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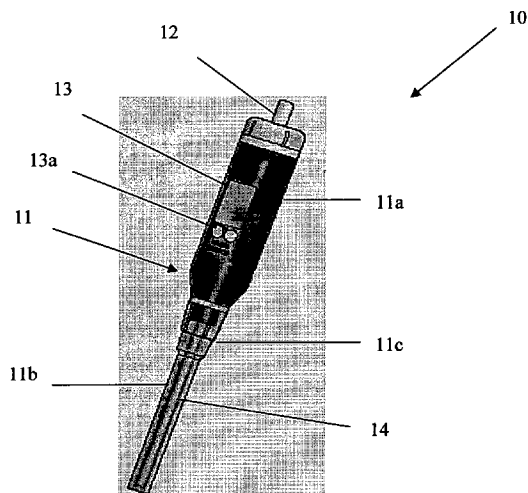
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(54) Title: APPARATUS FOR DETERMINING THE IN-SITU BIO-CHEMICAL PROPERTIES OF LIQUID AND FIRM MATERIALS

Figure 1



(57) Abstract: A hand-held easy to carry shaped sensor packaging that has special feature that protect the sensitive sensing elements from being destroyed and thus allow reliable and accurate reading of the measurand. The apparatus includes a casing, a signal processing unit contained within the casing and an internal sensor rod having a rod shaft connected with the processing unit. The rod shaft includes at least one cavity for receiving a sensing element to obtain data to provide the chemical properties readings during penetration into the liquid and firm materials.



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Apparatus for Determining The In-Situ Bio-chemical Properties
of Liquid and Firm Materials

Field of Invention

5

The present invention relates generally to a sensor apparatus,
more particularly to an apparatus having sensors and its
sensor packaging for in-situ chemical properties determination
in the firm texture products such as meat, vegetable and
10 fruits.

Background of the Invention

It is desired to provide for a rapid and efficient test for
15 the detection of various chemical and physical properties of
test samples from materials or surfaces. Various test
apparatuses and test methods have been developed for that
purpose. For example, it is widely desirable to determine or
to test through quantitative and qualitative tests for body
20 fluids, such as blood, and urine, as well as food, such as
meat products.

The packaging of sensors poses great challenge to the package
designer since it must allow precise, repeated and reliable
25 readings. Since chemical sensors must be in contact with the
measurand such as chemical species, moisture, pH etc, the

packaging of chemical sensors is much more challenging than the non-contact sensors for example accelerometers, gyroscopes. There are many applications of chemical sensors such in the food industry where they are used to determine for
5 example the acidity, the level of chemical traces, pollutants, the freshness and tenderness of the meat, level of toxins, and so on.

In the present invention, the apparatus that consists of the
10 sensor and its sensor packaging for in-situ chemical properties determination is presented. The object of the present invention is to provide the sensor apparatus which is relatively cheap to manufacture, and is strong enough to withstand repeated use while retaining its reliability of
15 operation.

Other objects of this invention will become apparent on the reading of this entire disclosure.

20 **Summary of the Invention**

In the present invention, an apparatus for determining chemical properties of liquid and firm materials comprises a casing having an upper portion, a lower portion connected to
25 the upper portion and a plunger secured on top of the upper portion, a signal processing unit contained within the casing,

and an internal sensor rod having a rod shaft connected with the processing unit at one end and a tip end at the other end for penetrating into the liquid and firm materials when the connected plunger is pressed, the rod shaft of the internal
5 sensor rod includes at least one cavity for receiving a sensing element to obtain data which is processed by the signal processing unit to provide the chemical properties readings during penetration into the liquid and firm materials. The sensing elements located inside the cavities
10 are protected from direct contact with the liquid and firm materials to avoid scratches and damages during the rod penetration.

Preferably the casing further comprising a display panel
15 provided at the upper portion of the casing, the display panel is connected with the signal processing unit to display the readings.

Preferably the signal processing unit is an analog and digital
20 signal processing chip which transduces the chemical signal to the equivalent electrical signal and then followed by the digital signal processing to increase the sensitivity and the selectivity of the sensing elements.

Brief Description of the Drawings

Other objects, features, and advantages of the invention will be apparent from the following description when read with
5 reference to the accompanying drawings. In the drawings, wherein like reference numerals denote corresponding parts throughout the several views:

Figure 1 shows a perspective view of the apparatus for
10 determining chemical properties of liquid and firm materials in accordance to an embodiment of the present invention;

Figure 2 depicts a side view of the apparatus of figure 1;

15 Figure 3 illustrates a front view of the internal sensor rod of the apparatus; and

Figure 4 is a side view of the internal sensor rod of figure 3.

20

Detailed Description of the Preferred Embodiments

In the following detailed description, numerous specific details are set forth in order to provide a thorough
25 understanding of the invention. However, it will be understood by those of ordinary skill in the art that the invention may

be practiced without these specific details. In other instances, well-known methods, procedures and/or components have not been described in detail so as not to obscure the invention. Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

Figures 1 and 2 show a hand-held chemical probe (10) of an apparatus for in-situ determining chemical properties of liquid and firm materials, the chemical probe (10) comprises of casing (11) which includes an upper portion (11a) and a bottom portion (11b), whereby the bottom portion (11a) having a smaller diameter than the upper portion (11a) of the probe (10). The upper portion (11a) and the lower portion (11b) of the casing (11) are interconnected at a tapered portion (11c). A plunger (12) being secured on top of the upper portion (11a) of the casing (11) as shown in figures 1 and 2.

The chemical probe (10) also includes a display panel (13) provided at upper portion (11a) of the casing (11) for displaying the reading of the sensors. The display panel (13) has function keys (13a) for manipulating the function of the display panel (13). An analog and digital signal processing unit (not shown) is connected to the display panel (13) and provided within the casing (11) of the chemical probe (10).

An internal rod with sensor (14) which comprises a connection member (15), a rod shaft (16) extended from the connection member (15) and terminated with a tip end (17) connected at the other end of the rod shaft (16) is shown in figures 3 and 4. The internal rod (14) has at least one sensing element (18) located in a cavity (19) at the rod shaft (16). The sensing element (18) has no direct contact with the firm material under inspection when the tip end (17) of the internal rod (14) of the chemical probe (10) has penetrated the surface of the firm material. Therefore, the sensing elements (18) are protected from scratches and damages during the rod penetration and thus allow reliable and accurate reading of the measurand.

In the present invention, a plurality of sensing elements (18) is provided at the opposing sides at predetermined locations in the cavities (19) provided at the internal sensor rod (14). The cavities (19) which contain the sensing elements (18) are located at the front and back sides of the internal sensor rod (14) as shown in figure 4. The sensing elements (18) which are the sensors are connected to respective conductors (not shown that extend to the signal processing unit. The signal processing unit is a analog and digital signal processing chip to transduce the chemical signal to the equivalent electrical signal and then followed by the digital signal processing (DSP) to increase the sensitivity and the selectivity of the

sensors. Different sensing elements (18) may be used for the chemical probe (10) to provide different chemical properties measurements.

5 The internal sensor rod (14) is preferably made of metal and consists of plurality types of sensing elements to allow the biochemical properties of the firm material to be determined, such as sensors for pH, temperature, chemical ions, toxicity, heavy metal and etc. The tip end (17) of the internal sensor
10 rod (14) can be disposed and new sensors can be replaced. Or alternatively the same set of sensors can be kept inside the enclosure for future use. The internal sensor rod (14) is connected to the signal processing unit at the tapered portion (11c) of the probe (10) with the connection member (15) of the
15 internal sensor rod (14) provides the mating contact and the internal sensor rod (14) positioned within the bottom portion (11b) of the casing (11).

During operation of the chemical probe (10) of the present
20 invention, when the plunger (12) of the probe (10) is pressed, the internal sensor rod (14) will protrude out at the other end of the casing (11). The sharp tip end (17) of the internal sensor rod (14) is then penetrates through the liquid and firm material having biochemical properties to be determined by the
25 chemical probe (10) of the present invention. The sensing elements (18) follow through and out from the casing (11) to

penetrate through the liquid and firm material. Since the sensing elements (18) are located inside the cavities (19) of the rod shaft (16), they are protected from being destroyed or similar damages during the penetration process. Once the
5 sensing elements (18) are inside the liquid and firm material, the sensing elements (18) will start the sensing process and the reading process is then registered by the signal processing unit and the readings are displayed at the display panel (13).

10

As will be readily apparent to those skilled in the art, the present invention may easily be produced in other specific forms without departing from its essential characteristics. The present embodiments is, therefore, to be considered as
15 merely illustrative and not restrictive, the scope of the invention being indicated by the claims rather than the foregoing description, and all changes which come within therefore intended to be embraced therein.

Claims

1. An apparatus for determining chemical properties of liquid and firm materials comprising:

5 a casing having an upper portion, a lower portion connected to the upper portion and a plunger secured on top of said upper portion;

a signal processing unit contained within said casing; and

an internal sensor rod having a rod shaft connected with said
10 processing unit at one end and a tip end at the other end for penetrating into said liquid and firm materials when the connected plunger is pressed, said rod shaft of the internal sensor rod includes at least one cavity for receiving a
sensing element to obtain data which is processed by said
15 signal processing unit to provide the chemical properties readings during penetration into the liquid and firm materials.

2. The apparatus as claimed in claim 1, wherein said internal
20 sensor rod has a plurality of cavities provided at the rod shaft for receiving a plurality types of sensing elements therein, whereby said sensing elements are protected from direct contact with the liquid and firm materials to avoid scratches and damages during the rod penetration.

3. The apparatus as claimed in claim 2, wherein said plurality of cavities with sensing elements is provided at the opposing sides at predetermined locations at the rod shaft of the internal sensor rod.

5

4. The apparatus as claimed in claim 2, wherein said internal sensor rod is made of metal and consists of plurality of different types of sensing elements.

10 5. The apparatus as claimed in claim 4, wherein said different types of sensing elements are used to determine chemical properties such as but not limited to pH, temperature, chemical ions and toxicity.

15 6. The apparatus as claimed in claim 5, wherein said internal sensor rod further includes a connection member provided at the opposed tip end of the rod shaft.

20 7. The apparatus as claimed in claim 6, wherein said tip end is detachably connected to the rod shaft of the internal sensor rod.

25 8. The apparatus as claimed in claim 1, wherein said casing further comprising a display panel provided at the upper portion of the casing, said display panel is connected with said signal processing unit to display the readings.

9. The apparatus as claimed in claim 8, wherein said signal processing unit is an analog and digital signal processing chip which transduces the chemical signal to the equivalent electrical signal and then followed by the digital signal processing to increase the sensitivity and the selectivity of said sensing elements.

10. The apparatus as claimed in claim 1, wherein said upper portion and lower portion of the casing are interconnected at a tapered portion.

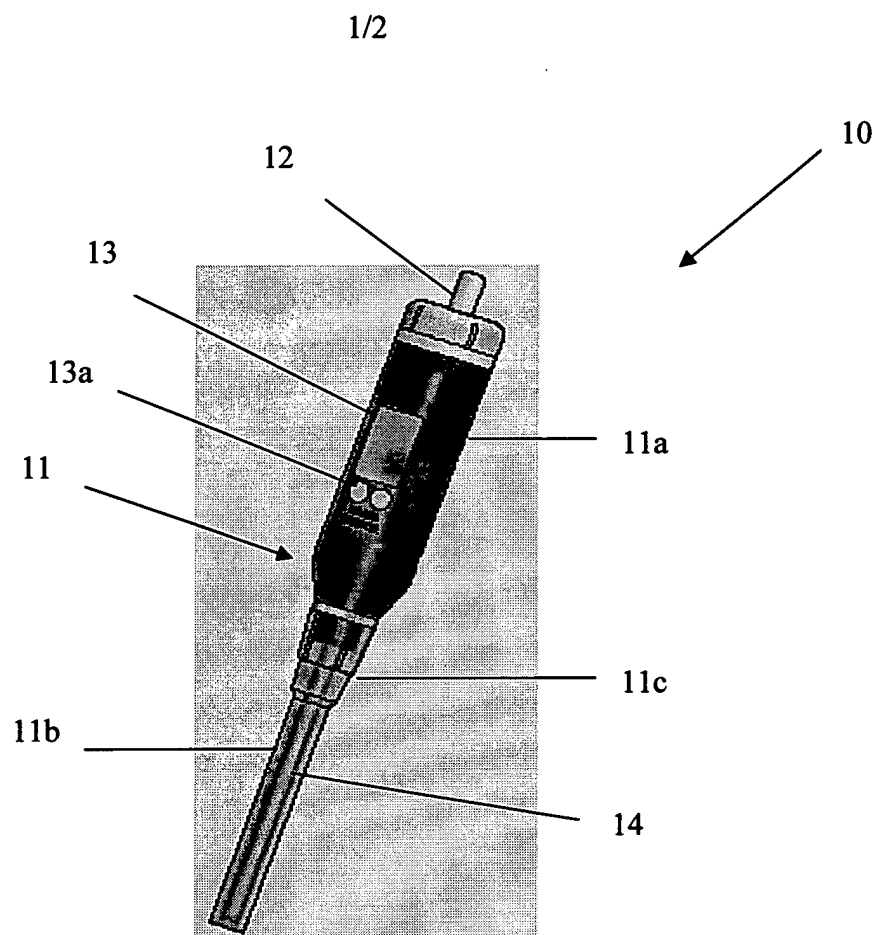


Figure 1

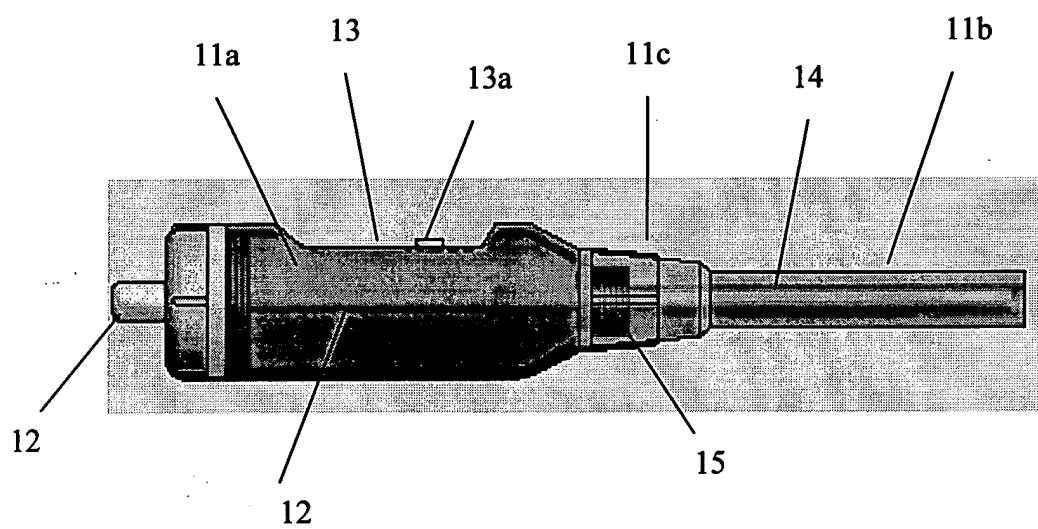


Figure 2

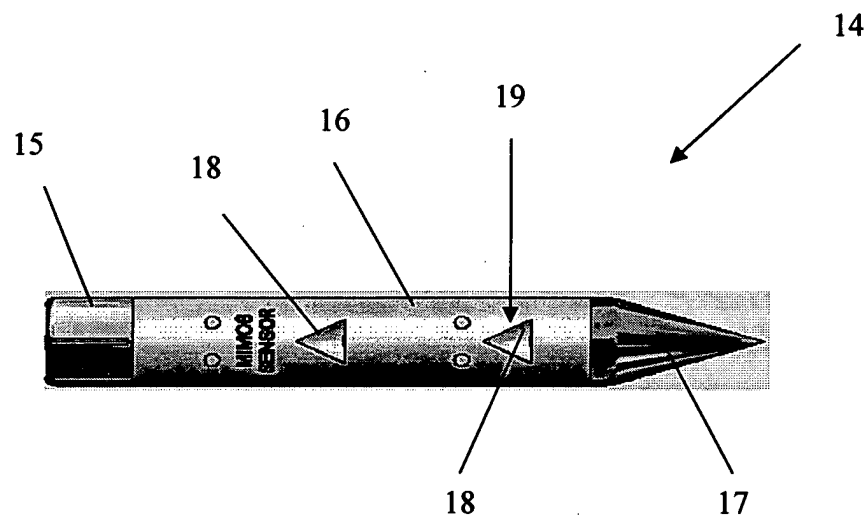


Figure 3

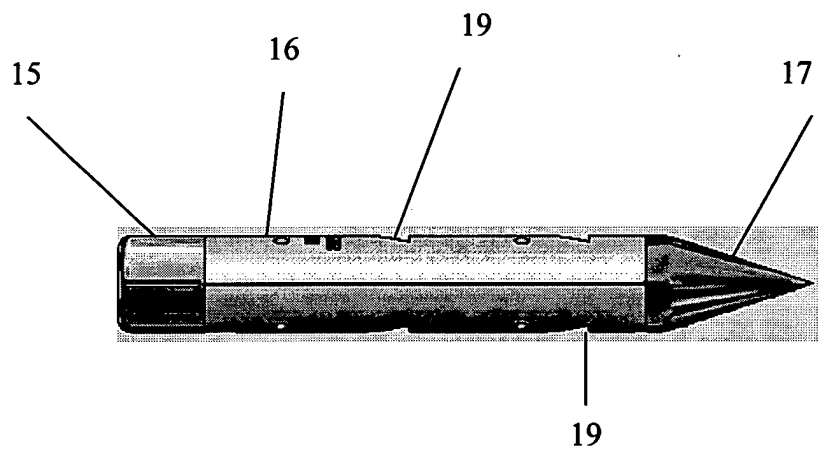


Figure 4