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(54) Benævnelse: **INTEGRERET FOTONISK REFERENCESENSOR**

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DESCRIPTION

Technical field of the invention

[0001] The present invention relates to sensing methods and systems. More particularly, the present invention relates to a photonic sensing system for sensing a target analyte wherein a reference signal can be taken into account based on reference sensor embedded in the photonic sensing system, as well as to a method of using such a photonic sensing system.

Background of the invention

[0002] Sensors, such as optical sensors, exist which measure a solute within a liquid environment. Practical applications include optical detection of glucose in body fluids, in vivo measurements in which the device is implanted in an animal or person, or optical measurement of glucose in a fermentation tank.

[0003] For the operation of such sensors, it is necessary to have a known, strong reference signal of the medium (e.g. filtered water) without the solute. Normally, the sensor is therefore subjected to one or multiple calibration environments of known concentrations of the solute under investigation using a calibration protocol, in order to define the sensor's output. However such a method is not able to take into account dynamic changes in the signal, e.g. due to signal drift or due to changes in the environmental circumstances. There is thus still a need in the art for better ways to provide a good reference signal for such sensors. EP 2 072 006 A1 describes an implantable product comprising an analyte container and a non-analyte container for optically characterising analytes in a sample.

Summary of the invention

[0004] It is an object of the present invention to provide good apparatus or methods for sensing target components.

[0005] It is an advantage of embodiments of the present invention that an accurate reference signal can be used, created by an embedded reference sensor, embedded in the photonic sensing system.

[0006] It is an advantage of embodiments of the present invention that the reference used is a dynamic reference based on diffusion of the reference substance through the encapsulation material.

[0007] The above objective is accomplished by a sensing system according to the present invention as defined in appended claim 1 and by a method according to the present invention as defined in appended claim 15. Particular embodiments of the invention are defined in the appended dependent claims.

[0008] It is an advantage of embodiments according to the present invention that the sensing system provides the possibility for obtaining simultaneously a target signal and a reference signal. It is an advantage of embodiments of the present invention that an accurate detection of target analytes can be performed since the presence of a reference sensor can allow for accurate compensation for fluctuations of components of the sensing system, such as for example fluctuations of an optical radiation source or a detector when the sensing is for example optical sensing, although embodiments are not limited thereto. For example, the sensing system also may be adapted for accurate compensation for variations in the reference substance, e.g. liquid, such as pH, temperature, concentrations of water, presence of ions, etc.

[0009] According to embodiments of the present invention, the first integrated sensor may be adapted to measure a target signal from the target analyte and/or the second integrated sensor may be adapted to measure a reference signal from the reference substance.

[0010] The encapsulation material is selectively permeable to the reference substance with respect to the target analyte.

[0011] It is an advantage of embodiments of the present invention that the second integrated sensor is selectively accessible by the reference substance through diffusion through the encapsulation material. It is an advantage of embodiments of the present invention that the reference substance is based on the sample but that the target analyte is filtered out through filtering by the encapsulation material. In this way, the reference substance is a true reference, having similar basic properties as the sample. Prior to use, the encapsulation material may be in contact with the second integrated sensor and, in use, the interface between the encapsulation material and the second integrated sensor may be adapted for upon diffusion of the reference substance through the encapsulation material, cause delamination of the encapsulation material from the second integrated sensor.

[0012] It is an advantage of embodiments of the present invention, that the reference substance can, during use, be positioned close to the second integrated sensor, such that its characteristics can be sensed by the second integrated sensor.

[0013] According to embodiments of the present invention, a top layer of the second integrated sensor may comprise a non-adhering surface. Such a non-adhering surface may comprise for example silicon carbide or diamond-like carbon, fluorinated polymers, atomic fluorine contamination. It may be a surface that is not targeted by the adhesion chemistry of the encapsulation.

[0014] It is an advantage of embodiments of the present invention, that a non-chemical adhesion may be formed between the encapsulation material and the second integrated sensor such that, upon diffusion of the reference substance through the encapsulation material, delamination between the encapsulation material and the second integrated sensor is promoted.

[0015] In another embodiment, prior to use, the sensing system may comprise a cavity between the second integrated sensor and the encapsulation material.

[0016] It is an advantage of at least some embodiments of the present invention that the possibility for measuring a reference substance is not dependent on delamination between the encapsulation material and the second integrated sensor.

[0017] In another embodiment, a capping structure may cover the cavity, the capping structure may comprise at least one opening for allowing the reference substance to fill the cavity.

[0018] In another embodiment, prior to use, the cavity may be filled with a reference substance.

[0019] It is an advantage of some embodiments of the present invention that a reference measurement can be used without requiring that the encapsulation material is to be permeable to the reference substance.

[0020] In another embodiment, prior to use, the sensing system may comprise a sacrificial layer between the second integrated sensor and the encapsulation material which may dissolve when the reference substance diffuses in.

[0021] In one embodiment, a cavity between the encapsulation material and the second integrated sensor caused by delamination or formed during fabrication may have a height in a direction perpendicular to the surface of the second integrated sensor of at least 1nm, advantageously 250nm or more and may have an upper limit of up to 10mm, e.g. an upper limit of 5mm.

[0022] In one embodiment, the integrated sensors may be adapted for sensing an optical property of the target analyte and/or the reference signal respectively.

[0023] It is an advantage of embodiments of the present invention that optical detection can be performed, allowing a good characterization of a plurality of targets for a plurality of applications. Examples of such applications may be sensing of one or more of glucose, urea, cotinine, triglyceride, protein, cholesterol, ethanol, ketones, hormones or lactate, although embodiments are not limited thereto.

[0024] In one embodiment, the second integrated sensor may comprise a waveguide configuration adapted for sensing a parameter of the reference substance based on evanescent wave detection.

[0025] In one embodiment, the second integrated sensor may be adapted for sensing a parameter of the reference substance based on a direct transmission or reflection measurement.

[0026] In one embodiment, the encapsulation material may comprise at least one polymer, preferably a silicone rubber. It may be at least one tailored polymer.

[0027] In one embodiment, the reference substance may comprise water.

[0028] The target analyte may comprise a molecule, for example a biomolecule, but also nonorganic and/or non-biological molecules, enzymes, ions, individual atoms, etc..

[0029] In one embodiment, a selection layer may cover the first integrated sensor, the selection layer being selectively permeable to the target analyte with respect to at least one further substance. It is an advantage of embodiments of the present invention that a selective permeability for the target analyte can be obtained. It is an advantage of some embodiments of the present invention that a plurality of sensors can be provided for detecting a plurality of target analytes. Different sensors then can be provided for measuring different target analytes or different groups of target analytes.

[0030] In one embodiment, when in use, the target analyte, the reference substance and, optionally, the at least one further substance may originate from a sample contacting the sensing system. It is an advantage of embodiments according to the present invention that the reference substance is not static but can adapt to the common mixture used for contacting the sensing system.

[0031] In one embodiment, the sensing system may be a biocompatible sensor. According to the present invention the encapsulation material is a biocompatible packaging material of the sensing system having good implantation properties. It is an advantage of embodiments according to the present invention that the sensing system can be used for example in an animal or human body as well as in a biological or chemical reactor, container, tank or pipeline.

[0032] The sensing system may be an implantable sensor. It is an advantage of embodiments according to the present invention that a sensing system is provided that can be implanted during a long time in a body of a living creature, such as for example in a human or animal body.

[0033] The sensing system may be an implantable sensor. It is an advantage of embodiments according to the present invention that a sensing system is provided that can be implanted during a long time in flora or soil thereof.

[0034] In one embodiment, the sensing system may comprise a controller, wherein the controller is adapted for measuring a reference signal after at least a predetermined time allowing sufficient diffusion of the reference substance through the encapsulation material.

[0035] The present invention also relates to a method as defined in appended claim 15.

[0036] The method may comprise delaying measuring of the reference signal using the second integrated sensor for allowing delamination between the encapsulation material and the second integrated sensor by diffusion of a reference substance through the encapsulation material.

[0037] The above and other characteristics, features and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention. This description is given for the sake of example only, without limiting the scope of the invention, which is defined and limited by the appended claims. The reference figures quoted below refer to the attached drawings.

Description of illustrative embodiments

[0038] The present invention will be described with respect to particular embodiments and with reference to certain drawings but the scope of the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes. The dimensions and the relative dimensions do not correspond to actual reductions to practice of the invention.

[0039] Furthermore, the terms first, second and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequence, either temporally, spatially, in ranking or in any other manner. It is to be understood that, within the scope of the appended claims, the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein.

[0040] Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes and not necessarily for describing relative positions. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other orientations than described or illustrated herein.

[0041] It is to be noticed that the term "comprising", used in the claims, should not be interpreted as being restricted to the means listed thereafter; it does not exclude other elements or steps. It is thus to be interpreted as specifying the presence of the stated features, integers, steps or components as referred to, but does not preclude the presence or addition of one or more other features, integers, steps or components, or groups thereof. Thus, the scope of the expression "a device comprising means A and B" should not be limited to devices consisting only of components A and B. It means that with respect to the present invention, the only relevant components of the device are A and B.

[0042] Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment, but may. Furthermore, within the scope of the appended claims, the particular features, structures or characteristics may be combined in any suitable manner, as would be apparent to one of ordinary skill in the art from this disclosure, in one or more embodiments.

[0043] Similarly, it should be appreciated that in the description of exemplary embodiments of the invention, various features of the invention are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of one or more of the various inventive aspects. This method of disclosure, however, is not to be interpreted as reflecting an intention that the claimed invention requires more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive aspects lie in less than all features of a single foregoing disclosed embodiment. Thus, the claims following the detailed description are hereby expressly incorporated into this detailed description, with each claim standing on its own as a separate embodiment of this invention.

[0044] Furthermore, while some embodiments described herein include some but not other features included in other embodiments, within the scope of the appended claims, combinations of features of different embodiments are meant to be within the scope of the invention, and form different embodiments, as would be understood by those in the art.

[0045] Furthermore, some of the embodiments are described herein as a method or combination of elements of a method that can be implemented by a processor of a computer system or by other means of carrying out the function. Thus, a processor with the necessary instructions for carrying out such a method or element of a method forms a means for carrying out the method or element of a method. Furthermore, an element described herein of an apparatus embodiment is an example of a means for carrying out the function performed by the element for the purpose of carrying out the invention.

[0046] In the description provided herein, numerous specific details are set forth. However, it is understood that embodiments of the invention may be practiced without these specific details. In other instances, well-known methods, structures and techniques have not been shown in detail in order not to obscure an understanding of this description.

[0047] The following terms are provided solely to aid in the understanding of the invention.

[0048] Where in embodiments of the present application reference is made to a photonics integrated circuit (PIC), this refers to a variety of forms and material systems such as for example low-index contrast waveguide platforms (e.g. polymer waveguides, glass/silica waveguides, $Al_xGa_{1-x}As$ waveguides, $In_xGa_{1-x}As_yP_{1-y}$ waveguides), high-index contrast waveguides (e.g. Silicon-on-Insulator, semiconductor membranes), plasmonic waveguides (e.g. metal nano-particle arrays, metal layers), also called Photonic Lightwave circuits (PLC). A photonic integrated circuit comprises at least one integrated optical component, such as for example but not limiting to an integrated optical cavity, an integrated optical resonator, an integrated optical interferometer, an integrated optical coupler, a waveguide, a taper, a tuneable filter, a phase-shifter, a grating, a modulator, a detector, a source, a multiplexer, a demultiplexer or a combination thereof. The optical components can be active or passive. The components can be integrated for example monolithically, heterogeneously or hybridly. Monolithic integration is the integration technology that uses a single processing flow to process the diverse components potentially using different materials, e.g. integrated germanium detectors in silicon photonics IC. Heterogeneous integration is the integration technology for which the components are processed in separate process flows, which are then integrated at die or wafer level, e.g. BCB bonding, wafer bonding, and other bonding schemes, 3D integration. Hybrid integration is the integration of components or materials on processed photonic integrated platforms, e.g. flip-chipping of detectors, bumping, gluing, wire bonding, copackaging, etc.

[0049] The devices and methods of the present invention are further described for the particular case of silicon photonics system (e.g. SOI (Silicon-on-Insulator) or SiN material systems). However, the devices and methods of the present invention can be based on other material systems, such as for example III-V material systems, metallic layers, low index contrast material systems or a combination thereof.

[0050] Silicon photonics is a very interesting material system for highly integrated photonic circuits. The high refractive index contrast allows photonic waveguides and waveguide components with submicron dimensions to guide, bend and control light on a very small scale so that various functions can be integrated on a chip. Moreover, silicon photonics offers a flexible platform for integration with surface plasmon based components which in turn allows for even higher levels of miniaturization. Both waveguide types allow a high level of miniaturization, which is advantageous. Furthermore, for both waveguide types light can be efficiently coupled in and out the PIC by use of e.g. a grating coupler or another coupling element.

[0051] Using silicon photonics also has some technological advantages. Silicon technology has reached a level of maturity in the CMOS industry that outperforms any other plane chip manufacturing technique by several orders of magnitude in terms of performance, reproducibility and throughput. Nano-photonic ICs can be fabricated with wafer-scale processes, which means that a wafer can contain a large number of photonic integrated circuits. Combined with the commercial availability of large wafers at a relative moderate cost, this means that the price per photonic integrated circuit can be very low.

[0052] Where in embodiments of the present invention reference is made to encapsulation material, reference is made to a material that assists in obtaining the possibility to limit or avoid negative interaction between the environment wherein the sensing system is to be used and the sensing system itself. In accordance with the invention, the sensing system and the encapsulation material are adapted for allowing implantation into a living creature providing good implantation properties and the encapsulation material is a biocompatible packaging. However, it's not limited to this and it also might serve as a mechanical, biological or chemical protection of the sensor system to avoid for example fouling, corrosion or degradation of the materials. According to at least some embodiments, where reference is made to "an encapsulation material" reference may be made to a single encapsulation material but alternatively also to a combination of encapsulation materials, all referred to as "an encapsulation material". Furthermore, the encapsulation and filtering function may be performed by two separate materials, e.g. a filtering material and an encapsulation material. Nevertheless, for the ease of description both materials, in case these are separate materials, may be referred to as encapsulation material, since also the filtering material will encapsulate the second reference sensor.

[0053] In accordance with the present invention the sensor or sensing system is packaged in a biocompatible packaging such that good implantation properties are obtained. The latter may be a sensor's protection that can also serve as a biocompatible packaging as known from prior art or a more dedicated biocompatible packaging, specifically designed for the sensor. The sensor may be packaged such that it is transparent for magnetic fields or incident electromagnetic radiation. The packaging may also enable a bio-mimic interface with its environment.

[0054] The invention will now be described by a detailed description of several embodiments of the invention. It is clear that other embodiments of the invention can be configured according to the knowledge of the person skilled in the art without departing from the true technical teaching of the invention, the invention being limited only by the terms of the appended claims.

[0055] In a first aspect, the present invention relates to a sensing system as defined in appended claim 1 comprising a photonics integrated circuit. The photonics integrated circuit is partially encapsulated by an encapsulation material. According to the present invention, the photonics integrated circuit comprises a first integrated sensor accessible to a target analyte. The first integrate sensor therefore is positioned in a part of the photonics integrated circuit not being encapsulated by an encapsulation material. According to the present invention, the photonics integrated circuit also comprises at least a second integrated sensor accessible to a reference substance. The second integrated sensor is positioned in a part of the photonics integrated circuit that is encapsulated by an encapsulation material, and therefore is not directly accessible by the target analyte. The sensing system furthermore is adapted to, when in use, comprise, between the reference sensor and the encapsulation material the reference substance but less or no target analyte, as compared to the amount of target analyte being present at the first integrated sensor. The latter can be obtained in a plurality of ways. For example, in some embodiments, the reference substance enters the respective sensing area during use by diffusion of the reference substance through the encapsulation material, whereby the target components are filtered out by the encapsulation material since these cannot diffuse through the encapsulation material. In other embodiments the reference substance may be introduced upfront, typically in a cavity between the reference sensor and the encapsulation material.

[0056] In some embodiments, the cavity is created between the encapsulation material and the second integrated sensor by delamination of the encapsulation material from the second integrated sensor. The reference substance thereby diffuses towards the area between the encapsulation material and the second integrated sensor. In other embodiments, a predetermined cavity is introduced between the encapsulation material and the second integrated sensor during manufacturing. In still other embodiments, a cavity is introduced by the dissolving of a sacrificial layer.

[0057] By way of illustration, embodiments of the present invention not being limited thereto, standard and optional features will now be described with reference to particular examples and drawings.

[0058] In a first example, a sensing system is described wherein the cavity is created by delamination of the encapsulation material.

[0059] In FIG. 1a and FIG. 1b, a sensing system 100 is schematically represented. As seen in Fig. 1a, the sensing system 100 comprises a photonics integrated circuit partially encapsulated by a selectively permeable soft encapsulation material 200, such as a polymer. The photonics integrated circuit comprises a substrate 300 carrying a first integrated sensor 410 and a second integrated sensor 420, electronics 500 enclosed in a dry hermetic compartment 600 and electrical connections 700 connecting the first and second integrated sensor 420 to the electronics 500. The encapsulation is such that the first integrated sensor 410 is exposed to the environment, whereas the second integrated sensor 420 is embedded under the soft encapsulation material 200.

[0060] Fig. 1b shows an enlarged view of the area indicated in Fig. 1a. The contact between the soft encapsulation material 200 and the substrate 300 comprises a strong chemical adhesion. Conversely, the contact between the soft encapsulation material 200 and the second integrated sensor 420 consists of a weaker non-chemical adhesion, for example based on Van der Waals or electrostatic interactions. Substances which can cross the selectively permeable encapsulation material 200, such as water, can disrupt the weaker non-chemical adhesion, thereby causing a delamination of the encapsulation material 200 above the second integrated sensor 420. A cavity 800 is thereby formed above the second integrated sensor 420, which is accessible only to substances which can permeate the encapsulation material 200.

[0061] The encapsulation material 200 is selected such that it is permeable to a reference substance (typically water or other small molecules), whereas it is not permeable, or at least less permeable, to a target analyte (typically a larger molecule such as a biomolecule).

[0062] Thus, when the sensing system 100 is contacted to a mixture of interest, the system is able to measure simultaneously a target signal from the mixture at the exposed first integrated sensor 410, and a reference signal from the filtered mixture above the second integrated sensor 420, i.e. from those compounds that can permeate the encapsulation material 200 to the cavity 800.

[0063] In a second example a sensing system is described wherein a predetermined cavity 800 is present. FIG. 2 illustrates such a sensing system 100, schematically represented. The sensing system 100 comprises a photonics integrated circuit partially encapsulated by a selectively permeable soft encapsulation material 200, such as a polymer. The photonics integrated circuit comprises a substrate 300 carrying a first integrated sensor 410 and a second integrated sensor 420. The encapsulation is such that the first integrated sensor 410 is exposed to the environment, whereas the second integrated sensor 420 is embedded under the soft encapsulation material 200. The electronics 500 enclosed in a dry hermetic compartment 600 and electrical connections 700 connecting the first and second integrated sensor 420 to the electronics 500, as shown in Fig. 1a, are omitted for the ease of representation.

[0064] The sensing system 100 differs from the one in example 1 in that a predetermined cavity 800 is present, enclosed by a capping structure 900. The capping structure 900 comprises one or more openings, such as an opening 910 in the lid of the capping structure 900 and/or an opening 920 between the capping structure 900 and the substrate 300, and is attached to the substrate 300 at an anchor point 930. The encapsulation material 200 covers the capping structure 900 and substances which have permeated the encapsulation material 200 can fill the cavity 800 above the second integrated sensor 420 by virtue of the one or more openings 910 and/or 920. As such, the cavity 800 is again selectively accessible only to substances which can permeate the encapsulation material 200.

[0065] Also here, the encapsulation material 200 is selected such that it is permeable to a reference substance (typically water or other small molecules), whereas it is not permeable, or at least less permeable, to a target analyte (typically a larger molecule such as a biomolecule).

[0066] Thus, when the sensing system 100 is contacted to the sample or mixture of interest, the system is able to again measure simultaneously: i.e. a target signal from the sample or mixture at the exposed first integrated sensor 410, and a reference signal from the filtered mixture above the second integrated sensor 420, i.e. from those compounds that can permeate the encapsulation material 200 to the cavity 800.

[0067] In yet another example, the cavity may be formed by a sacrificial material that initially is present but that may disappear, e.g. dissolve, when in use, for example when the material is brought into contact with the reference material upon diffusion of the reference material through the encapsulation material. Such sacrificial material may be for example salt, sugar, Fructose, PVA (polyvinylalcohol), PEG (polyethylene glycol), Polyacrylic acid or combinations of these.

[0068] In another aspect, the present invention relates to a method for measuring a target signal and/or a reference signal, comprising providing a sensing system as described above, contacting a sample to the sensing system, the sample comprising at least a target analyte and a reference substance, and measuring the target signal using the first integrated sensor and/or measuring the reference signal using the second integrated sensor. Method steps corresponding with features of the system as described in the first aspect may furthermore be part of a method according to embodiments of the present invention. The method also may be especially suitably be performed using a system as defined in appended claim 1.

REFERENCES CITED IN THE DESCRIPTION

Cited references

Patent documents cited in the description

- EP2072006A1 [0003]

INTEGRERET FOTONISK REFERENCESENSOR

Patentkrav

1.- Følesystem (100) til registrering af en analysand i en prøve, hvor følesystemet (100) omfatter et fotonisk integreret kredsløb og et indkapslingsmateriale (200), idet det fotoniske integrerede kredsløb er delvist indkapslet af indkapslingsmaterialet (200), idet det fotoniske integrerede kredsløb omfatter:

- en første integreret sensor (410), der er tilgængelig til at tage en prøve med analysanden, og mindst

- en anden integreret sensor (420), der er tilgængelig for et referencestof, hvor referencestoffet, for eksempel vand eller andre små molekyler, er baseret på prøven, men analysanden er mindste delvist filtreret væk ved filtrering med indkapslingsmaterialet (200), således at referencestoffet har lignende grundlæggende egenskaber som prøven, idet den anden integrerede sensor (420) er placeret i den del af det delvist indkapslede fotoniske integrerede kredsløb, som er indkapslet af indkapslingsmaterialet (200);

hvor følesystemet (100) er konfigureret, således at, når følesystemet (100) anvendes, mellem den anden integrerede sensor (420) og indkapslingsmaterialet (200), er referencestoffet til stede, men ingen analysand, eller mindre analysand end den mængde analysand, der er til stede ved den første integrerede sensor (410), og hvor

den første integrerede sensor (410) er placeret i den resterende del af det delvist indkapslede fotoniske integrerede kredsløb, der ikke er indkapslet af indkapslingen (200), kendetegnet ved

at indkapslingsmaterialet (200) er et biokompatibelt emballagemateriale af følesystemet (100), der har gode implantationsegenskaber.

2.- Følesystemet (100) ifølge krav 1, hvor indkapslingsmaterialet (200) er selektivt gennemtrængeligt for referencestoffet med hensyn til analysanden.

3.- Følesystemet (100) ifølge et hvilket som helst af de foregående krav, hvor indkapslingsmaterialet (200) omfatter silikonegummi.

4.- Følesystemet (100) ifølge et hvilket som helst af kravene 2 til 3, hvor indkapslingsmaterialet (200) før anvendelse konfigureres til at være i kontakt med den anden integrerede sensor (420), og hvor grænsefladen mellem indkapslingsmaterialet (200) og den anden integrerede sensor (420) under anvendelse konfigureres, således at delaminering af indkapslingsmaterialet fra den anden integrerede sensor (420) kan forårsages efter diffusion af referencestoffet gennem indkapslingsmaterialet (200).

5.- Følesystemet (100) ifølge krav 4, hvor et øverste lag af den anden integrerede sensor (420) omfatter en ikke-klæbende overflade.

6.- Følesystemet (100) ifølge et hvilket som helst af kravene 1 eller 2, hvor følesystemet (100) før anvendelse omfatter et hulrum (800) mellem den anden integrerede sensor (420) og indkapslingsmaterialet (200).

7.- Følesystemet (100) ifølge krav 6, hvor følesystemet (100) omfatter en kapslingsstruktur (900), der dækker hulrummet (800), idet kapslingsstrukturen (900) omfatter mindst én åbning, der tillader referencestoffet af fylde hulrummet (800).

8.- Følesystemet (100) ifølge krav 6, hvor følesystemet før anvendelse omfatter et referencestof, og hvor hulrummet (800) før anvendelse er fyldt med referencestoffet.

9.- Følesystemet (100) ifølge et hvilket som helst af kravene 1 eller 2, hvor følesystemet (100) før anvendelse omfatter et offerlag mellem den anden integrerede sensor (420) og indkapslingsmaterialet (200), der er konfigureret til at opløses, når referencestoffet spredes derind.

10.- Følesystemet (100) ifølge et hvilket som helst af de foregående krav, hvor et hulrum mellem indkapslingsmaterialet (200) og den anden integrerede sensor (420), der er forårsaget af delaminering ved anvendelse af følesystemet (100) eller dannet under fremstilling, har en højde i en retning, som er vinkelret på overfladen af den anden integrerede sensor (420), og som er i intervallet mellem 1 nm og 10 mm, for eksempel i et interval mellem 250 nm og 5 mm.

11.- Følesystemet (100) ifølge et hvilket som helst af de foregående krav, hvor den anden integrerede sensor (100) omfatter en bølgelederkonfiguration, der er tilpasset til at registrere en parameter for referencestoffet på grundlag af kortbølgeregistrering.

12.- Følesystemet (100) ifølge et hvilket som helst af de foregående krav, hvor følesystemet omfatter et udvælgelseslag, der dækker den første integrerede sensor (410), idet udvælgelseslaget er selektivt gennemtrængeligt for analysanden med hensyn til mindst ét yderligere stof.

13.- Følesystemet (100) ifølge et hvilket som helst af de foregående krav, hvor analysanden, referencestoffet og, valgfrit, det mindst ene yderligere stof ved anvendelse af følesystemet (100), stammer fra en prøve, der er i kontakt med følesystemet (100).

14.- Følesystemet (100) ifølge et hvilket som helst af de foregående krav, hvor følesystemet (100) er en implanterbar biokompatibel sensor.

15.- Fremgangsmåde til måling af et destinationssignal og/eller et referencesignal, der omfatter:

a. tilvejebringelse af et følesystem (100) ifølge et hvilket som helst af de foregående krav,
b. sammenføring af en prøve med følesystemet (100), idet prøven omfatter mindst én analysand og et referencestof, og
c. måling af destinationssignalet ved hjælp af den første integrerede sensor (410) og/eller måling af referencesignalet ved hjælp af den anden integrerede sensor (420).

DRAWINGS

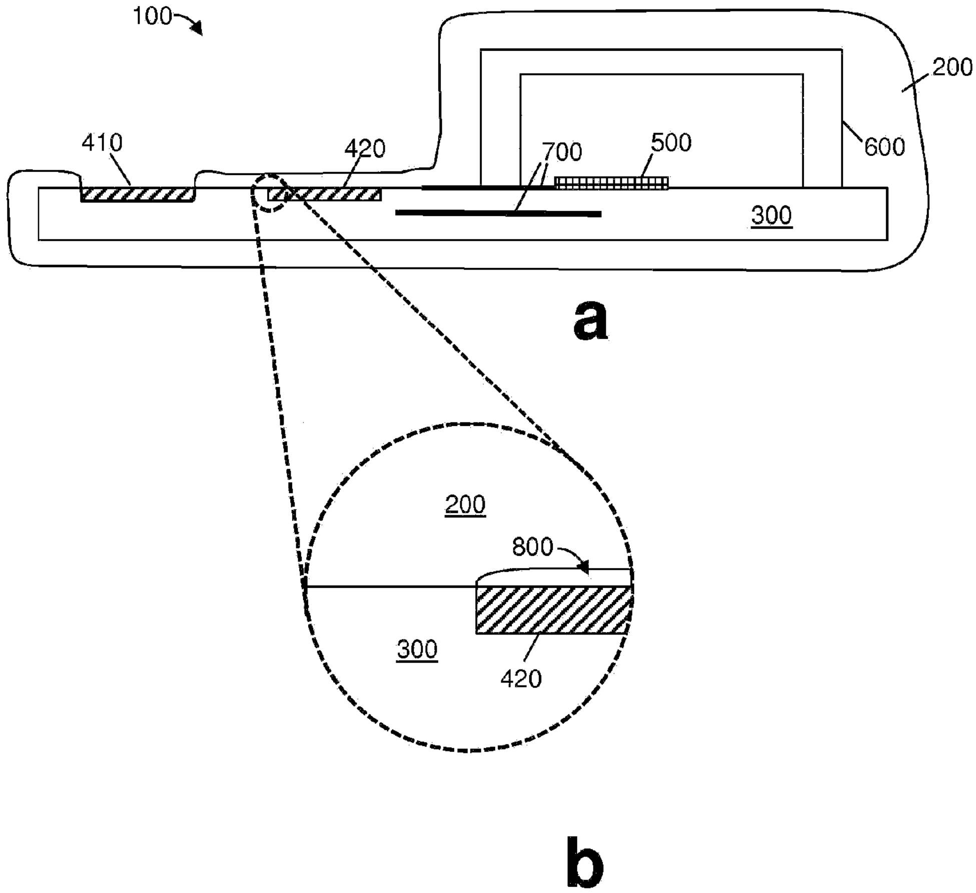

FIG. 1

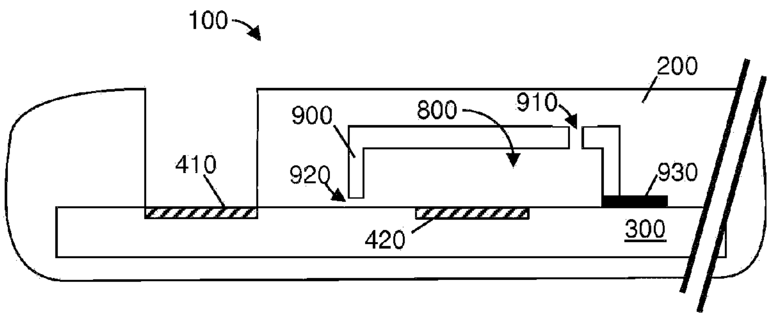

FIG. 2