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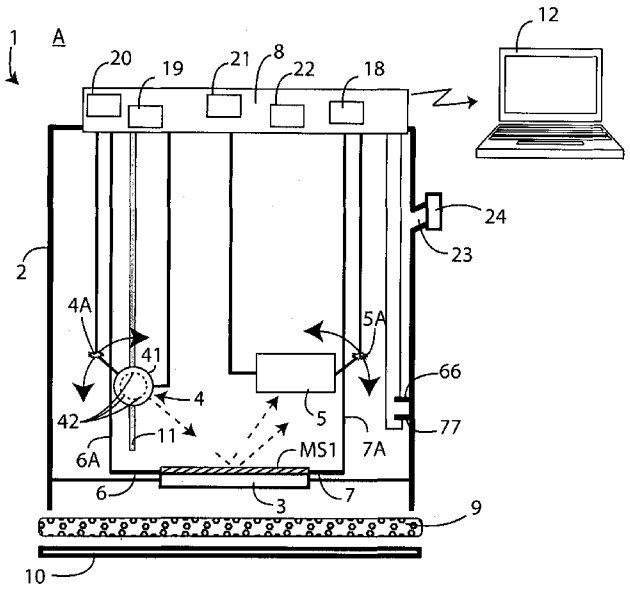

Fig. 1

(57) Abstract: The present invention relates to a detecting device (1) for detecting contaminant and/or composition chemical agents, particularly in an environmental liquid, a food or a biologic fluid, comprising: - a housing (2), - at least one material (MSI, MS2) responsive to at least one contaminant and/or composition chemical agent, - supporting means (3) for supporting said at least one material, - a detection unit (8) for detecting said contaminant and/or composition chemical agent through changes in optical and/or electrical properties of said material, - at least a light source or emitter (4) for emitting one or more luminous radiation on said responsive material, - an optical receiver (5) for receiving the light radiation reflected from said material and/or emitted by it, and - a pair of electrodes (6, 7; 6', 7'), each of which has one end in contact with said material, and the other end electrically connected to said detection unit (8).

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CHEMICAL- PHYSICAL SENSING DEVICE FOR CHEMICAL - TOXICOLOGICAL DIAGNOSTICS IN REAL MATRICES

The present invention relates to a detection sensing device, in the following also indicated as SNOOP, to detect contaminant chemical agents and/or composition chemical agents in real matrices, such as environmental liquids, foodstuffs or human or animal biological fluids.

More specifically, the invention relates to the structure of a device of the above kind that allows the identification of contaminant chemical agents, such as xenobiotics and agro-zootechnical residuals, and/or composition agents, as well as allows to define their amount by changes of optical and/or electrical properties of a material responsive to said chemical agents, and/or electrochemical properties of contaminant chemical agents and/or composition chemical agents of the real matrix to be examinated.

At present, environmental politics of different industrialized countries aims to promote eco-friendly chemical processes (the so called "Green Chemistry"), in order to reduce antropic pollution. However contamination of environment and of environment – alimentary production interface, due to the continuous and heavy admission of chemical agents, of old and new synthesis, remains one of the environmental and food emergency still existing.

In order to check degree and danger of contamination and/or composition changes of real matrices, many devices, and analytical methods thereof, have been developed for diagnostics and monitoring of said contaminant and/or composition chemical agents.

Most of traditional devices for identifying and quantifying contaminant and/or composition chemical agents are devices which are used in a laboratory. However, said traditional devices have some drawbacks.

A first drawback is that, for detection of said chemical and/or composition agents it is necessary to be present at the site where the presence of chemical agents is to be detected, to take a sample and to bring said sample to a laboratory for its analysis, thus wasting time, also in view of possible corrective actions.

Another drawback is that said devices do not permit an in situ monitoring of said agents or substances.

A further drawback is due to the fact that cumbersome and/or expensive analytical methods are used to analyze said sample.

Devices are also known for detection of chemical agents that can be used in situ.

However, also said devices have some drawbacks.

A drawback is that each device can detect a single contaminant chemical agent, or composition chemical agent, or, when more than one agent is detected by a plurality of devices, it is not provided an automatic processing of obtained data taken as a whole.

A further drawback is that they usually are bulky, and thus they cannot be easily transported or handled.

Still another drawback is that chemical-physical interferences are possible due to presence of many and different types of chemical agents in real matrices, this being even worse for contaminant agents due to their level of concentration, generally being at very low level of concentration.

Therefore, it is high the need of providing devices that can detect in real time the presence of contaminant and/or composition chemical agents, taking into consideration possible interferences deriving from the complexity of the real matrix to be examinated, so that necessary precautions can be timely taken and/or introducing corrective actions for preserving human health.

Object of the present invention is that of overcoming said drawbacks, by providing a sensing device, also indicated as SNOOP, which allowa to detect in an unambiguous way the presence of one or more contaminant and/or composition chemical agents in a real matrix, such as an environmental liquid, a food or a biological fluid, to be used in situ, said device operating in real time and with reduced costs, and at the same time preventing possible interferences by other contaminant and/or composition chemical agents, usually present in the same real matrix. These results have been obtained by providing a detecting device which detecs the presence of said contaminant and/or composition chemical agents by the changes of optical properties, such as luminescence or reflectance, and/or of electrical properties of at least a material responsive to one or more of said contaminant and/or composition chemical agents, said material being provided within said device, by a comparison and/or a combination of comparisons between data received and processed by

said device and stored data, the latter being obtained by laboratory simulated tests.

It is therefore specific object of the present invention a detecting device for detecting contaminant and/or chemical agents in a real matrix, particularly in an environmental liquid, a food or a biologic fluid, said device comprising:

- a housing
- at least one material responsive to at least one contaminant and/or composition chemical agent present in said real matrix,
- supporting means for supporting said at least one material,
- a detection unit for detecting said contaminant and/or chemical agent by the changes in optical and/or electrical properties of said material.

Said device further comprises, for each material responsive to at least one contaminant and/or composition chemical agent:

- at least one light source or emitter for emitting one or more luminous radiation on said responsive material, said light source being connected to said detection unit,
- an optical receiver for receiving the light radiation reflected from said material and/or emitted by it, said optical receiver being connected to said detection unit and transmitting to it one or more signals containing information on the optical properties of said material,
- a pair of electrodes, each of which has one end in contact with said material, and the other end electrically connected to said detection unit, said detection unit applying, through said electrodes, a potential difference on said responsive material so that the latter generates one or more response signals containing information on its electrical properties.

Particularly, said luminous radiations are emitted in sequence by said light source, and each luminous radiation has a respective predetermined wavelength; and said detection unit comprising a database, within which they are stored:

- a plurality of predetermined responsive materials;
- a plurality of optical spectra associated to each one of said predetermined responsive materials, obtained in absence and in presence of a predetermined potential difference applied to each one of them, each optical spectrum being associated to the interaction with one or more predetermined contaminant and/or composition chemical agents,

- a plurality of changes of electrical properties associated with each one of said predetermined responsive materials, each change of the electrical property being associated with interaction with one or more predetermined contaminant and/or composition chemical agents.

The detection unit is configured to receive signals containing information about the optical properties of said responsive material, and/or signals containing information about the electrical properties of the same responsive material, to obtain the optical spectra of each responsive material, in the presence or the absence of a potential difference applied by said detection unit, starting from luminous radiations received from said optical receiver, and to carry out a first comparison between each optical spectrum of said contaminant and/or composition chemical agent and the respective stored optical spectrum, and/or to carry out a second comparison between the changes of electrical properties of each responsive material and the changes of electrical properties of each responsive material stored within said database, so that from one of said comparisons or from a combination of said comparisons one or more contaminant and/or composition chemical agents in said real matrix is/are indentified.

According to the invention, said device can comprise a further pair of electrodes, spaced each other, each one of them having a first end fixed to said housing, and electrically connected with said detection unit, and a plurality of predetermined tension-current curves can be stored within the database of the detection unit, each one associated with at least a predetermined contaminant and/or composition chemical agent. Said detection unit can be configured to apply one or more predetermined potential differences, constant and/or variable, to said further pair of electrodes, to measure a respective received electric current signal, and to carry out a third comparison between the tension-current curve obtained and the predetermined tension-current curves, so that, electrochemical features of said contaminant and/or composition chemical agents are identified from said third comparison, and so that possible identification ambiguities are eliminated from the combination of said first and second comparison, and said contaminant and/or composition chemical agents are quantified.

It is preferred that device comprises a plurality of light sources and that detection unit can activate, in sequence, a light source at a time.

Particularly, the radiation emitted by a light source can have a greater wavelength up to a maximum of 50nm with respect to the wavelength of light radiation emitted by a light source activated before by detection unit.

Still according to the invention, it is possible to provide that at least a light source comprises supporting means and a plurality of light emission diodes or LEDs arranged on said support means, and that said detection unit activates, in sequence, a light source at a time.

Particularly, said supporting means can comprise a rotating base, and said LEDs can be arranged close to the edge of said rotating base.

According to the invention, the detection device can comprise a plurality of materials responsive to at least one contaminant and/or composition chemical agent that can be arranged on one or more supporting means. In this specific case, for each responsive material it is provided a respective pair comprised of a light source and an optical receiver, which is optically decoupled from the other pairs by opaque and non-conductive separation means, and it is provided a respective pair of electrodes which is electrically decoupled from the other electrode pairs by an electrical insulation.

Advantageously, said detection unit can comprise a memory for storing optical and/or electrical properties of responsive materials and/or electrochemical properties of matrix to be examinated, in absence and/or in presence of at least one contaminant and/or composition chemical agent.

Preferably, said supporting means can be removably fixed to the inner surface of the device by engaging/disengaging means, and detection device can comprise, for each light source and for each optical receiver, respective adjusting means for adjusting the position and orientation of said source light and said optical receiver with respect to the material; said adjusting means being controlled by said detection unit.

Furthermore it is preferred that said device comprises displaying means for displaying the results of the processing of said detection unit.

According to the invention, said detection unit can be connected to a computer for remote monitoring of said real matrix, and/or the for setting one or more parameters of said detection unit and/or for storing of

information concerning optical and/or electrical properties of the material in absence and presence of at least one contaminant chemical agent.

Particularly, each material can be a synthetic organic material, such as an organic material belonging to the class of tetrapyrrolic macrocycles or a material for OLED, or a material for LED, or a biological system, and said supporting means are made up of Teflon® or glass or quartz or any other inert material.

Still according to the invention, the detection device can comprise a filter element for separating suspended solid particles and/or substances dissolved in said real matrix, said filter element being fixed on said device so as to be arranged between said real matrix, outside said detection device and with which it is in contact, and said supporting means. Particularly, said filter element can be comprised of cellulose acetate or Teflon®, or it is made up of polyether sulfone, or it is made up of any other material with selective permeability. Said filter element can be a membrane.

Furthermore, according to the invention, said device can be provided with an opening or hole and a removable closing element for said opening, so as to allow a passage of air on the outside of the device in order to facilitate, inside of said device, the crossing of the filter element by a fluid containing the contaminant and/or composition chemical agent.

Advantageously, the device can further comprise acoustic and/or visual means for emitting acoustic and/or visual alarms when the value of the concentration of a composition and/or contaminant chemical agent exceeds a predetermined threshold.

The present invention will be now described, for illustrative, but not limitative, purposes, according to its embodiments, making particular reference to the enclosed drawings, wherein:

figure 1 schematically shows a section view of a first embodiment of the device for detecting contaminant chemical agents in a real matrix according to the invention;

figure 2 schematically shows a section view of a second embodiment of the device for detecting contaminant chemical agents in a real matrix according to the invention.

Making particular reference to figure 1, in the first embodiment described, it is provided a device 1 for detecting contaminating chemical agents present in environment, foodstuffs or in biological fluids.

In the example described, the device 1 is used for detecting at least one contaminant chemical agent in a real matrix which is a fluid A. Advantageously, the same device can be used for detecting one or more composition chemical agents, in combination or in alternative with said at least one contaminating chemical agent, in the same real matrix, or in another real matrix, without departing from the invention.

Said device 1 comprises a housing 2, within which the following elements are provided:

- a material MS1 responsive to at least one contaminant chemical agent present in said fluid A, provided on supporting means 3,
- a detection unit 8 for detecting said contaminant chemical agent through changes in optical and/or electrical properties of said material MS1,
- a light source or emitter 4 for emitting one or more luminous radiation on said responsive material MS1, connected to said detection unit 8,
- an optical receiver 5 for receiving the light radiation reflected from said material MS1 and/or emitted by the material MS1 itself, for effect of the luminous radiation incident on the same (e.g. by fluorescence), said optical receiver being connected to said detection unit 8 and transmitting to it one or more signals containing information on the optical properties of said material MS1,
- two electrodes 6, 7, each of which is provided with an electrically insulated outer surface, and has one end in contact with said material MS1, and the other end electrically connected to said detection unit 8 by a respective electric cable 6A, 7A,
- two further electrodes 66, 77, spaced from each other, each one of which has a first end fixed to said housing 2, and a free second end faced within said device, and is electrically connected with said detection unit 8.

Particularly, the light source 4 is a discontinue light source, since each emitted luminous radiation has a predetermined wavelength.

According to the invention, said light source 4 comprises a rotating base having a circular section and a plurality of light emission diodes or LEDs 42 close to the edge of said rotating base.

Said LEDs are activated in sequence by the detection unit 8 so that the responsive material MS1 is hit by a plurality of luminous radiations in succession, each one having a respective predetermined wavelength.

It is preferred that the radiation emitted by a LED has a wavelength which is, at most, 50nm distant from the wavelength of luminous radiation emitted by a LED previously activated.

The device is further provided with switching on/off means 18 for switching on/off said device 1 suitable to activate said detection unit 8, said light source 4 and said optical receiver 5, as well as supply means 21 to supply said device.

The detection unit 8 applies a predetermined potential difference to said electrodes 6, 7, by electrical cables 6A, 7A, so that material MS1 responsive to at least a contaminant chemical agent generates one or more response signals containing information about its electrical properties and that detection unit 8 receives and processes said response signals. Processing of said signals allows to detect the contaminant chemical agent by changes of electrical properties of the material MS1.

On one side, to detect changes of optical properties of the responsive material MS1, the detection unit 8 receives and processes signals sent to itself by the optical receiver 5. Processing of said signals allows to detect the contaminant chemical agent by the changes of optical properties of the material MS1. According to the invention, said detection unit 8 further comprises a database 22 within which the following data are stored: a plurality of predetermined responsive materials, a plurality of optical spectra, each of which is associated with a preselected responsive material, obtained in absence and in presence of a predetermined potential difference applied to each one of them, a plurality of changes of electrical properties associated with each one of said predetermined responsive materials, wherein each change of electrical property is associated with the presence of one or more predetermined contaminant chemical agents, as well as a plurality of predetermined tension-current curves, each one associated with at least one contaminant chemical agent.

In the described embodiment, said detection unit is configured to receive signals containing information about optical properties of said responsive material MS1, and signals containing information about

electrical properties of the same responsive material, to obtain optical spectra of each responsive material MS1, in presence or absence of a potential difference applied by said detection unit 8, starting from luminous radiations received from said optical receiver 5.

Furthermore, said detection unit 8 is configured to process received signals, to carry out a first comparison between each optical spectrum of said contaminant chemical agent to be detected and the respective optical spectrum stored within said database 22, and/or to carry out a second comparison between changes of electrical properties of each responsive material MS1 and changes of electrical properties of each responsive material stored within said database 22, so that from the combination of said comparisons one or more contaminant agents in the fluid A is/are indentified, as well as, after having applied one or more predetermined potential differences on said two further electrodes 66, 77, to measure a respective received electric current signal, and to carry out a third comparison between tension-current curve obtained and the predetermined tension-current curves stored in the database 22, so that, electrochemical features of said contaminant chemical agents are identified.

In other words, according to the invention, the detection unit 8 is suitable to detect the presence of a contaminant chemical agent on the basis of optical and electrical properties of material MS1 arranged on the supporting means 3 by processing signals sent respectively by said optical receiver 5 and by the material MS1 through electrodes, when a potential difference is applied to said electrodes, and to identify electrochemical features of said contaminant chemical agent by said tension-current curves.

By comparison between optical and electrical properties of material MS1 measured in the absence of a contaminant chemical agent and those in the presence of a contaminant chemical agent, the detection unit 8 determines the extent of changes of said optical and/or electrical properties of said responsive material, as well as electrochemical properties of said contaminant chemical agent.

Although in described example the detection unit combines information obtained by three comparisons, it is advantageously possible providing that detection unit carries out the first comparison as an alternative to, or in combination with, the second comparison, and that it

carries out the third comparison in combination with said first comparison and/or said second comparison, without departing from the scope of the present invention. In fact, depending on the contaminant chemical agent to be detected, it can be sufficient one of the first two comparisons, or their combination.

Furthermore, the detection unit 8 can be programmed to identify, by said changes, the contaminant chemical agent, and possibly to determine its amount. In fact, the plurality of responsive materials that can be used permits a plurality of combinations of optical signals and/or electrical signals and/or electrochemical signals, by which it is possible to unambiguously identify one or more chemical contaminant agents, thus eliminating ambiguity deriving from possible interferences.

A memory 19 for storing optical properties and/or electrical properties of material MS1 in the absence of contaminant chemical agent is provided in said detection unit 8.

In the described embodiment, supporting means 3 on which material MS1 responsive to at least a contaminant chemical agent is arranged, comprise a support with a rectangular section which is fixed to the inner structure of the housing 2, so as to be horizontal within said housing 2, i.e. perpendicular to the inner surface of said housing.

Said support can be removably fixed by quick coupling/release means (not shown) to the inner surface of the housing 2.

Advantageously, removable coupling of supporting means to the housing 2 permits to a user to remove said support means, and the material MS1 supported on the supporting means itself, replacing the supporting menas with another one supporting a responsive material that can be the same as the one removed, e.g. in case of wearing and/or damaging of the same material, or different, so that one or more further chemical agents present in fluid A can be detected by the same device.

The device 1 comprises respective adjustment means 4A and 5A for adjusting the position and orientation of said light source 4 and of said optical receiver 5 with respect to the material MS1; said adjusting means being controlled by said detection unit 8.

Position and orientation are two parameters that can be predetermined before or predetermined by an operator by said detection unit 8.

Advantageously, a micro adjustment permits optimizing the angle between the light source and the receiver, i.e. the angle of the received signal.

The device 1 also comprises displaying means 20 for displaying the results of the processing of said detection unit 8.

Advantageously, according to the invention, detection unit 8 can be programmed to record and compare the optical spectrum, e.g. of luminescence or of reflectance of the responsive material MS1 in the absence or in the presence of a contaminant chemical agent.

The detection unit 8 can be connected to a computer 12, e.g. by an electric cable or a wireless connection, for remotely monitoring the fluid A, setting one or more parameters of said detection unit 8, and storing of information relating to the optical and/or electric properties of responsive material MS1 in the absence or in the presence of one or more contaminant chemical agents.

In the described embodiment, the device 1 further comprises a sensor 11 to detect the temperature of the fluid A, connected with aid detection unit 8, as well as a filter element 9 for separating suspended solid particles and/or substances dissolved within said fluid A by chemical agents in issue.

Said filter element is a membrane and it is fixed to the lower end of housing 2 of said device 1 by an O-ring 10, so that it is placed between fluid A, outside said housing and with which it is in contact, and support means 3 of material MS1 responsive to at least one contaminant chemical agent.

Outer surface of housing 2 is opaque so that luminous radiation arriving from outside does not interfere when detecting chemical agents in issue.

The responsive material MS1 can be either a synthesic organic material, such as an organic material belonging to the class of tetrapyrrolic macrocycles or a material for OLED, or a material for LED, or a biological system.

Said supporting means 3 can be made up of Teflon® or glass or quartz or any other inert material.

The light source 4 can be a light emitting diode or LED, or it can be an light emitting organic diode or OLED, and the receiver 5 can be a photodiode.

The supply means 21 of the device can comprise a battery or a accumulator rechargeable by electric power or solar power, or a manual dynamo.

The filter element 9 can be comprised of cellulose acetate or Teflon®, or can be made up of polyether sulfone, or it is made up of any other material provided with a selective permeability.

According to the invention, it is possible providing an opening or hole 23 and a removable closing element 24 for said opening, so as to allow a passage of air on the outside of the device, once that said closing element is removed, in order to facilitate, inside of said device, the crossing of the filter element 9 by the fluid A containing the contaminant chemical agent.

Advantageously, mechanical or manual means can be applied on said opening to create a negative pressure thus easing the contact between said fluid and said material, mainly in the presence of a filter element 9 which is less permeable to the fluid.

In a different arrangement (not shown), device 1 can be further provided with acoustic and/or visual signaling means to emit acoustic and/or visual alarms when value of concentration of a chemical agent exceed a predetermined threshold, i.e. a concentration value which is taken as the highest tolerable limit.

In the second embodiment, shown in figure 2, supporting means 3 support, in addition to the material MS1, a second material MS2, which is responsive to a second contaminant chemical agent.

When two responsive materials are present, a second light source 4 to emit a luminous radiation on said second responsive material MS2 and a second optical receiver 5 for receiving luminous radiation reflected and/or emitted by said second responsive material MS2 are provided within the housing 2.

Two electrodes 6', 7', each one having an end contacting said responsive material MS2 and the other end electrically connected with said detection unit 8 by a respective electric cable 6'A, 7'A. Said pair of electrodes is electrically decoupled with respect to pair of electrodes 6, 7 for first responsive material MS1 by an electric insulation (not shown).

Particularly, responsive materials MS1, MS2 are provided on opposed surfaces of the support 3, which has a rectangular section and is fixed on the inner structure of the housing 2, so as to be vertically placed

within said housing 2, i.e. parallel with respect to inner surface of the housing 2.

In this second embodiment, each light source emits a plurality of luminous radiations in succession on a respective responsive material, each one at a predetermined wavelength, and each optical receiver 5 receives the luminous radiation reflected and/or emitted by a respective responsive material.

In other words, the responsive material MS1 arranged on one face of the support is optically and electrically decoupled with respect to responsive material provided on the opposite face of the same support by suitable opaque and not conductive separation means. In the described example, said separation means comprise, for each responsive material, a respective separation septum 13, fixed to the inner surface of housing 2.

Although the two embodiments described in the above the supporting means 3 have a rectangular cross-section and support respectively a responsive material and two responsive materials, said supporting means 3 can have any section and can support a even higher number of responsive materials, said material being the same or different each other.

For example, the supporting means 3 can have a triangular section, a squared section or they can have any poligonal section so as to support a suitable responsive material on at least one face of said polygon, provided that the responsive material arranged on a face is optically decoupled with respect to responsive materials arranged on the other faces, and pair of electrodes of every sensible material is electrically decoupled with respect to pairs of electrodes provided for other responsive materials.

In case in which the supporting means 3 support three or more responsive materials, the device 1 comprises a plurality of pairs comprised of a light source 4 and an optical receiver 5, in number corresponding to the number of responsive materials arranged on said supporting means 3, so that radiation emitted by each one of said light sources 4 is only directed on a respective responsive material and that luminous radiation reflected and/or emitted by each one of said responsive materials is received only by one corresponding optical receiver 5.

Furthermore, the section of said supporting means 3 can be a hollow section so that a responsive material can be applied on at least the

inner face, i.e. faced toward the cavity and/or on at least an outer face, i.e. opposit to said inner face.

A first advantage, already mentioned in the above, is due to the fact that device according to the invention is suitable to detect in situ and in real time the presence of one or more contaminant chemical agents and/or of composition chemical agents, to indentify said contaminant and/or composition chemical agents, and possibly determining their concentration.

A second advantage is possibility of realizing said device with limited dimensions so that it can be easily transported by an operator, even with such dimensions to be put within a pocket.

Another advantage is due to possibility of obtaining a statistic about contaminant chemical agents and/or composition chemical agents in environment, in foodstuffs, or in biological fluids, when the same responsive material is fixed on the support, or information about different chemical agents, when a plurality of responsive materials is fixed on said support.

A further advantage is that alarm signals can be sent when the detected concentration of one or more contaminant chemical agents exceed a predetermined threshold value.

The present invention has been described for illustrative, but not limitative purposes according to its preferred embodiments, but it is to be understood that variations and/or modifications can be introduced by those skilled in the art without departing from the relevant scope, as defined in the enclosed claims.

CLAIMS

1. Detecting device (1) for detecting contaminant and/or composition chemical agents in a real matrix, particularly in an environmental liquid, in a food or in a biologic fluid, said device comprising:

- a housing (2)

- at least one material (MS1, MS2) responsive to at least one contaminant and/or composition chemical agent present in said real matrix,

- supporting means (3) for supporting said at least one material (MS1, MS2),

- a detection unit (8) for detecting said contaminant and/or composition chemical agent through changes in optical and/or electrical properties of said material (MS1, MS2),

and further comprising for each material (MS1, MS2) responsive to at least one contaminant and/or composition chemical agent:

- at least a light source or emitter (4) for emitting one or more luminous radiation on said responsive material (MS1, MS2), said light source being connected to said detection unit (8),

- an optical receiver (5) for receiving the light radiation reflected from said material (MS1, MS2) and/or emitted by it, said optical receiver being connected to said detection unit (8) and transmitting to it one or more signals containing information on the optical properties of said material (MS1, MS2), and

- a pair of electrodes (6, 7; 6', 7'), each of which has one end in contact with said material (MS1, MS2), and the other end electrically connected to said detection unit (8), said detection unit (8) applying, through said electrodes, a potential difference on said responsive material (MS1, MS2) so that the latter generates one or more response signals containing information on its electrical properties,

said device being characterized in that

said luminous radiations are emitted in sequence by said light source (4), and each luminous radiation has a respective predetermined wavelength;

and in that

said detection unit (8) comprises a database (22), within which they are stored:

- a plurality of predetermined responsive materials;

- a plurality of optical spectra associated with each one of said predetermined responsive materials, obtained in the absence and in the presence of a predetermined potential difference applied to each one of them, each optical spectrum being associated with the interaction with one or more predetermined contaminant and/or composition chemical agents,

- a plurality of changes of electrical properties associated with each one of said predetermined responsive materials, each change of electrical property being associated with the interaction with one or more predetermined contaminant and/or composition chemical agents,

wherein said detection unit (8) is configured to receive signals containing information about optical properties of said responsive material (MS1, MS2), and/or signals containing information about electrical properties of the same responsive material, to obtain optical spectra of each responsive material (MS1, MS2), in presence or absence of a potential difference apllied by said detection unit (8), starting from luminous radiations received from said optical receiver, and to carry out a first comparison between each optical spectrum of said contaminant and/or composition chemical agent to be detected and the respective optical spectrum stored within said database (22), and/or to carry out a second comparison between changes of electrical properties of each responsive material (MS1, MS2) and changes of electrical properties of each responsive material (MS1, MS2) stored within said database (22), so that from one of said comparisons or from combination of said comparisons one or more contaminant and/or composition chemical agents in said real matrix is/are indentified.

2. Device (1) according to the previous claim, characterized in that it

further comprises a further pair of electrodes (66, 77), spaced from each other, each of which has a first end fixed to said housing (2), and a second end which is faced within said device and electrically connected with said detection unit,

in that

a plurality of predetermined tension-current curves are stored within database (22) of said detection unit (8), each one associated with at least a predetermined contaminant and/or composition chemical agent, and

in that

said detection unit (8) is configured to apply one or more predetermined potential difference, constant and/or variable, on said further pair of electrodes (66, 77), to measure a respective received electric current signal, and to carry out a third comparison between tension-current curve obtained and predetermined tension-current curves, so that, by said third comparison, electrochemical features of said contaminant and/or composition chemical agents are indentified, and so that, from the combination with said first and second comparison, possible identification ambiguities are eliminated and said contaminant and/or composition chemical agents are quantified.

3. Device (1) according to one of the preceding claims, characterized in that it comprises a plurality of light sources (4) and in that said detection unit (8) activates, in succession, a light source (4) at a time.

4. Device (1) according to one of the preceding claims, characterized in that radiation emitted by a light source (4) has a greater wavelength up to a maximum of 50nm with respect to the wavelength of light radiation emitted from a light source (4) activated before by detection unit (8).

5. Device (1) according to one of the preceding claims, characterized in that at least one light source (4) comprises supporting means (41) and a plurality of light emission diodes or LEDs (42) arranged on said support means (41), and in that said detection unit (8) activates, in succession, a light source at a time.

6. Device (1) according to the preceding claim, characterized in that said supporting means (41) comprises a rotating base, and in that said LEDs (42) are arranged close to the edge of said rotating base.

7. Device (1) according to one of the preceding claims, characterized in that, when it comprises a plurality of materials (MS1, MS2) responsive to at least one contaminant and/or composition chemical agents, said materials being arranged on one or more supporting means (3), for each responsive material (MS1, MS2) the respective pair comprised of a light source (4) and an optical receiver (5), is optically decoupled from the other pairs by opaque and non-conductive separation means (13), and the pair of electrodes of a respective responsive material is electrically decoupled from the other pairs of electrodes by an electrical insulation.

8. Device (1) according to one of the preceding claims, characterized in that said detection unit (8) comprises a memory (19) for storing optical and/or electrical properties of responsive materials (MS1, MS2) and/or electrochemical properties of matrix to be examinated, in absence and/or in presence of at least one contaminant and/or composition chemical agent.

9. Device (1) according to one of the preceding claims, characterized in that said supporting means (3) are removably fixed to the inner surface of the device by engaging/disengaging means.

10. Device (1) according to one of the preceding claims, characterized in that it comprises, for each light source (4) and for each optical receiver (5), respective adjusting means (4A, 5A) for adjusting the position and orientation of said light source (4) and said optical receiver (5) with respect to the material; said adjusting means (4A, 5A) being controlled by said detection unit (8).

11. Device (1) according to one of the preceding claims, characterized in that it comprises displaying means (20) for displaying the results of the processing of said detection unit (8).

12. Device (1) according to one of the preceding claims, characterized in that said detection unit (8) is connected to a computer (12) for remote monitoring of said real matrix, and/or setting one or more parameters of said detection unit (8) and/or for storing of information on optical and/or electrical properties of the material (MS1, MS2) in absence and presence of at least one contaminant chemical agent.

13. Device (1) according to one of the preceding claims, characterized in that each material (MS1, MS2) is a synthetic organic material, such as an organic material belonging to the class of tetrapyrrolic macrocycles or a material for OLED, or a material for LED, or a biological system.

14. Device (1) according to one of the preceding claims, characterized in that said supporting means (3) are made up of Teflon® or glass or quartz or any other inert material.

15. Device (1) according to one of the preceding claims, characterized in that it comprises a filter element (9) for separating suspended solid particles and/or substances dissolved in said real matrix; said filter element being fixed on said device (1) so as to be arranged

between said real matrix, outside said detection device and with which it is in contact, and said supporting means.

16. Device (1) according to preceding claim, characterized in that said filter element (9) is comprised of cellulose acetate or Teflon®, or it is made up of polyether sulfone, or it is made up of any other material with selective permeability.

17. Device (1) according to one of the preceding claims, characterized in that said filter element (9) is a membrane.

18. Device (1) according to one of the preceding claims, characterized in that it is provided with an opening or hole (23) and a removable closing element (24) for said opening, so as to allow a passage of air on the outside of the device in order to facilitate, inside of said device, the crossing of the filter element (9) by a fluid (A) containing the contaminant and/or composition chemical agent.

19. Device (1) according to one of the preceding claims, characterized in that it further comprises acoustic and/or visual signaling means for emitting acoustic and/or visual alarms when the value of the concentration of a contaminant chemical agent exceeds a predetermined threshold.

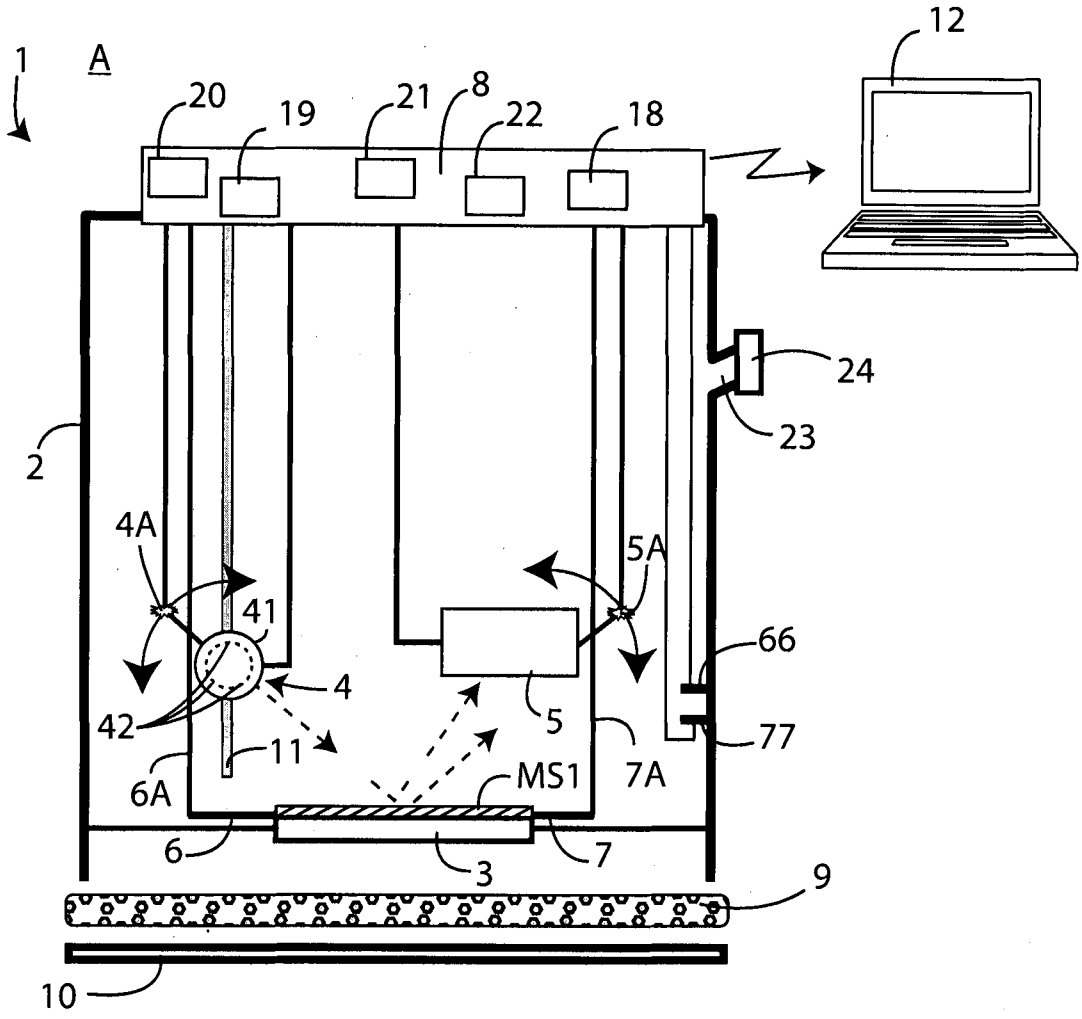

Fig. 1

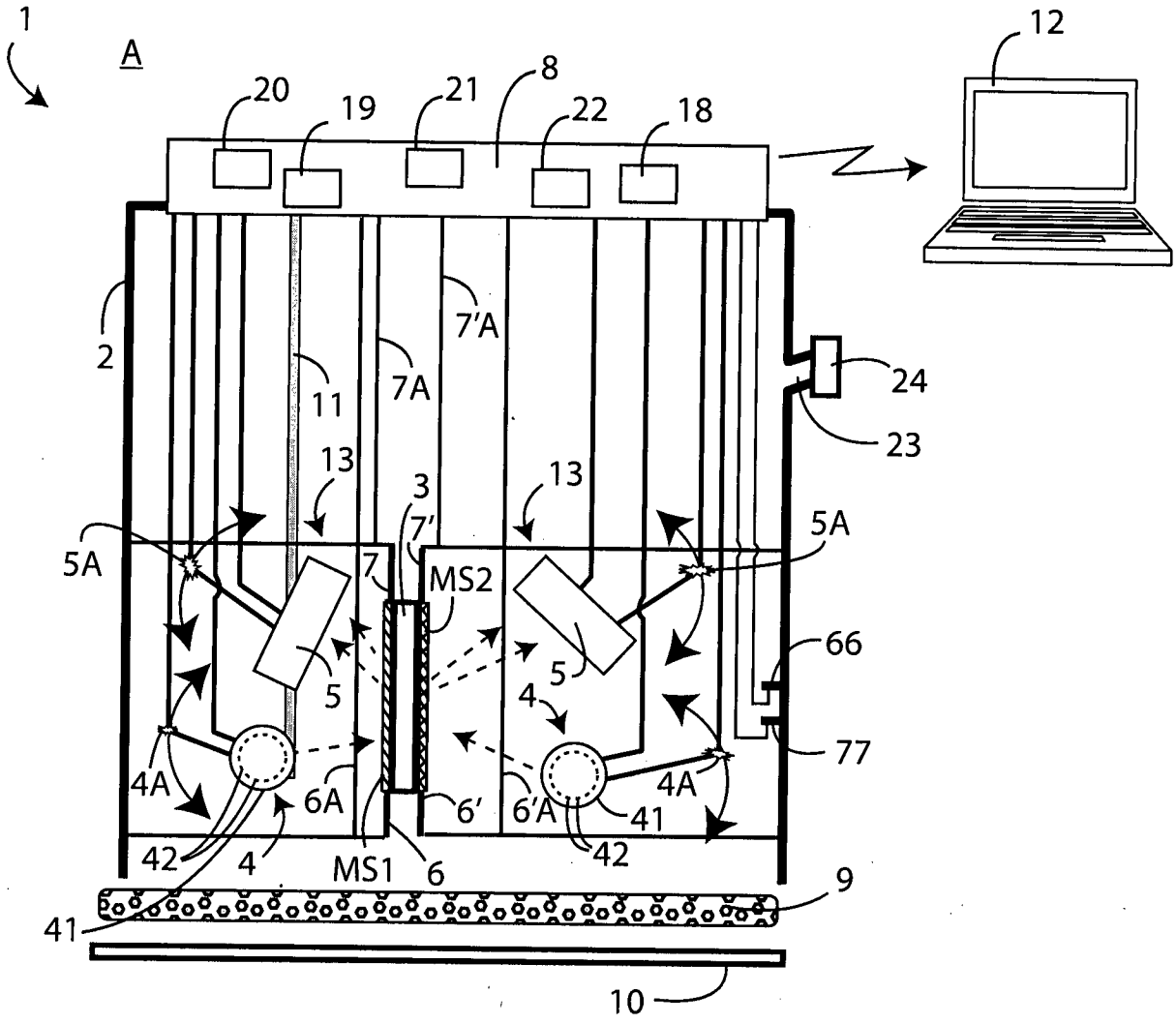
1
A
12
20
19
21
8
22
18
2
11
7A
7'A
24
23
13
3
7'
13
5A
5A
7
MS2
66
5
5
4
77
4A
6A
6'
6'A
4A
41
42
4
MS1
6
42
9
41
10

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2012/000110

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01N21/77 G01N27/12
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2010/068653 A2 (SMITHS DETECTION INC [US]; HUANG WEIJIE [US]; LOUSSAERT JAMES ANDREW [) 17 June 2010 (2010-06-17) paragraphs [0032], [0034] - [0044]; figures 10-12	1-19
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 August 2012	21/08/2012

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2012/000110

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	BEKYAROVA E ET AL: "Mechanism of ammonia detection by chemically functionalized single-walled carbon nanotubes: In situ electrical and optical study of gas analyte detection", JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, AMERICAN CHEMICAL SOCIETY, WASHINGTON, DC; US, vol. 129, no. 35, 5 September 2007 (2007-09-05), pages 10700-10706, XP002584266, ISSN: 0002-7863, DOI: 10.1021/JA0703271 [retrieved on 2007-08-15] the whole document	1
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International application No
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