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(54) METHOD AND DEVICE FOR MONITORING ANALYTE CONCENTRATION BY OPTICAL DETECTION

VERFAHREN UND VORRICHTUNG ZUR ÜBERWACHUNG DER ANALYTKONZENTRATION DURCH OPTISCHEN NACHWEIS

PROCEDE ET DISPOSITIF DE SUIVI DE LA CONCENTRATION D'UN ANALYTE PAR DETECTION OPTIQUE

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Description

[0001] This invention relates to biological sensors, more specifically to implantable sensors for optically detecting compounds such as glucose, in a living creature, for example, in the human or animal body. More specifically, but not exclusively, this invention relates to biological sensors for the detection of glucose in blood or tissue of a diabetic patient.

[0002] Diabetic patients can improve their life quality and life expectancy by maintaining their blood glucose concentration close to the natural level of a healthy person. To achieve this natural concentration, diabetic patients must frequently measure their glucose concentration, and adjust their insulin dosing in accordance with the measured concentration. Usually, a blood sample is obtained for measurement of blood glucose concentration, and there are a number of different glucose test kits on the market based on measurement from a blood sample. The disadvantage of these test kits is the need to take a blood sample which must be collected from a suitable place in the body.

[0003] Self monitoring devices, based on capillary blood glucose, are practical but still require repeated and frequent skin punctures, which is inconvenient for the patient and require certain hygienic precautions.

[0004] Biological sensors in the form of implantable devices are also known in the art and include electrochemical devices and optical devices based on the creation of an electrical or optical signal by the consumption of the compound detected by the analysis. An example is to be found in US 6,011,984, which discloses methods utilising an amplification component. The sensitivity and the responsivity of such devices are influenced by the formation of a bio film, for example, by fibrous encapsulation of the device which reduces the transport rate of the compound to the sensor. Depending on the specific sensor, other mechanisms which cause deterioration of sensor performance of implanted devices, may also be present, for example, membrane de-lamination and degradation, enzyme degradation and electrode passivation.

[0005] Various proposals have been made for non-invasive measurement of glucose levels in the human body by spectroscopic methods but the effects of water in the body, the low concentration of glucose to be measured and the optical effects produced by skin all contribute to the difficulty of making satisfactory measurements.

[0006] One solution proposed (Gowda et al Proc. SPIE Vol. 4263 (2001) p. 11 et seq) has been to provide an implanted window in the skin but, leaving aside any other considerations, some patients, at least, would find this unpleasant.

[0007] Another solution (US 5,372,135) is to perform the analysis through the ear lobe and perform a computer analysis on results before and after the volume of the blood in the tissue has been changed. This technique has the disadvantage that the skin has an effect both on the entry and the exit of light.

[0008] WO00/33065 discloses an implantable glucose sensor comprising a photodetector unit, for detecting light from an external light source, and a signal processing unit for evaluating glucose concentrations. Data may be transmitted to a drug delivery pump.

[0009] From WO01/6600 a device is known for in-vivo measurements of concentrations of substances in a body fluid comprising a light source, a light detector and a light transmitter/reflector to be implanted within the body. In one embodiment, the light transmitter may comprise two light reflecting surfaces at different levels beneath the skin, one forming a measurement surface and the other forming a reference surface. By subtracting the measurement signal - obtained by reflection detection from the measurement surface - from the reference signal - obtained from the reference surface - this difference signal is largely independent from influences of the skin and yields a measurement value representative of the concentration of the substance.

[0010] It is an object of the invention to provide an implantable device which can be used for monitoring analyte concentration but enables the effects of skin in the analysis to be reduced.

[0011] The present invention provides a device for implantation beneath the skin of a living creature, the device having outer surfaces of biocompatible material and comprising the features as defined in claim 1.

[0012] The difference between the said distances allows a differential analysis to take place so that the effects of skin in the results can be reduced or avoided. The differential analysis may be a simple formation of a difference in signals or may be a complex computer correlation. The analysis may be performed within the device or externally.

[0013] Such a device can be used to provide an alternative way to overcome the discomfort and inconvenience for diabetic patients, by providing (once the initial implantation is finished) a non-invasive measurement method for glucose concentration.

[0014] The implanted detector may be divided into areas at different levels. By this means, the distance travelled by the light through the compound of interest in the body tissues, and thus the interaction of light with the compound, varies from area to area.

[0015] The spacing between the different levels may, for example, be between 0.5 and 5 millimetres, for example, between 0.5 and 3 millimetres, for example between 1 and 2.5 millimetres.

[0016] The number of areas within a group may, for example, be between 2 and 30, for example, between 5 and 25, for example, between 10 and 20.

[0017] The device may include means to provide a differential analysis of signals arising from the said difference in distances. Instead, a differential analysis may be performed on the data in an external apparatus to which the device transmits data.

[0018] Heating means and/or cooling means may be provided to act on the body region surrounding the de-

vice.

[0019] The areas may be provided within wells to reduce the effects of stray light.

[0020] The areas may be covered by optical filter means to prevent light of wavelengths other than those of interest from reaching the areas.

[0021] Preferably, groups of areas are provided, each group of areas forms a common level, and the common levels have a predetermined spacing from each other to provide the said difference in distance over which light interacts with compounds and tissue.

[0022] Preferably, the first group of areas is formed at a base level of the device and the second group of areas is formed by projections from the said base level to a top level.

[0023] Preferably, the device further includes a spacer covering one of said at least one areas or groups so that compounds and tissue are unable to fill the volume of the spacer, the spacer providing the difference in distance over which light interacts with compounds and tissue.

[0024] The spacer can be formed by a sealed volume above some of the areas so that light reaching those areas experiences less interaction with the compound and tissues than light reaching uncovered reflecting areas.

[0025] At least one substantially flat area constituting a third area or group of areas may be provided and form a common level between the base level and the top level.

[0026] At least a part of one of said areas may be formed by a permeable membrane.

[0027] The said membrane may be permeable to glucose.

[0028] The invention also provides a method for optically detecting the content of a compound in the body of a living creature, the method comprising:

directing a light source on different areas of an implanted device containing detection means, the distance, between the skin and said detection means, over which light from a light source interacts with compounds and tissue in respect of one area differing from the distance, between the skin and said detection means, over which light from a light source interacts with compounds and tissue in respect of another area;

obtaining light-representing signals by means of said detection means; and

analysing the detected signals, the analysis preferably being based on the difference between the detected signals, to obtain a value for the content of a compound being detected.

[0029] Preferably, the analysis of the detected signals is a differential analysis or is based ou an average of signals.

[0030] The compound may be glucose.

[0031] The measuring principle used in this invention is not, however, limited to implanted devices in diabetic patients for measuring glucose concentration, but can be used in many other applications. The basic principle can be used for measuring compounds in locations which are difficult to access, and where the physical and chemical conditions vary over time. Measurement can be made of glucose concentration in a bioreactor, glucose in fruit juice etc.

[0032] The invention also provides a device for implantation beneath the skin of a living creature, the device having outer surfaces of biocompatible material and comprising:

reflection means for reflection of light, the said reflection means comprising at least one substantially flat area constituting a first area or, when a plurality of areas are provided, a first group of areas and at least one substantially flat area constituting a second area or, when a plurality of areas are provided, a second group of areas; and wherein the arrangement of the first and second areas or groups of areas within the device is such that the distance, between the skin and said reflection means, over which light from a light source interacts with compounds and tissue in respect of said first area or group of areas differs from the distance, between the skin and said reflection means, over which light from the light source interacts with compounds and tissue in respect of said second area or group of areas.

[0033] Implantable devices constructed in accordance with the invention and methods in accordance with the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic representation showing an optical device, an implanted device and a receiving device;

Fig. 2 is a schematic representation of a first implantable device embodying the invention, the device containing photo detectors and being coated with a biocompatible material;

Fig. 3 is a schematic representation of a second implantable device embodying the invention, the device being step-like and having two detector levels;

Fig. 4 is a schematic representation of a third implantable device embodying the invention, the device containing a multiplicity of detection areas at two different levels;

Fig. 5 is a schematic representation of a fourth implantable device embodying the invention, the device having photo detectors placed in detector wells;

Fig. 6 is a schematic representation of a fifth implantable device embodying the invention, the device having detection areas covered by a membrane on the top;

Fig. 7 is a schematic representation of a sixth implantable device embodying the invention, the device having detection areas covered partly by a membrane and partly by a lid on the top;

Fig. 8 is a schematic representation of a seventh implantable device embodying the invention, the device including electric connections and an electronic circuit device;

Fig. 9 is a schematic representation of an eighth implantable device embodying the invention the device including a spacer covering some of the areas of the device;

Fig. 10 shows a section through figure 9 along the line X-X and shows the spacer.

[0034] In the illustrated embodiments of the invention, optical methods based on the interaction of light with compounds and body tissues are utilised. The optical methods in their general aspects correspond to those described in the literature, for example, using Beer-Lambert law and/or radiative transport theory and will not therefore be described further here.

[0035] In the illustrated embodiments of the invention, light from a light source is incident on an implanted detector, the light is detected by a detection device in the implanted detector, and a signal is transmitted to a receiving device for analysis. The characteristics of the detected light depend on the interaction with the compounds encountered on the way from the light source to the detector.

[0036] In the illustrated embodiments of the invention, the implanted detector is divided into areas at different levels, so that the distance for the light through the compounds, - and thus the interaction with light, varies from area to area. A differential analysis is performed on signals produced by the detector.

[0037] Referring now to fig. 1, an implanted device 1 is placed underneath the skin 2 so that the compound to be measured is contained between the skin and the implanted device. An optical device 3, containing a light source 30 and a lens system 5, is placed external to the skin above the implanted device, and a signal for the detected light is transferred from the implanted device to a receiver 6.

[0038] The light intensity emitted from the light source is preferably approximately constant over the whole of the implanted device. It is thereby ensured that variations in the detected light are due only to absorption in the path from light source to detector and not due to variations in emitted light intensity.

[0039] Referring still to fig. 1, the light source is, for example, a light source of a broad continuous spectrum, for example a thermal white light source, depending on the compound to be measured. In the case of measuring glucose concentration, the wavelength should be well represented in the near infrared spectrum, more specifically between 1000 and 2500 nm. The light source is in this case therefore, for example, an LED, one or more laser diodes or an LED array producing wavelengths in this range. Alternatively a monochromator can be used with a white light source to select light within a desired wavelength range and directed onto the implanted device.

[0040] Wavelength specific light detection can also be obtained by covering the detectors with a film, transparent for only a specific wavelength or wavelength range. In this way is it possible to detect within a range of wavelengths simply by having a light source with a range of wavelengths and a number of detectors with different films. The film covering each detector also prevents detection of background light, as this not will pass through the film. Alternatively the detection within a range of wavelengths can be carried out by having more than one light source, and successively directing light of different wavelengths on the implanted device.

[0041] The light absorption for some compounds is temperature dependent, meaning that the detected light on the implanted device varies with the temperature of the compounds and tissue. Fig. 1 shows a cooling/heating device 7, such as a Pelletier element, formed as a ring around the light emitting area. With this element it is possible to perform measurements at different temperatures, so as to facilitate and improve the analysis. In case of analysis at different temperatures, the actual temperature can be recorded by a thermo element or the like, placed in the device 3.

[0042] Referring to fig. 8, the implanted device 1 contains a number of photo detectors 8, which by wires 17 are connected to an electronic circuit device 18. The electronic circuit device can be operated by power and data transmission without the use of connecting wires to the outside. Such power transmission can be implemented by the use of a so-called inductive link, which is basically a coreless transformer. Transmission of data from the electronic circuit device to the external receiver can take place, for example, by varying the load seen by the secondary of the transformer located in the implanted device (for example, the resistance change of a photo conductivity cell), or for example, by measuring the change of resonance frequency of a series resonant circuit (for example, the change of capacitance due to the photo current in a photo diode).

[0043] Referring now to fig. 2, the implanted device shown here consists of a number of detectors 8, contained in a polymeric or elastomeric matrix with biocompatible surfaces. The shape of the detector is made steplike to provide two levels of detection areas, base level 9 and extended level 10. In this way the detected light

varies depending on which level the light is detected in, and-the variation is dependent on the interaction of light with compounds and components in the volume between the two levels, henceforth called the measurement volume 11.

[0044] The implanted device can, for example, have a step-like shape in one direction, as indicated by an arrow in fig. 3, or a step-like shape in two directions as indicated by two arrows in fig, 4. Having more than one detector at each level increases the sensitivity of the analysis, as the signals from each level can then be averaged.

[0045] Referring now to fig. 5, each detector is shown placed in a detection well 12 so that only parallel light is detected. This has the effect that only the emitted and directly transmitted light is detected and not light from another light source, such as background light.

[0046] Covering the device with a membrane 13 can reduce interference by other compounds and noise due to scattering components. The membrane is sufficiently transparent at the appropriate wavelengths employed for the measurement (if placed on top of the measurement volume), and is permeable to the compound to be measured, for example glucose, but prevents other molecules larger than the compound to be measured from entering the measurement volume. The membrane can be placed above the measurement volumes, that is, between measurement volumes and the light source and detector, and/or to the sides of the measurement volumes. Placing the membrane to the side of the measurement volume enables a long optical path length and at the same time a relatively short response time of the device with respect to changes in the concentration in the surrounding tissue and liquid. This is because a larger membrane area is available for permeation into the measurement volume and because the required diffusion length of the compound in the measurement volume can be shorter than the optical path length. The measurement volume can be filled with liquid or with a solid matrix permeable to a compound to be analysed.

[0047] The detected signal of the device is calibrated to a known concentration of the compound to be analysed, either one time for all or preferably from time to time. Measuring the concentration in a sample, taken at the same time as the optical measurement, can be used to achieve this calibration. The device however can be made self-calibrating, if two measurement volumes contain a known concentration of compound.

[0048] In fig. 7 a part of the device is covered with a diffusion proof lid 14 instead of with a membrane. This forms two measurement volumes 15, 16 with known concentrations of the compound under analysis, preferably one volume with a concentration in the lower end and one volume with a concentration in the high end of the required measurement range.

[0049] The formation of a bio film on the implanted device will have less effect than is the case for electrochemical devices or other devices in which the compound to be measured is consumed in the measurement process. As long as the bio film is sufficiently transparent at the optical wavelengths employed, the bio film will have very little effect on the measurement. In the case where a membrane is used, as described above, the bio film may influence the response time with respect to changes in the concentration in the surrounding tissue and liquid, but is will still have little effect on the measurement itself.

[0050] The two levels of detection areas can be increased to three or more different levels. By increasing from two to three or more levels, the dynamic range of the sensor can be increased, as the analysis of the detected signal then discloses three or more levels corresponding to 2 or more interaction volume optical path lengths. Also more information is made available for data analysis to establish compound concentrations using, for example, chemometric, multivariant data analysis approaches. More levels also facilitate consistency and quality control of data.

[0051] Turning now to figure 9, the implanted device is shown made as a laminated structure, where a base plate 19 contains the detectors, the wiring and an electronic circuit device. The top part 20 is laminated on the base plate, where after the base plate and the top part together forms the implantable device.

[0052] In the top part 20 two spaces 21 and 22 are made, simply by removing some material from the top part 20. The two spaces form two areas so that the device is able to detect light from two areas. The space 21 is created on the surface of the top part which faces away from the base plate so that compounds and tissue have access to the space when the device is implanted. The space 22 however is formed on the surface of the top part which faces towards the base plate so that compounds and tissue have no access to the space 22 when the device is implanted, as the space 22 is closed. This is indicated in figure 10, showing a section through X-X of the top part of figure 9. The detecting area underneath space 21 and space 22 is formed on the same surface but as the space 22 is closed, the interaction of light with compounds and tissue occurs over a larger distance at space 21 than at space 22. The closed space 22 forms a spacer. A spacer can also be formed of a solid material transparent to the incident light. A "spacer" is to be understood as a volume in which no interaction of light with compounds and tissue occurs.

Claims

1. A device (1) for implantation beneath the skin (2) of a living creature, the device having outer surfaces of biocompatible material and comprising:

   - detection means (8) for detection of light,
   - transmitting means for transmitting a signal derived from said detection means to an external device,wherein

said detection means (8) positioned at,

- a first group of a plurality of substantially flat areas at a first level and
- a second group of a plurality of substantially flat areas at a second level,

the arrangement of the first and second groups of areas within the device is such that the distance between the skin (2) and said detection means (8), over which light from a light source (4) interacts with compounds and tissue in respect of said first group of areas differs from the distance between the skin (2) and said detection means (8), over which light from a light source interacts with compounds and tissue in respect of said second group of areas.

2. A device according to claim 1, wherein each area of each group of areas forms a common level, and the common levels have a predetermined spacing from each other to provide the said difference in distance over which light interacts with compounds and tissue.

3. A device according to claim 2, wherein said first group of areas is formed at a base level (9) of the device and said second group of areas is formed by projections (10) from the said base level to a top level.

4. A device according to claim 1, further including a spacer (21, 22), covering one of said groups of areas so that compounds and tissue are unable to fill the volume of the spacer, the spacer (21, 22)providing the difference in distance over which light interacts with compounds and tissue.

5. A device according to claim 3, wherein at least one substantially flat area constituting a third area or group of areas is provided and forms a common level between said base level and said top level

6. A device according to any one of claims 1 to 5, wherein at least a part of one of said areas is formed by a permeable membrane.

7. A device according to claim 6, wherein the said membrane is permeable to glucose.

8. A method for optically detecting the content of a compound in the body of a living creature, the method comprising:

directing a light source (4) on different areas of an implanted device containing detection means, the distance, between the skin (2) and said detection means (8), over which light from a light source interacts with compounds and tissue in respect of one area differing from the distance, between the skin (2) and said detection means (8), over which light from a light source interacts with compounds and tissue in respect of another area;
obtaining light-representing signals by means of said detection means (8); and
analysing the detected signals, the analysis preferably being based on the difference between the detected signals, to obtain a value for the content of a compound being detected.

9. A method according to claim 8 wherein the analysis is based on an average of signals.

10. A method according to claim 8 or claim 9, wherein the compound is glucose.

11. A method according to claim 8, wherein the implanted device (1) is in accordance with any one of the claims 1 to 7.

Patentansprüche

1. Ein Gerät (1) zur Implantation unter der Haut (2) eines Lebewesens, wobei das Gerät äußere Oberflächen aus einem biokompatiblen Material hat und Folgendes aufweist:

- Nachweismittel (8) zum Nachweisen von Licht,
- Übertragungsmittel zur Übertragung eines Signals aus den Nachweismitteln zu einem externen Gerät,

wobei die Nachweismittel (8) an

- einer ersten Gruppe einer Vielzahl von im Wesentlichen flachen Bereichen in einem ersten Plan, und
- einer zweiten Gruppe einer Vielzahl von im Wesentlichen flachen Bereichen in einem zweiten Plan

angebracht sind,
wobei die Anordnung der ersten und der zweiten Gruppen von Bereichen im Gerät so ist, dass der Abstand zwischen der Haut (2) und den Nachweismitteln (8), über den Licht aus einer Lichtquelle (4) mit Präparaten und Gewebe in bezug auf die erste Gruppe von Bereichen zusammenwirkt von dem Abstand zwischen der Haut (2) und den Nachweismitteln (8) abweicht, über den Licht aus einer Lichtquelle (4) mit Präparaten und Gewebe in bezug auf die zweite Gruppe von Bereichen zusammenwirkt.

2. Ein Gerät nach Anspruch 1, in dem jeder Bereich aus jeder Gruppe von Bereichen einen gemeinsa-

men Plan bilden, und die gemeinsamen Pläne vorbestimmte Abstände zu einander haben um die genannte Abweichung zu schaffen, über die Licht mit Präparaten und Gewebe zusammenwirkt.

3. Ein Gerät nach Anspruch 2, in dem die erste Gruppe von Bereichen in einem Grundplan (9) des Gerätes ausgebildet ist, und die zweite Gruppe von Bereichen durch Projizierungen (10) vom Grundplan auf ein Oberplan ausgebildet ist.

4. Ein Gerät nach Anspruch 1, das zusätzlich ein Abstandstück (21, 22) aufweist, das eine der genannten Gruppen von Bereichen so abdeckt, dass Präparate und Gewebe außer Stande sind das Volumen des Abstandstücks auszufüllen, wobei das Abstandstück (21, 22) die Abweichung des Abstandes schafft, über die Licht mit Präparaten und Gewebe zusammenwirkt.

5. Ein Gerät nach Anspruch 3, in dem mindestens ein im Wesentlichen flacher Bereich vorgesehen ist, der einen dritten Bereich oder eine dritte Gruppe von Bereichen ausmacht, und der einen gemeinsamen Plan zwischen dem Grundplan und dem Oberplan bildet.

6. Ein Gerät nach jedem der Ansprüche 1 bis 5, in dem zumindest ein Teil von einem der genannten Bereiche durch eine durchdringbare Membran gebildet ist.

7. Ein Gerät nach Anspruch 6, in dem die genannte Membran für Glukose durchdringbar ist.

8. Ein Verfahren zum optischen Nachweisen des Gehalts eines Präparats im Körper eines Lebewesens, wobei das Verfahren die folgenden Stufen umfasst:

- Richten einer Lichtquelle (4) auf verschiedene Bereiche eines implantierten Gerätes, das Nachweismittel aufweist, wobei der Abstand zwischen der Haut (2) und den Nachweismitteln, über den Licht aus einer Lichtquelle mit Präparaten und Gewebe in bezug auf einen Bereich zusammenwirkt, von dem Abstand zwischen der Haut (2) und den Nachweismitteln (8) abweicht, über den Licht aus einer Lichtquelle mit Präparaten und Gewebe in bezug auf einen anderen Bereich zusammenwirkt;
- Erzielen von licht-darstellenden Signalen mit Hilfe der Nachweismittel (8); und
- Analysieren der nachgewiesenen Signale, wobei die Analyse vorzugsweise auf die Differenz zwischen den nachgewiesenen Signalen basiert, um einen Wert für den Gehalt eines nachzuweisenden Präparates zu erzielen.

9. Ein Verfahren nach Anspruch 8, in dem die Analyse auf einen Durchschnitt von Signalen basiert.

10. Ein Verfahren nach Anspruch 8 oder 9, in dem das Präparat Glukose ist.

11. Ein Verfahren nach Anspruch 8, in dem das implantierte Gerät 1 nach jedem der Ansprüche 1 bis 7 ist.

Revendications

1. Dispositif (1) destiné à être implanté sous la peau (2) d'une créature vivante, ce dispositif ayant des surfaces externes en matériau biocompatible et comprenant :

- des moyens de détection (8) pour détecter la lumière,
- des moyens de transmission pour transmettre un signal issu desdits moyens de détection à un dispositif externe, dans lequel

lesdits moyens de détection (8) sont positionnés au niveau

- d'un premier groupe d'une pluralité de surfaces sensiblement plates à un premier niveau et
- d'un second groupe d'une pluralité de surfaces sensiblement plates à un second niveau,

la disposition des premier et second groupes de surfaces à l'intérieur du dispositif est telle que la distance entre la peau (2) et lesdits moyens de détection (8), sur laquelle la lumière issue d'une source de lumière (4) interagit avec des composés et du tissu au niveau dudit premier groupe de surfaces, diffère de la distance entre la peau (2) et lesdits moyens de détection (8), sur laquelle la lumière issue d'une source de lumière interagit avec des composés et du tissu au niveau dudit second groupe de surfaces.

2. Dispositif selon la revendication 1, dans lequel chaque surface de chaque groupe de surfaces forme un niveau commun, et dans lequel les niveaux communs ont un espacement prédéterminé l'un par rapport à l'autre pour assurer ladite différence de distance sur laquelle la lumière interagit avec des composés et du tissu.

3. Dispositif selon la revendication 2, dans lequel ledit premier groupe de surfaces est formé à un niveau de base (9) du dispositif et ledit second groupe de surfaces est formé par des protubérances (10) entre ledit niveau de base et un niveau de dessus.

4. Dispositif selon la revendication 1, comprenant en outre un séparateur (21, 22), recouvrant l'un desdits

groupes de surfaces de telle sorte que les composés et le tissu ne peuvent remplir le volume du séparateur, le séparateur (21, 22) assurant la différence de distance sur laquelle la lumière interagit avec des composés et du tissu.

5. Dispositif selon la revendication 3, dans lequel au moins une surface sensiblement plate, constituant un(e) troisième surface ou groupe de surfaces, est prévue et forme un niveau commun entre ledit niveau de base et ledit niveau de dessus.

6. Dispositif selon l'une quelconque des revendications 1 à 5, dans lequel au moins une partie de l'une desdites surfaces est formée d'une membrane perméable.

7. Dispositif selon la revendication 6, dans lequel ladite membrane est perméable au glucose.

8. Procédé de détection optique du contenu d'un composé dans le corps d'une créature vivante, ce procédé comprenant :

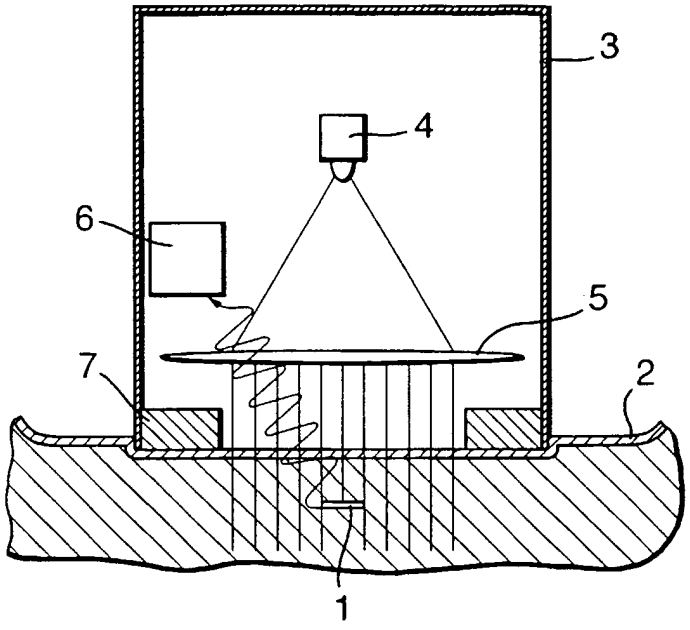
l'orientation d'une source de lumière (4) sur différentes surfaces d'un dispositif implanté contenant des moyens de détection, la distance, entre la peau (2) et lesdits moyens de détection (8), sur laquelle la lumière issue d'une source de lumière interagit avec des composés et du tissu au niveau d'une surface différant de la distance, entre la peau (2) et lesdits moyens de détection (8), sur laquelle la lumière issue d'une source de lumière interagit avec des composés et du tissu au niveau d'une autre surface ;
l'obtention de signaux représentant la lumière au moyen desdits moyens de détection (8) ; et
l'analyse des signaux détectés, cette analyse étant basée de préférence sur la différence entre les signaux détectés, pour obtenir une valeur du contenu d'un composé détecté.

9. Procédé selon la revendication 8, dans lequel l'analyse est basée sur une moyenne des signaux.

10. Procédé selon la revendication 8 ou la revendication 9, dans lequel le composé est du glucosc.

11. Procédé selon la revendication 8, dans lequel le dispositif implanté (1) est conçu selon l'une quelconque des revendications 1 à 7.

Fig.1.



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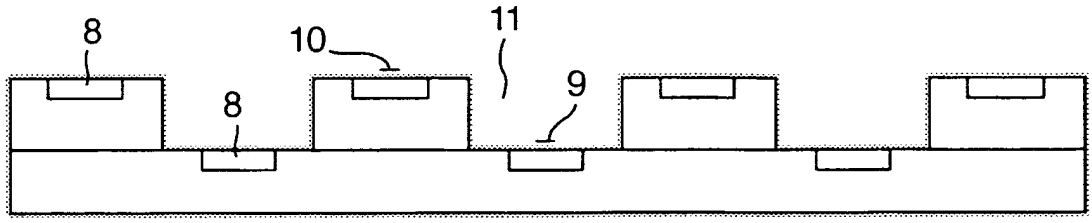

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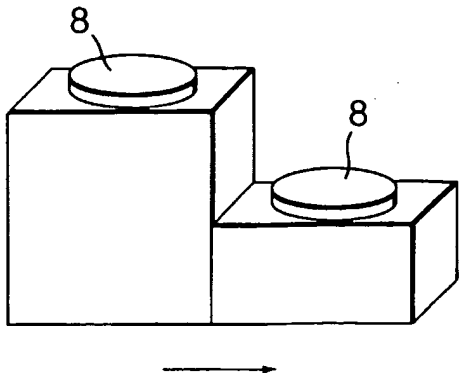

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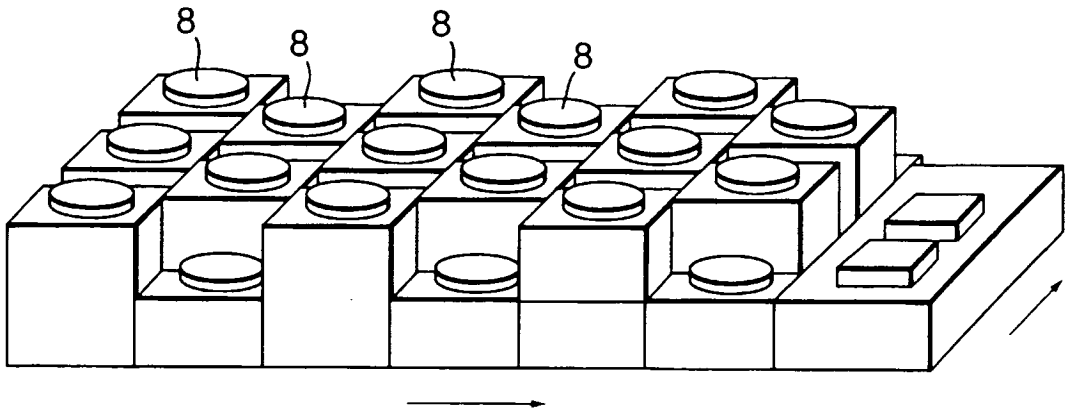

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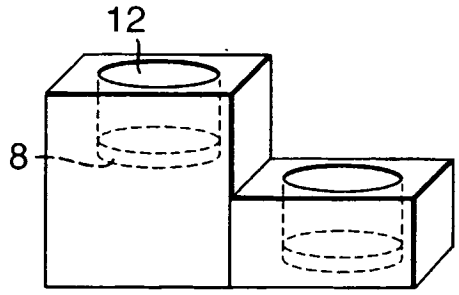


Fig.6.

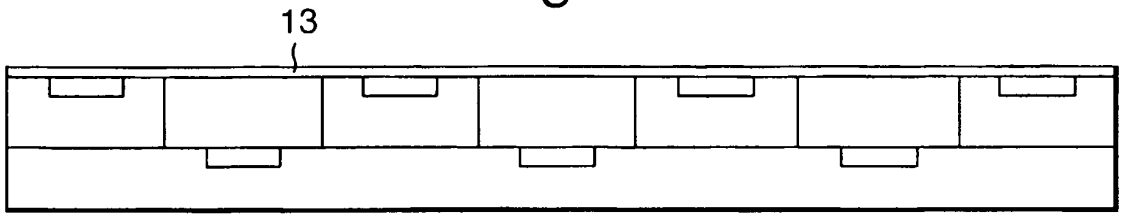


Fig.7.

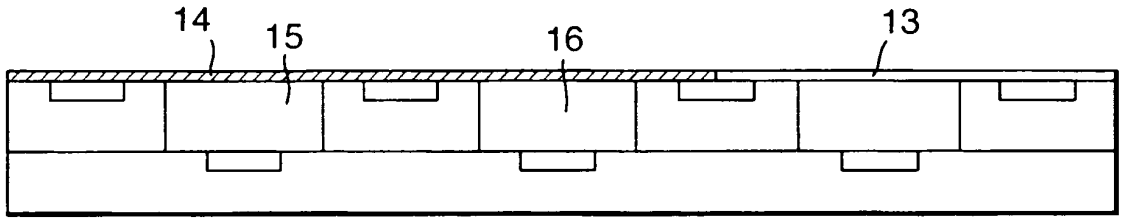


Fig.8.

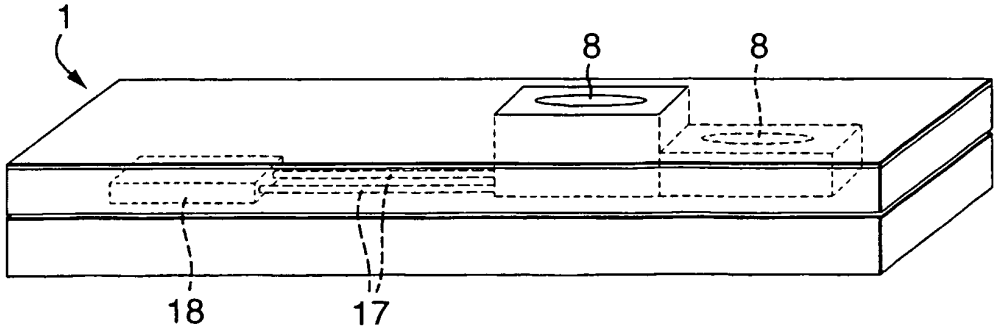


Fig.9.

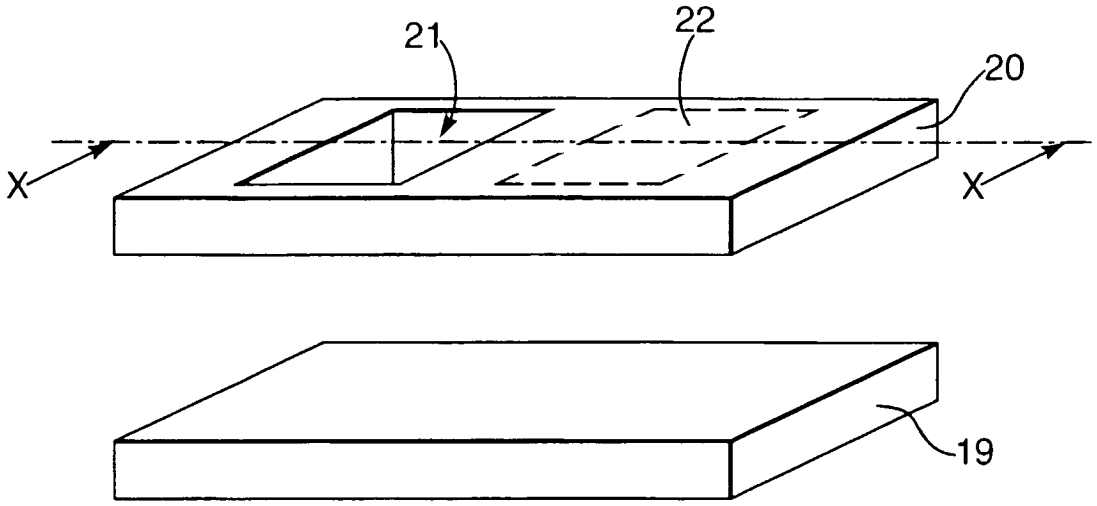
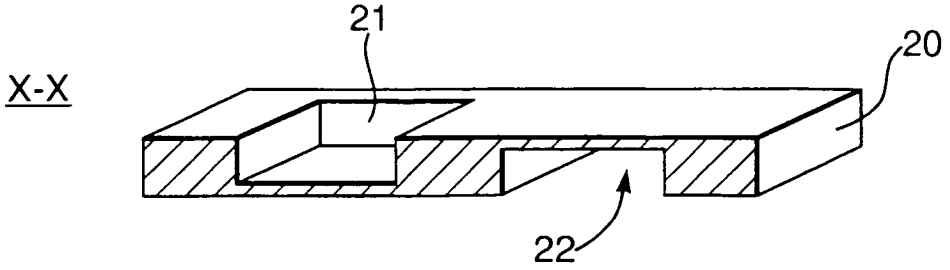


Fig.10.



REFERENCES CITED IN THE DESCRIPTION

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- WO 0033065 A **[0008]**
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- **GOWDA et al.** *Proc. SPIE,* 2001, vol. 4263, 11 **[0006]**

专利名称(译)	通过光学检测监测分析物浓度的方法和装置		
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申请(专利权)人(译)	DANFOSS A / S		
当前申请(专利权)人(译)	BMC VENTURES A / S		
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IPC分类号	A61B5/00 G01N21/17 G01N33/49 G01N21/35 G01N33/487		
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其他公开文献	EP1455641A1		
外部链接	Espacenet		

摘要(译)

提供了一种用于确定身体组织中化合物浓度的方法和装置。该方法利用基于光与化合物相互作用的光学方法，由此确定分析中的化合物的浓度。该方法特别适用于分析糖尿病患者的血液或组织中的葡萄糖浓度，植入在患者皮肤下面的装置，并且该方法通过使用植入装置进行。装置（1）包含通过导线（17）连接到电子电路装置（18）的不同高度的光电检测器（8）。对来自检测器（8）的信号进行差分分析，以减少皮肤对分析的影响。

Fig.1.

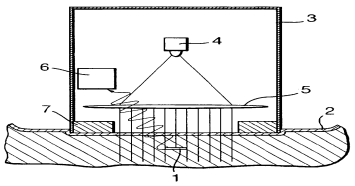

Fig.2.

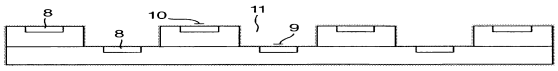

Fig.3.