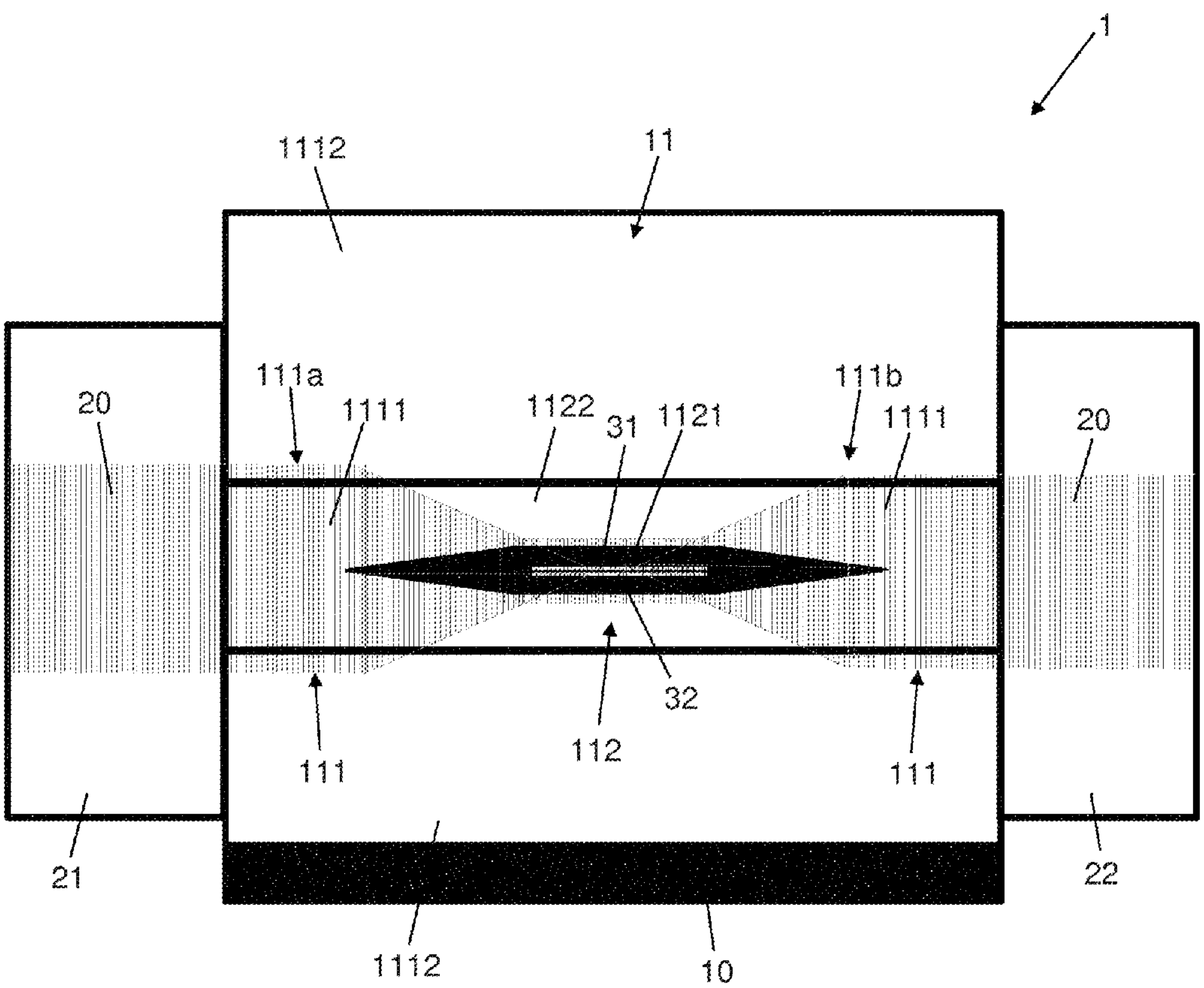
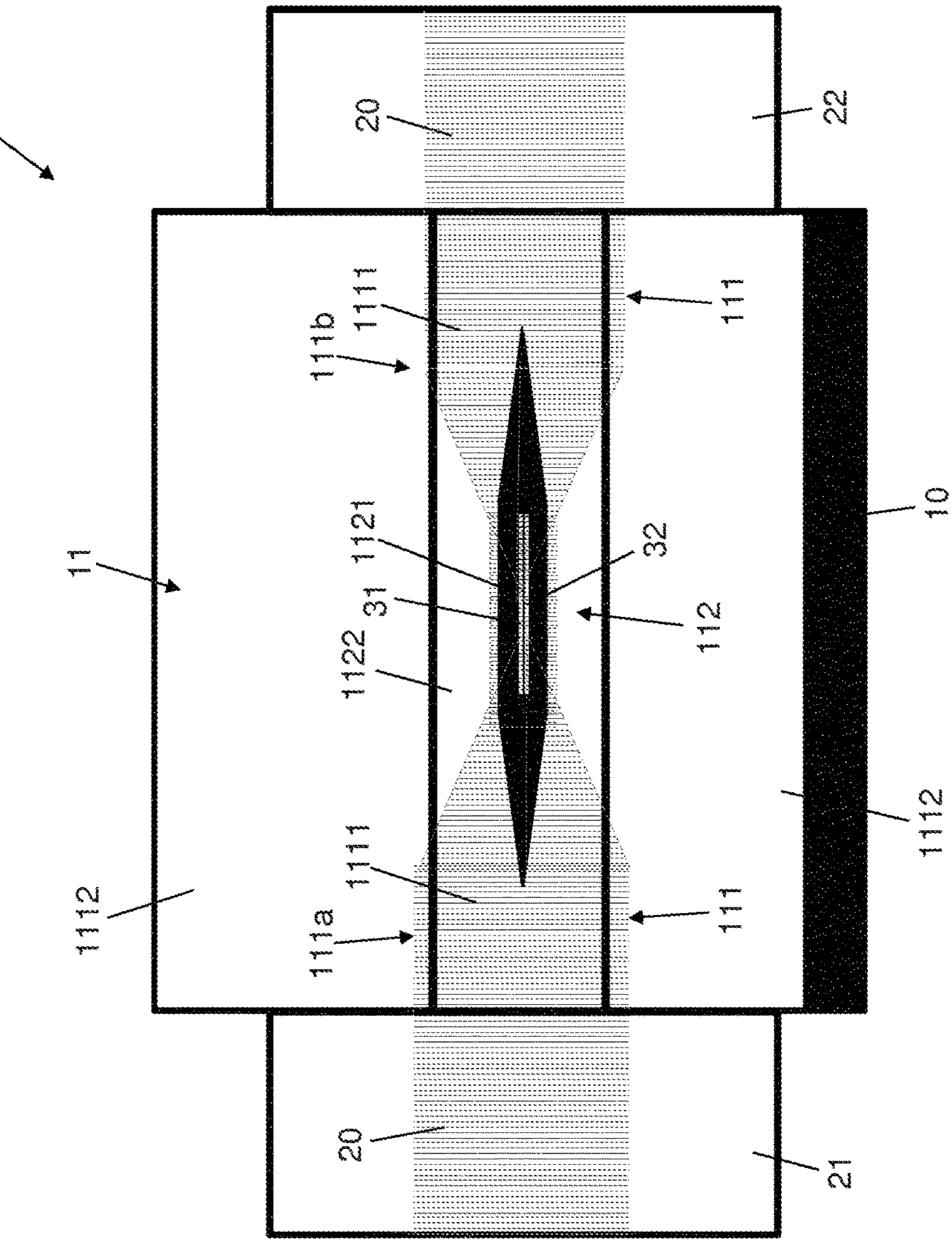
(57) **ABSTRACT**

An optoelectronic component includes an optical waveguide including at least one passive and at least one active section. The active section has at least one layer formed from a two-dimensional material. The layer composed of the two-dimensional material is arranged at least partly in a waveguide core of the active section or in a manner at least partly adjoining the waveguide core of the active section. The difference in refractive index relative to the same wavelength between a core material forming the waveguide core of the active section and a cladding material forming a waveguide cladding of the active section is greater than the difference in refractive index between a core material forming a waveguide core of the passive section and a cladding material forming a waveguide cladding of the passive section.




1
20
22
111b
1111
111
11
1121
32
10
31
112
1122
1112
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111a
111
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20
21

FIG 1

FIG 2

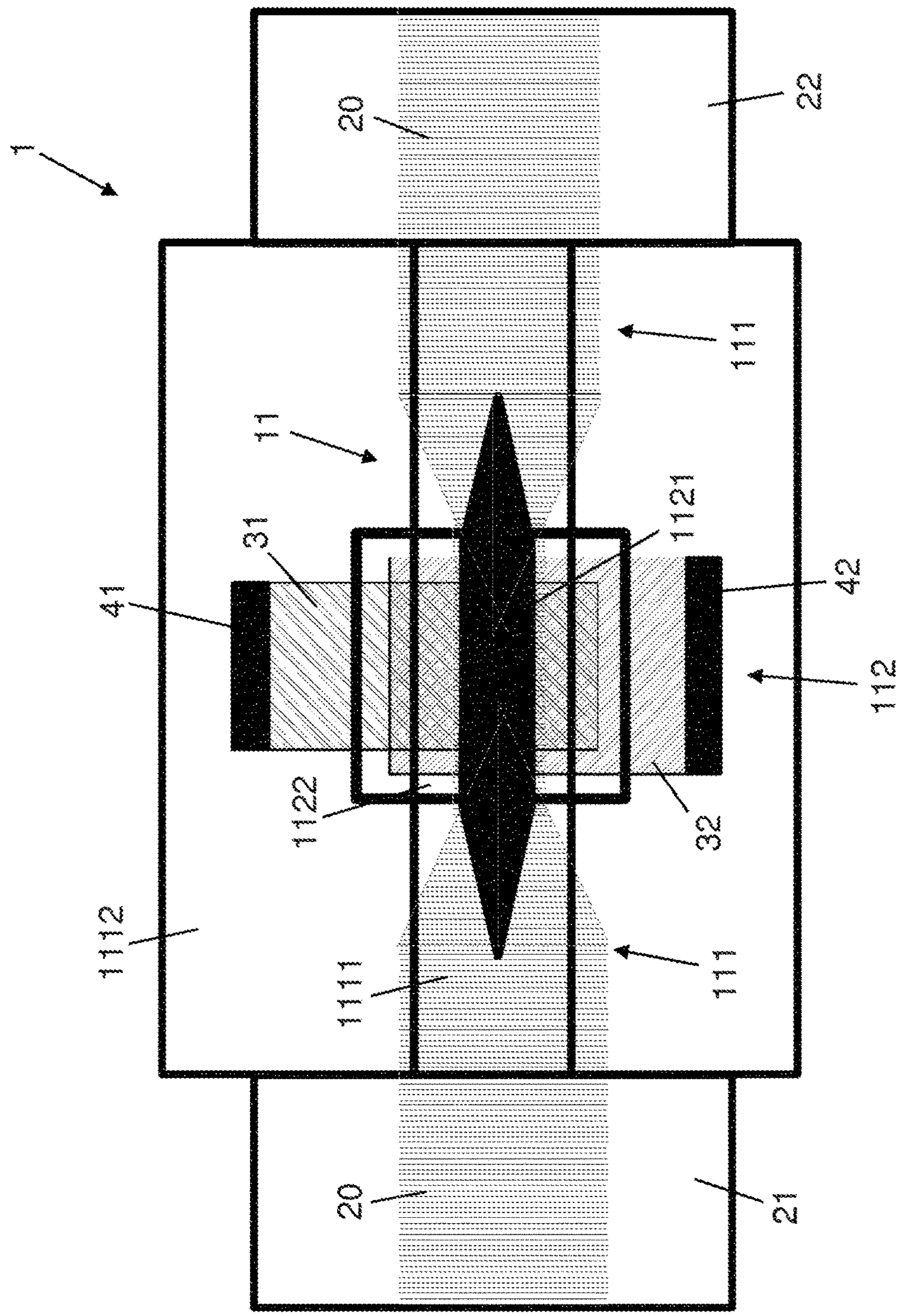


FIG 4

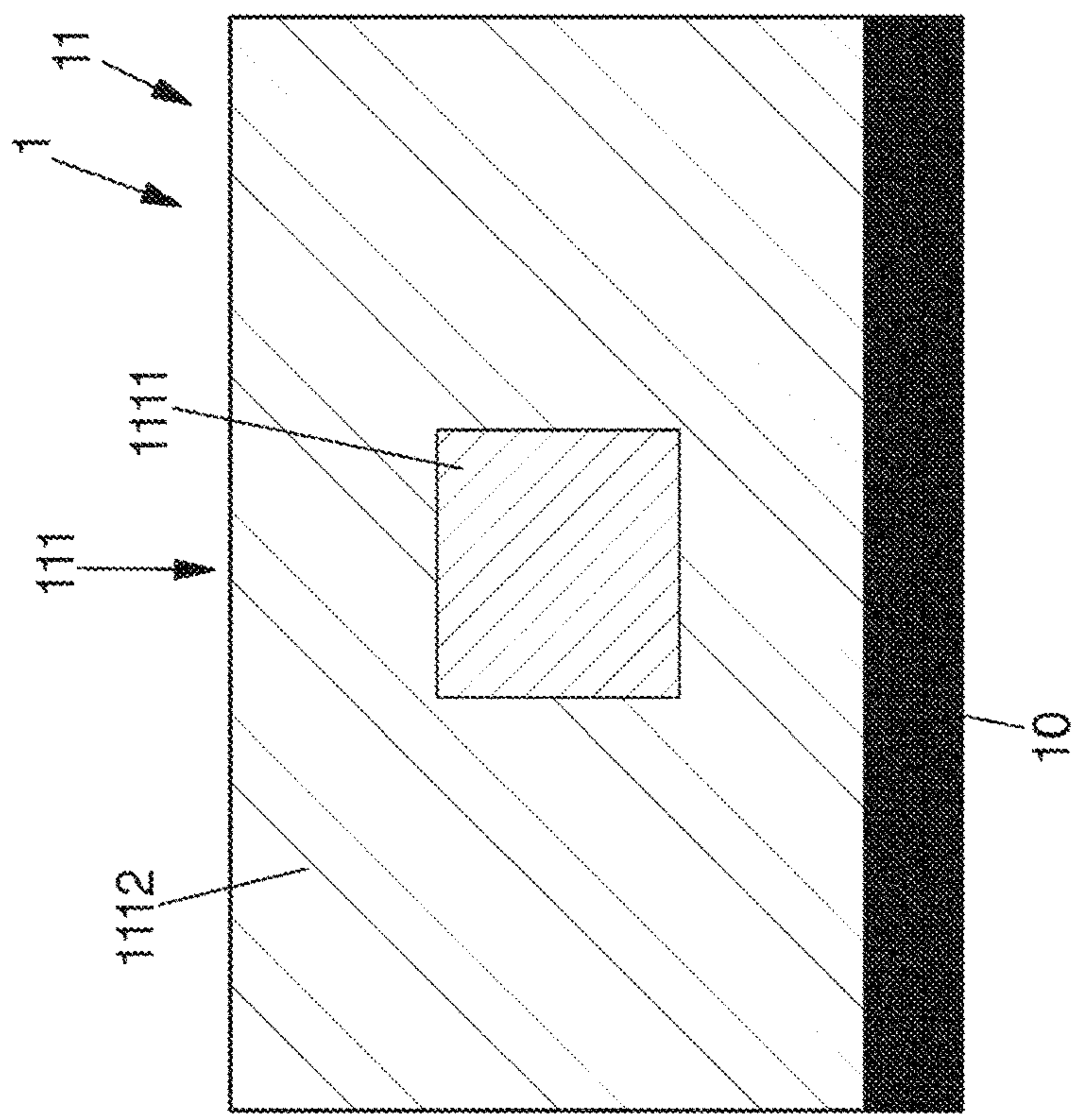

11
1
1111
111
1112
10

FIG 3

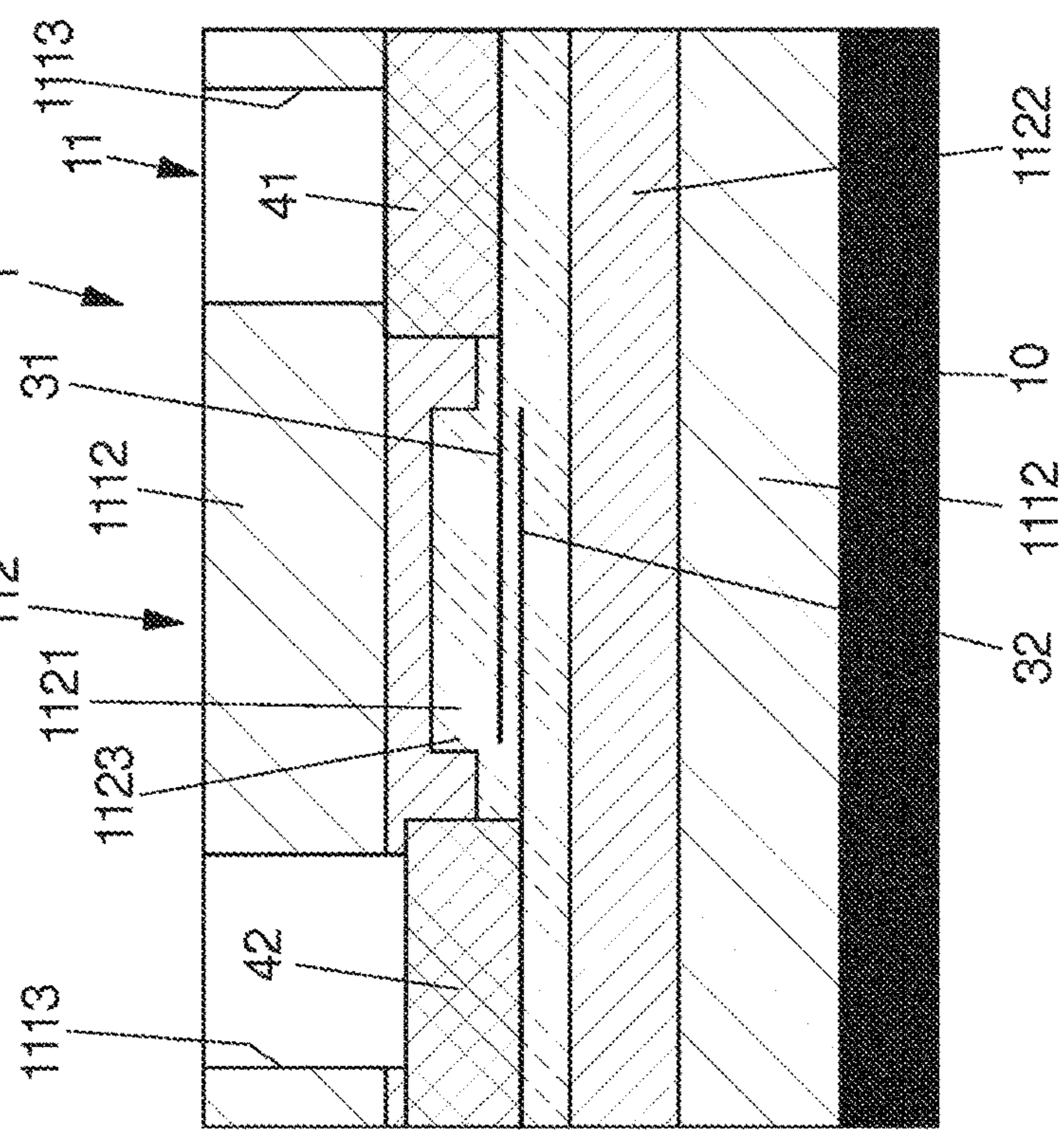
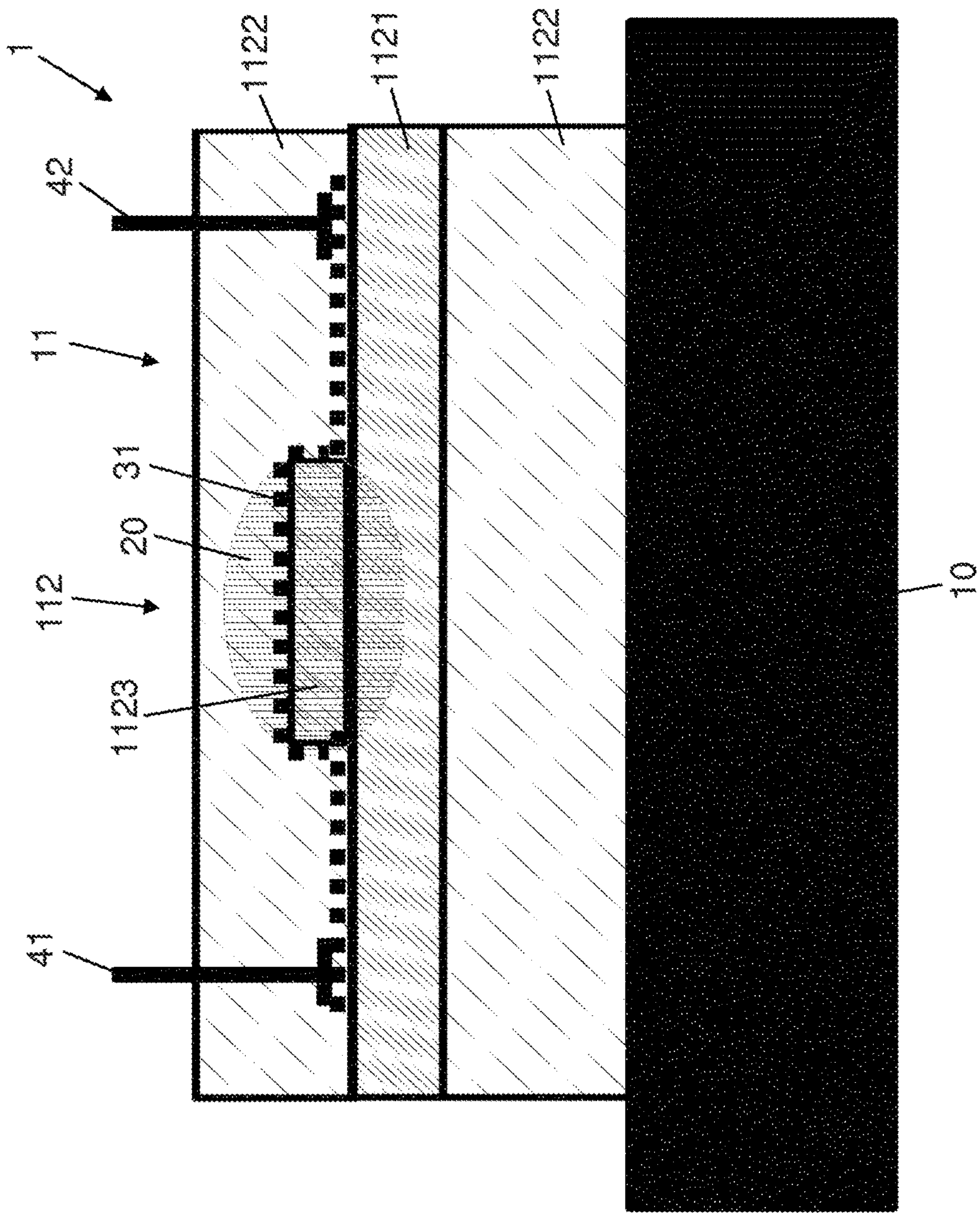

1113
11
41
1
1122
31
10
1112
1112
112
32
1121
1123
42
1113

FIG 5



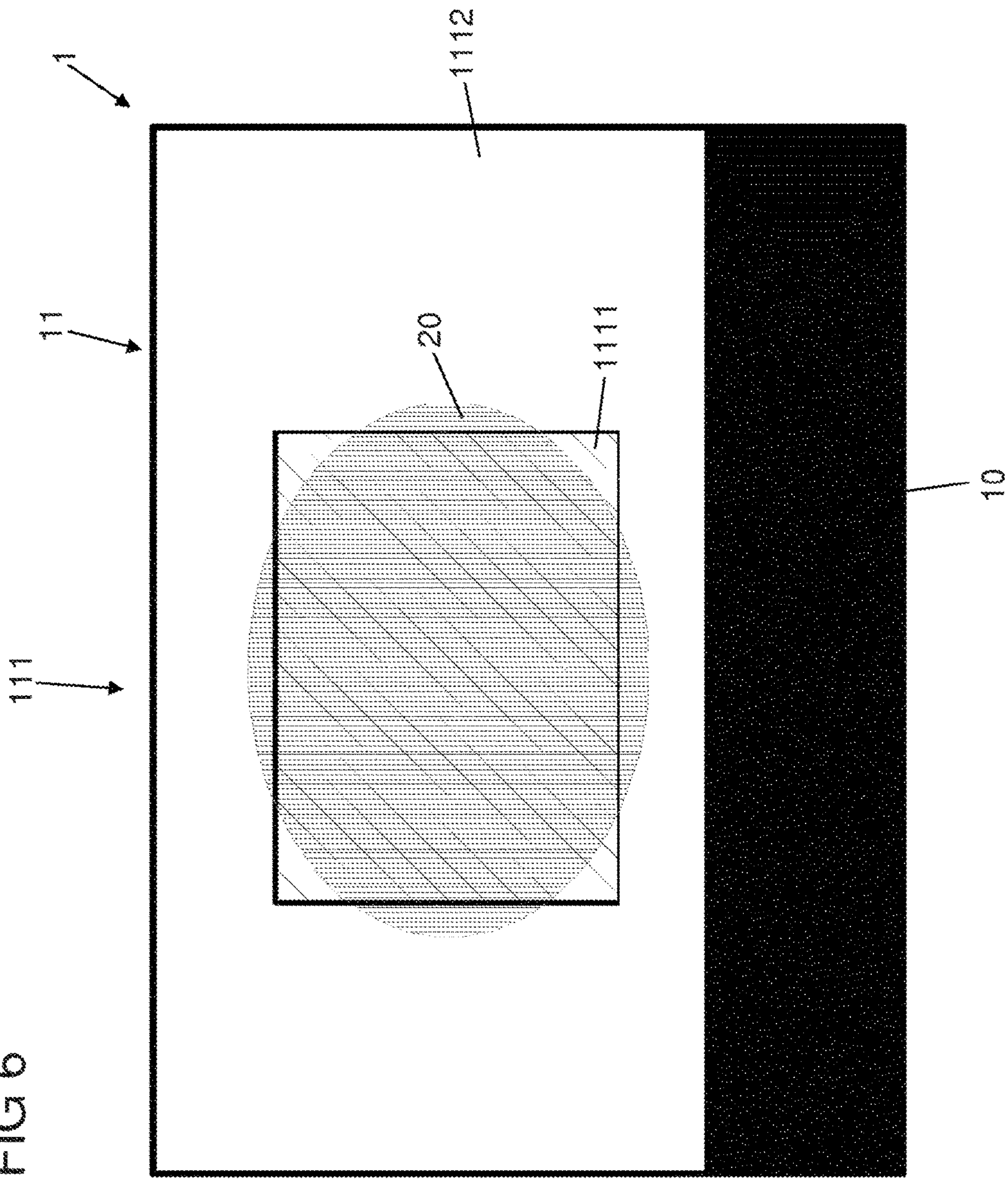


FIG 6

OPTOELECTRONIC COMPONENTS AND METHOD FOR PRODUCING AN OPTOELECTRONIC COMPONENT

[0001] The invention relates to optoelectronic components as claimed in the preambles of claims **1** and **15**, and a method for producing an optoelectronic component as claimed in the preamble of claim **23**.

[0002] Two-dimensional materials of such optoelectronic components consist of an almost monoatomic or monomolecular layer in a characteristic arrangement. Such materials have fundamentally different properties than conventional three-dimensional crystals composed of the same atoms or molecules with a different structure. Particularly interesting properties of the two-dimensional materials are their high mechanical strength and, from an electro-optical standpoint, a band gap that can be adjusted e.g. from 0 eV to a plurality of eV by applying a voltage. Consequently, the two-dimensional materials can be used to realize e.g. photodetectors and light modulators for very wide wavelength ranges. One known two-dimensional material is graphene, which is based on carbon atoms and which is produced e.g. on copper carriers and detached from the latter after production.

[0003] In order to form optoelectronic components, layers composed of a two-dimensional material are integrated in particular into optical waveguides. In this regard, EP 2 584 397 A1, for example, discloses an optical waveguide comprising a silicon core forming a rib structure, wherein a layer of graphene is placed over the rib structure. With this arrangement, the intensity maximum of the waves guided in the waveguide is at a distance from the graphene layer, however. Moreover, the light modes propagating in the waveguide have a distinctively different diameter than modes in optical fibers composed of glass that are used to couple light into and out of the component. High coupling losses can occur as a result.

[0004] The invention addresses the problem of realizing firstly the best possible guidance of a light wave and secondly a coupling of the component to an optical fiber composed of glass in a manner that exhibits the least possible losses.

[0005] This problem is solved by the provision of the optoelectronic components having the features of claim **1** and of claim **15**, respectively, and also by the method for producing an optoelectronic component as claimed in claim **23**. Developments of the invention are specified in the dependent claims.

[0006] Accordingly, an optoelectronic component is provided, comprising

[0007] an optical waveguide comprising at least one passive and at least one active section, wherein

[0008] the active section has at least one layer formed from a two-dimensional material (and provided in particular with a contact), wherein the layer composed of the two-dimensional material is arranged at least partly in a waveguide core of the active section or in a manner at least partly adjoining the waveguide core of the active section, and wherein

[0009] the difference in refractive index relative to the same wavelength between a core material forming the waveguide core of the active section and a cladding material forming a waveguide cladding of the active section is greater than the difference in refractive index between a core material forming a waveguide core of the passive section and a cladding material forming a waveguide cladding of the passive section.

[0010] As a result of the greater difference in refractive index in the active section of the waveguide, a light wave experiences a stronger guidance there than in the passive waveguide section. This has the consequence that the light wave has a smaller extent in the active section and thus a higher intensity in the center of the waveguide, i.e. in the region of the layer composed of the two-dimensional material. Consequently, this increases the efficiency of the interaction of the light wave with the two-dimensional material and hence the efficiency of the entire component. At the same time, the light wave experiences a weaker guidance in the passive section, which results in a larger extent of the light wave in this region. This in turn reduces coupling losses between the optoelectronic component and an optical fiber composed of glass via which the light wave is coupled into the component and/or out of the component. The waveguide core of the active section is arranged in the waveguide cladding in particular such that it is embedded into the cladding material on both sides (i.e. with its top side and underside).

[0011] Furthermore, the layer composed of the two-dimensional material is positioned in the waveguide core of the active section in particular such that the core material in each case at least partly covers two mutually opposite sides of the layer, i.e. the core material adjoins a top side and an underside of the layer composed of the two-dimensional material. It is also conceivable, however, for the layer composed of the two-dimensional material to adjoin the core material only on one side, i.e. the core material is situated only on one side of the layer. By way of example, here the layer composed of the two-dimensional material is positioned between the core material and the cladding material. In particular, the layer composed of the two-dimensional material at least partly (in particular directly) adjoins a top side or underside of the waveguide core of the active section. In this regard, the layer can adjoin the core material for example directly from the top or bottom. The top side and the underside of the waveguide core are formed in particular by a side of the waveguide core facing away from a substrate and a side of the waveguide core facing a substrate, respectively.

[0012] Furthermore, the core material of the active section differs in particular from the core material of the passive section and/or the cladding material of the active section differs from the cladding material of the passive section. Possible materials for forming the core material of the active and of the passive section, respectively, and for forming the cladding material of the active and of the passive section, respectively, are explained further below.

[0013] In accordance with another configuration of the invention, the active section of the optical waveguide is embodied in a strongly guiding fashion and the passive section of the optical waveguide is embodied in a weakly guiding fashion. By way of example, the difference in refractive index between the core material and cladding material of the active section is at least 0.2, at least 0.3 or at least 0.4. The difference in refractive index between the core material and cladding material of the passive section is for example at most 0.1 or at most 0.05. By way of example, the core material and the cladding material (e.g. a polymer or doped or undoped silicon dioxide) of the passive region each have a refractive index of between 1.40 to 1.55, wherein the refractive index of the core material is greater than the refractive index of the cladding material.

[0014] It is furthermore possible for the core material of the active section to be structured for laterally guiding a light wave. By way of example, the core material of the active section has a rib or strip structure. In particular, it is thereby possible to form a so-called "single mode" (monomode) waveguide.

[0015] It is additionally conceivable for the active section of the waveguide (in particular the difference in refractive index there between the core material and the cladding material) to be embodied such that the light wave guided in this region has a diameter of less than 3 μm or less than 2 μm (e.g. between 2 and 3 μm). By contrast, the passive section of the waveguide (in particular in the region of a facet of the waveguide) can be embodied such that the light wave guided there has a diameter of at least 3 μm or at least 5 μm (e.g. between 5 and 10 μm).

[0016] It is then also possible for the layer composed of two-dimensional material to project laterally from the waveguide core at least in one direction of the lateral plane and the projecting part of the layer to be electrically contacted via a metal contact at a distance from the guided optical wave. It is thus possible to avoid losses of the guided optical wave as a result of the metal contact.

[0017] In accordance with another development of the invention, the core material of the active section extends into the passive section of the waveguide, wherein the extent of the core material perpendicular to the longitudinal direction, i.e. the width and/or the height, of the optical waveguide decreases with distance from the active section. By way of example, the extent of the core material decreases continuously with distance from the active section (from the layer composed of the two-dimensional material) over a span of at least 30 μm or at least 50 μm. This embodiment serves for the lossless transformation of optical modes of the passive and active sections of the waveguide.

[0018] The guidance of the light waves through the core material of the active section becomes weaker and weaker as a result of the tapering of the core toward the passive section, wherein the diameter of the light waves increases more and more until finally the passive section fully undertakes the guidance. It is conceivable for the continuous tapering of the core material, for technological simplification, at least predominantly to be restricted to that region of the core material which extends below or above the layer composed of the two-dimensional material. It is also possible for the width and/or the thickness of the core material not to tend continuously down to zero, rather a residual width and/or thickness, i.e. a step, can be present in each case at the ends of the core material.

[0019] It is also conceivable for the cladding material of the active section to shape at least one part of the core material of the passive section, i.e. for the cladding material of the active section to be at least partly identical with the core material of the passive section. In particular, the core material of the passive section extends continuously (integrally) both in the passive section and in the active section, wherein in the active section, as mentioned, it forms the waveguide cladding of the active section. The core and cladding layers of the active and passive sections of the waveguide are arranged in particular on a common carrier. In particular, the component according to the invention is part of a waveguide platform which is e.g. a constituent of a larger arrangement. By way of example, the waveguide platform is integrated into a waveguide network or a sensor system.

[0020] The two-dimensional material consists for example of one atomic layer or of a maximum of ten atomic layers. By way of example, the two-dimensional material is formed from graphene, triazine-based graphitic carbon nitride, germanene, molybdenum disulfide, molybdenum diselenide, silicene and/or black phosphorus or comprises at least one of these materials, specifically in each case in one and a plurality of atomic layers.

[0021] The active section of the waveguide (i.e. the active section of the component) is embodied e.g. as a photodetector. By way of example, for this purpose, one layer (e.g. composed of graphene) composed of the two-dimensional material is present and correspondingly connected up. In particular, the layer composed of the two-dimensional material is provided with two electrical contacts. Light guided in the optical waveguide is at least partly absorbed by the two-dimensional material, wherein a resulting photocurrent can be measured via the contacts.

[0022] It is also possible for the active section to be embodied as a light modulator, wherein in particular at least two layers each composed of a two-dimensional material are present, which are electrically insulated from one another by a dielectric. It is conceivable for the core material of the active section of the waveguide simultaneously also to form the dielectric. In particular, the two layers composed of the two-dimensional material are connected to contacts (in particular composed of a metal) which are electrically insulated from one another and via which a voltage can be applied to the layers. The contacts are situated in particular outside the extent of a light wave guided in the active section of the waveguide. What is realized, in particular, is a longitudinal transmission of radiation through the layers composed of the two-dimensional material, in which the layers are arranged parallel to the longitudinal direction of the optical waveguide.

[0023] The optoelectronic component according to the invention can also be coupled to an optical fiber composed of glass, wherein an end side of the optical fiber composed of glass is connected to a facet of the component (of the optical waveguide); e.g. by adhesive-bonding or latching connection.

[0024] By way of example, the component according to the invention is operated in a wavelength range of 0.4 μm to 1.7 μm, 0.82 μm-0.87 μm, 0.97 μm-1.070 μm, 1.26 μm-1.36 μm and/or 1.5 μm-1.65 μm.

[0025] In a further aspect, the invention relates to an optoelectronic component, embodied in particular as explained above, comprising

[0026] an optical waveguide comprising at least one active section having at least one layer formed from a two-dimensional material, wherein

[0027] the layer composed of the two-dimensional material is arranged at least partly in a waveguide core of the active section or in a manner at least partly adjoining the waveguide core of the active section, and wherein

[0028] the active section comprises a cladding material at least partly surrounding the core material, wherein

[0029] the refractive index of a core material forming the waveguide core of the active section relative to visible light lies in the range of 1.9 to 2.5 and the refractive index of the cladding material lies in the range of 1.4 to 1.55.

[0030] The core material of the active section is for example a dielectric formed from a nitride, an oxide and/or a silicate. The dielectric comprises for example silicon nitride, titanium dioxide, hafnium dioxide, hafnium silicate, zirconium silicate, zirconium dioxide and/or aluminum dioxide or is formed from these materials.

[0031] Furthermore, the core material of the active section can have a thickness of at least 50 nm, at least 100 nm or at least 200 nm or in the range of 50 to 500 nm or 100 to 200 nm.

[0032] In accordance with another configuration, the cladding material of the active section comprises silicon dioxide and/or a polymer and/or the cladding material of a passive section of the waveguide comprises silicon dioxide and/or a polymer.

[0033] The core material of a passive section of the waveguide comprises for example a polymer (e.g. having a refractive index of between 1.4 and 1.55) and/or doped silicon dioxide, and/or the cladding material of the passive section comprises a polymer and/or silicon dioxide. The polymer can be formed by an acrylate, an ormocer, a spin-on-glass polymer or silicone (in each case e.g. having a refractive index of 1.40 to 1.55 or 1.44 to 1.49).

[0034] It goes without saying that the optoelectronic component of the second aspect of the invention can additionally also have features explained above of the optoelectronic component of the first aspect of the invention. In this regard, the optical waveguide in particular also comprises a passive section besides the active section. It is also possible for two layers each composed of a two-dimensional material to be present, which are electrically insulated from one another by a dielectric. Furthermore, it is possible to use the above-mentioned materials for forming the layer composed of the two-dimensional material.

[0035] Conversely, the optoelectronic component of the first aspect of the invention can contain features explained above in relation to the second aspect of the invention. This concerns, for example, the core and cladding materials for forming the passive and active sections of the waveguide as mentioned in relation to the second aspect of the invention.

[0036] The invention also relates to a method for producing an optoelectronic component, in particular as described above, comprising the following steps:

[0037] producing an optical waveguide comprising at least one active and at least one passive section, wherein

[0038] producing the optical waveguide comprises arranging at least one layer formed from a two-dimensional material at least partly in a waveguide core of the active section or in a manner at least partly adjoining the waveguide core, wherein

[0039] the optical waveguide is produced such that the difference in refractive index relative to the same wavelength between a core material forming the waveguide core of the active section and a cladding material forming a waveguide cladding of the active section is greater than the difference in refractive index between a core material forming a waveguide core of the passive section and a cladding material forming a waveguide cladding of the passive section.

[0040] The invention is explained in greater detail below on the basis of exemplary embodiments with reference to the figures, in which:

[0041] FIG. **1** schematically shows a lateral sectional view of an optoelectronic component in accordance with one exemplary embodiment of the invention;

[0042] FIG. **2** shows the component from FIG. **1** in a partly transparent view from above;

[0043] FIG. **3** shows a sectional view through the component from FIG. **1** in the region of the active section;

[0044] FIG. **4** shows a sectional view through the component from FIG. **1** in the region of the passive section;

[0045] FIG. **5** schematically shows a sectional view through the active section of an optoelectronic component in accordance with a further exemplary embodiment of the invention; and

[0046] FIG. **6** shows a sectional view through the passive section of the component from FIG. **5**.

[0047] The optoelectronic component **1** according to the invention as illustrated in FIG. **1** comprises an integrated optical waveguide **11** arranged on a substrate **10**, wherein a first end of the optical waveguide **11** is coupled to a first optical fiber **21** composed of glass and a second end of the waveguide **11** is coupled to a second optical fiber **22** composed of glass. By way of example, a light wave **20** (vertically hatched region in FIG. **1**) is coupled into the optical waveguide **11** via the first optical fiber **21** composed of glass and is coupled out of the waveguide **11** via the second optical fiber **22** composed of glass.

[0048] The optical waveguide **11** has an active section **112** and a passive section **111**, wherein, in the exemplary embodiment in FIG. **1**, one partial section **111***a* of the passive section **111** is situated upstream of the active section **112**, i.e. between a facet of the component **1** that is coupled to the first optical fiber **21** composed of glass and the active section **112**, and another partial section **111***b* is situated downstream of the active section **112**, i.e. between the active section **112** and a facet of the component **1** that is coupled to the second optical fiber **22** composed of glass.

[0049] The active section **112** of the waveguide **11** is distinguished by the fact that in its waveguide core **1121** two layers **31**, **32**, each consisting of a two-dimensional material (e.g. graphene), are embedded, specifically in such a way that a core material of which the waveguide core **1121** of the active section **112** consists also extends between the layers **31**, **32** and electrically insulates the layers **31**, **32** from one another. The core material thus extends in a manner respectively adjoining two mutually opposite sides of the layers **31**, **32**.

[0050] The active section **112** is considered to be, in particular, that region of the waveguide **11** in which the layers **31**, **32** are situated. Nevertheless, the core material of the waveguide core **1121** extends into a waveguide core **1111** both of the front and of the rear partial section **111***a*, **111***b* of the passive section **111**, wherein in the example both the thickness and the height of the core material decrease continuously toward the outside (away from the layers **31**, **32**). This specific lateral structuring of the core material of the active section is readily discernible in FIG. **2**, in particular. The likewise laterally structured waveguide core **1111** of the passive section **111** extends in turn in a manner adjoining the waveguide core **1121** into the active section **112** of the waveguide **11** and forms there a waveguide cladding **1122** of the active section **112**. The tapering of the core material of the waveguide core **1121** into the passive section **111** serves for reducing coupling losses between the passive and active sections **111**, **112**.

[0051] The waveguide core **1111** of the passive section **111** is surrounded by a waveguide cladding **1112**, wherein the cladding material of the cladding **1112** extends continuously from the front partial section **1111***a* of the passive section **111** via the active section **112** as far as the end of the rear partial section **1111***b* of the passive section **111**.

[0052] The active section **112** has different light guiding properties than the passive section **111** of the waveguide **11**. In particular, the materials of the waveguide claddings **1112** and **1122** of the passive and active sections **111**, **112** and also the core materials of the waveguide cores **1111** and **1121** are different. Furthermore, these materials are chosen such that the difference in refractive index between the core material of the waveguide core **1121** and the material of the cladding **1122** of the active section **112** is greater than the difference in refractive index between the material of the core **1111** and the material of the cladding **1112** and the passive section **111**.

[0053] In particular, the differences in refractive index of the passive and active sections **111**, **112** are such that the active section **112** is embodied in a strongly light-guiding fashion and the passive section is embodied in a weakly light-guiding fashion. This has the consequence that the light wave **20** guided in the optical waveguide **11** has a larger extent in the passive section **111** than in the active section **112**, as illustrated in FIG. **1**. In particular, the extent of the light wave **20** in the passive partial sections **111***a*, **111***b* is in each case comparable with the extent of the light wave in the optical fibers **21**, **22** composed of glass, such that the coupling losses between the optical fibers **21**, **22** composed of glass and the waveguide **11** are as low as possible.

[0054] On account of the strong guidance by the active section **112** of the waveguide **11**, the light wave has a reduced cross section here, as a result of which it has a higher intensity in the central region of the active section **112** and thus in the region of the layers **31**, **32** composed of the two-dimensional material. Accordingly, this also results in a stronger effect of the light wave on the layers **31**, **32** and thus a better efficiency of the interaction between the light wave and the layers **31**, **32**. A lateral guidance of the light wave in the active section **112** is produced by virtue of the fact that the waveguide core **1121** forms a rib **1123**. The material of the cladding **1122** laterally adjoins the rib **1123**; cf. FIG. **3**, which shows a sectional view perpendicular to the waveguide **11** through the active section **112**. By contrast, the waveguide core **1111** of the passive region **111** has an at least approximately rectangular or square cross section, as is illustrated in the sectional view through the passive section **111** in FIG. **4**.

[0055] The core material of the waveguide core **1121** of the active section **112** is for example a dielectric (e.g. silicon nitride), wherein the core material in particular also extends between the two layers **31**, **32**. However, it is also conceivable for a different dielectric to be used as electrically insulating material between the layers **31** and **32** compared with that used for the rest of the waveguide core **1121**. A polymer, for example, is suitable as material of the cladding **1112** which is identical to the material of the core **1111** of the passive section **111**. The cladding **1112** of the passive section **111** is e.g. likewise formed from a polymer. In particular, materials are used which result in a refractive index (relative to visible light or some other operating wavelength of the optoelectronic component) of the material of the core **1121** of the active section **112** in the range of 1.9 to 2,5 and a refractive index of the cladding material of the active section **112** in the range of 1.4 to 1.55.

[0056] As shown in the plan view of the optoelectronic component **1** in FIG. **2** and in FIG. **3**, the layers **31**, **32** composed of the two-dimensional material are provided with metal contacts **41**, **42**, via which an electrical voltage is able to be coupled to the layers **31**, **32** and a light modulator is able to be realized in this way. The contacts **41**, **42** are respectively arranged on a portion of the layers **31**, **32** which projects laterally from the waveguide core, wherein above the contacts **41**, **42** cutouts **1113** are situated in the waveguide cladding **1112** of the passive section, via which cutouts the contacts **41**, **42** are accessible. The metal contacts **41**, **42** are thus at sufficient distance from the guided wave to avoid light losses.

[0057] A further embodiment of the optoelectronic component **1** according to the invention is illustrated in FIGS. **5** and **6**. This component also comprises a passive and an active section **111**, **112**, wherein FIG. **5** shows a sectional view through the active section **112** and FIG. **6** shows a sectional view through the passive section **111**. Unlike in the previous exemplary embodiments, only one layer **31** composed of a two-dimensional material is present, which moreover is not situated in the waveguide core **1121** of the active section **112**, but rather is arranged in a manner adjoining the waveguide core **1121**. More precisely, the layer **31** extends across a rib **1123** of the waveguide core **1121** and extends in each case laterally with respect to the rib **1123** as far as contacts **41**, **42**, via which e.g. a photocurrent generated in the layer **31** is measurable and the component **1** is thus operable as a photodetector. The contacts **41**, **42** are positioned such that they lie outside the optical wave **20** guided in the active section **112**.

1. An optoelectronic component, comprising:

an optical waveguide comprising at least one passive and at least one active section, wherein

the active section has at least one layer formed from a two-dimensional material, wherein the layer composed of the two-dimensional material is arranged at least partly in a waveguide core of the active section or in a manner at least partly adjoining the waveguide core of the active section, and

the difference in refractive index relative to the same wavelength between a core material forming the waveguide core of the active section flirt and a cladding material forming a waveguide cladding of the active section is greater than the difference in refractive index between a core material forming a waveguide core of the passive section and a cladding material forming a waveguide cladding of the passive section.

2. The optoelectronic component as claimed in claim **1**, wherein the core material of the active section is structured for laterally guiding a light wave coupled into the waveguide.

3. The optoelectronic component as claimed in claim **1**, wherein at least the active section forms a monomode waveguide.

4. The optoelectronic component as claimed in claim **1**, wherein the layer composed of two-dimensional material projects laterally from the waveguide core at least in one direction and the projecting layer is electrically contacted at a distance from the guided optical wave.

5. The optoelectronic component as claimed in claim 1, wherein the core material of the active section differs from the core material of the passive section, and/or the cladding material of the active section differs from the cladding material of the passive section.

6. The optoelectronic component as claimed in claim 1, wherein at least one of:

the active section of the optical waveguide is embodied in a strongly guiding fashion and the passive section of the optical waveguide is embodied in a weakly guiding fashion, and

the active section of the waveguide is embodied such that the light wave guided there has a diameter of less than 3 μm or less than 2 μm, and/or the passive section of the waveguide is embodied such that the light wave guided there has a diameter of at least 3 μm or at least 5 μm.

7. The optoelectronic component as claimed in claim 1, wherein the difference in refractive index between the core material and cladding material of the active section is at least 0.2, at least 0.3, or at least 0.4, and/or the difference in refractive index between the core material and cladding material of the passive section is at most 0.1 or at most 0.05.

8. (canceled)

9. The optoelectronic component as claimed in claim 1, wherein the core material of the active section extends into the passive section, wherein the extent of the core material perpendicular to the longitudinal direction of the optical waveguide decreases with distance from the active section.

10. The optoelectronic component as claimed in claim 9, wherein the extent of the core material decreases continuously with distance from the active section over a span of at least 30 μm or at least 50 μm.

11. The optoelectronic component as claimed in claim 1, wherein the cladding material of the active section shapes at least one part of the core material of the passive section.

12. The optoelectronic component as claimed in claim 1, wherein at least one of:

the two-dimensional material consists of one atomic layer or of a maximum of ten atomic layers, and

the two-dimensional material is formed from graphene, triazine-based graphitic carbon nitride, germanene, molybdenum disulfide, molybdenum diselenide, silicone, and/or black phosphorus or comprises at least one of these materials.

13. (canceled)

14. The optoelectronic component as claimed in claim 1, wherein the active section has at least two layers each composed of a two-dimensional material, which are electrically insulated from one another by a dielectric.

15. An optoelectronic component, comprising:

an optical waveguide comprising at least one active section having at least one layer formed from a two-dimensional material, wherein

the layer composed of the two-dimensional material is arranged at least partly in a waveguide core of the active section or in a manner at least partly adjoining the waveguide core of the active section, and wherein

the active section comprises a cladding material at least partly surrounding the core material, and wherein

the refractive index of a core material forming the waveguide core of the active section relative to visible light lies in the range of 1.9 to 2.5 and the refractive index of the cladding material lies in the range of 1.4 to 1.55.

16. The optoelectronic component as claimed in claim 15, wherein the core material of the active section is a dielectric formed from a nitride, an oxide, and/or a silicate.

17. The optoelectronic component as claimed in claim 16, wherein the dielectric is silicon nitride, titanium dioxide, hafnium dioxide, hafnium silicate, zirconium silicate, zirconium dioxide, and/or aluminum dioxide.

18. The optoelectronic component as claimed in claim 15, wherein the core material of the active section has a thickness of at least 50 nm, at least 100 nm, or at least 200 nm.

19. The optoelectronic component as claimed in claim 15, wherein the cladding material of the active section comprises silicon dioxide and/or a polymer and/or the cladding material of a passive section of the waveguide comprises silicon dioxide and/or a polymer.

20. The optoelectronic component as claimed in claim 15, wherein the core material of a passive section of the waveguide comprises a polymer and/or doped silicon dioxide, and/or the cladding material of the passive section comprises a polymer and/or silicon dioxide.

21. (canceled)

22. The optoelectronic component as claimed in claim 13, wherein the layer composed of the two-dimensional material at least partly adjoins a top side or underside of the waveguide core of the active section.

23. A method for producing an optoelectronic component, comprising:

producing an optical waveguide comprising at least one passive and at least one active section, wherein

producing the optical waveguide comprises arranging at least one layer formed from a two-dimensional material at least partly in a waveguide core of the active section or in a manner at least partly adjoining the waveguide core of the active section, and wherein

the optical waveguide is produced such that the difference in refractive index relative to the same wavelength between a core material forming the waveguide core of the active section and a cladding material forming a waveguide cladding of the active section is greater than the difference in refractive index between a core material forming a waveguide core of the passive section and a cladding material forming a waveguide cladding of the passive section.

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