Title

AN APPARATUS AND METHOD FOR DETECTING BIOLOGICAL STATE IN A SAMPLE USING BIOMARKERS.

Field of the Invention

[0001] The invention presented herein relates generally to detection of biological state in a sample. More particularly, the present invention relates to an apparatus and method for detecting biological state in the sample using biomarkers.

Background of the Invention

[0002] Biomarkers are increasingly recognized for their potential not only as biologic harbingers that provide early warnings of disease but also biochemical monitors of patient responses to therapies. However, the field is hampered by a lack of reliable, quantifiable, easily measured biomarkers that correlate well with biochemical measures of disease progression.

[0003] The presence or absence of chemical compounds can be used to infer the disease status of the subject, as some diseases cause the accumulation of specific chemical compounds, or to detect chemical deficiencies of the subject. Devices for biological sample analysis utilize sensor for detection of biomarkers or chemical compounds.

[0004] The sensor has a surface containing one or more specific binding substances immobilized by physical adsorption or by chemical binding. The one or more specific binding substances can be bound to their binding partners. The one or more specific binding substances or binding partners can be selected from the group consisting of nucleic acids, polypeptides, antigens, polyclonal antibodies, monoclonal antibodies, single chain antibodies (scFv), F (ab) fragments, F (ab’). Sub.2 fragments, Fv fragments, small organic molecules, cells, viruses, bacteria, polymers, protein solutions, peptide solutions, single or double stranded DNA solutions, RNA solutions, solutions containing compounds from a combinatorial chemical library and biological samples.

[0005] Diagnostics devices are well known for monitoring the biomarkers in a biological sample. Examples of various biological samples are blood, plasma, serum, gastrointestinal secretions, homogenates of tissues or tumors, synovial fluid, feces, saliva, sputum, cyst fluid, amniotic fluid, cerebrospinal fluid, peritoneal fluid, lung lavage fluid, semen, lymphatic fluid, tears, and prostatitc fluid.

[0006] At present many of the diagnostic devices having sensor, where the sensor housing is compact and contains all the sensor components, the configuration of the apertures may entrap air inside the housing that causes measurement errors. Because the segmented walls between the apertures hinder thorough cleaning, the sensor is non-reusable.

[0007] Moreover, in unitary microchip-based detection device employs a microcantilever sensor to detect a biochemical reaction in a single detection chamber. These devices fail to analyze a number of solutions simultaneously, and for the same it would be necessary to utilize an equal number of these chips.

[0008] For the reasons stated above, which will become apparent to those skilled in the art upon reading and understanding the present specification, there is a need in the art for an apparatus and method for detection of biological state of a sample using biomarkers which allows low cost measurement while still providing reusability and economical significance.

Summary of the Invention

[0009] According to one aspect of the invention there is provided an apparatus for detecting biological state of a sample using biomarkers, the apparatus comprising: a reusable slide including, a sensor platform comprising a plurality of interaction cells, each of the interaction cells embedded with the biomarker, the interaction cells including an inlet for receiving the sample, and at least one sensor disposed in it, the sensor is capable of deflecting in response to chemical interaction between the biomarker and the sample; an integrated circuitry coupled to the reusable slide for performing the electronic measurements on the sensor platform, converting the signals to a digital representation and to exchange the data and other information with the apparatus; and an electrical contact to receive power from the apparatus; and a diagnostic device having a slide inserting slot and an interface for accommodating the reusable slide.

[0010] In another aspect, the invention includes a method for detecting biological state in a sample using biomarkers, the method comprising the steps of: providing the sample on a reusable slide, wherein the reusable slide is having the sensor platform; washing off the excess sample using suitable agents; inserting the reusable slide into a diagnostic device for detecting and reading data from the sensor on the slide; and analyzing the responses of the sensors deflection due to chemical interaction between the biomarker and sample.

[0011] In another aspect, the invention includes a system for detecting biological state in a sample using biomarkers, the system comprising: a reusable slide including, a sensor platform comprising a plurality of interaction cells, each of the interaction cells embedded with the biomarker, the interaction cells including an inlet for receiving the sample, and at least one sensor disposed in it, the sensor is capable of deflecting in response to chemical interaction between the biomarker and the sample; an integrated circuitry coupled to the reusable slide for performing the electronic measurements on the sensor platform, converting the signals to a digital representation and to exchange the data and other information with the apparatus; and an electrical contact to receive power from the apparatus; a diagnostic device having a slide inserting slot and an interface for accommodating the reusable slide, wherein the diagnostic device including a display and an antenna; at least one communication network; and at least one server including a database for storing the data received from the diagnostic device.

[0012] Additional advantages and features of the present invention will be more apparent from the detailed description and accompanying drawings, which illustrate preferred embodiments of the invention.

Brief description of the drawings

[0013] Figure 1 shows a reusable slide (top view) according to one embodiment of the invention.

[0014] Figure 2 shows an apparatus for detecting biological state of a sample using biomarkers according to one embodiment of the invention.

[0015] Figure 3 shows a flow chart of a method for detecting biological state in a sample using biomarkers according to one embodiment of the invention.

[0016] Figure 4 shows a system for detecting biological state in a sample using biomarkers according to one embodiment of the invention.

Detail description of the Invention

[0017] In the following description, various aspects of the present invention will be described. However, it will be understood by those skilled in the art that the present invention may be practiced with only some or all aspects of the present invention. For purposes of explanation, specific numbers, materials and configurations are set forth in order to provide a thorough understanding of the present invention. However, it will also be apparent to those skilled in the art that the present invention may be practiced without these specific details.

[0018] Additionally, various operations will be described as multiple discrete steps in turn in a manner that is helpful in understanding the present invention. However, the order of description should not be construed as to imply that these operations are necessarily order dependent, in particular, the order of their presentation.

[0019] Reference in the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment.

[0020] Referring now to Figure 1, there is illustrated a reusable slide according to one embodiment of the invention. Figure 1 shows a reusable slide 100 having a sensor platform 110, an integrated circuitry 120 and a pair of electrical contacts 130. The reusable slide 100 made out of a suitable substrate such as glass, plastic, ceramic etc. The substrate of the slide 100 is independent of the material like plastic or ceramic or glass. The reusable slide 100 is either single use or it can be re-used after suitable cleaning and re-conditioning. The sensor platform 120 is integrated into the reusable slide 100. The sensor platform 120 having plurality of sensors, where each individual sensor has a surface containing one or more specific binding substances immobilized by physical adsorption or by chemical binding. The sensor array is so designed to accept various spectrum of biomarkers such as gases, antigens and foreign particles from biological warfares and blood, plasma, serum, gastrointestinal secretions, homogenates of tissues or tumors, synovial fluid, feces, saliva, sputum, cyst fluid, amniotic fluid, cerebrospinal fluid, peritoneal fluid, lung lavage fluid, semen, lymphatic fluid, tears, prostatic fluid etc.

[0021] The one or more specific binding substances or binding substances can be bound to their binding partners. The one or more specific binding substances or binding partners can be selected from the group consisting of nucleic acids, polypeptides, antigens, polyclonal antibodies, monoclonal antibodies, single chain antibodies (scFv), F(ab) fragments, F(ab').sub.2 fragments, Fv fragments, small organic molecules, cells, viruses, bacteria, polymers, protein solutions, peptide solutions, single- or double-stranded DNA solutions, RNA solutions, solutions containing compounds from a combinatorial chemical library and biological samples.

[0022] The reusable slide 100 includes integrated circuitry 120 to perform the electronic measurements on all sensors, convert the signals to a digital representation and to exchange the data and other information with other components via a serial wired or wireless interface. The integrated circuitry 120 is a miniaturized electronic circuit (consisting mainly of semiconductor devices, as well as passive components) that has been manufactured in the surface of a thin substrate of semiconductor material. The integrated circuitry 120 is embedded because the same circuitry components can switch quickly and also consume little power (compared to their discrete counterparts) because of their small in size and the components are close together. Preferably, the integrated circuitry 120 is designed for converting the analog signals to digital signals (example: A/D converter).

[0023] The reusable slide 100 having electrical contacts 130 through which the power is received from the rest of the device to the integrated circuitry 120. In the case of wired interface, at least two contacts to allow serial transfer of data to/from the reusable slide 100 which may include a clock line, and receive and/or transmit lines.

[0024] Referring now to Figure 2, there is illustrated an apparatus for detecting biological state of a sample using biomarkers according to one embodiment of the invention. Figure 2 shows an apparatus 200 including a portable diagnostic device 210 and a reusable slide 220. The diagnostic device 210 having a slide insertion slot 230, a touch screen display 240 and an antenna 250 for transmitting the data. The slide insertion slot 230 is for accommodating different reusable slides for detecting biomarkers or chemical compounds in biological samples. The detachable aspect of the reusable slide 220 by separating the biosensor from the diagnostic device 210. The apparatus make the reusability factor more prominent. The reusable slide 220 used for multiple tests and for multiple indications (example disease, gaseous etc). The diagnostic device 210 includes a touch screen display 240 for displaying the data attained from the analysis of the biological sample. The antenna 250 is coupled to the diagnostic device 210 to transmit the data (example: measurements) to a remote central location for further analysis of the biological sample. The apparatus 200 may be equipped in a mobile telephone or other portable equipment with any of simple or obvious modification.

[0025] In an operation of the apparatus 200, the reusable slide 220 is inserted into the diagnostic device 210. The diagnostic device 210 detects the reusable slide 220 through an interface (not shown in figure). The apparatus 200 is designed such that the interface between the diagnostic device 210 and the reusable slide 220 is independent of the type of sensor array on the slide, the number of sensors on the slide or the capability of the slide to perform pre-processing or any conditioning of the measurement data before exchanging the data with the rest of the apparatus.

[0026] Once the reusable slide 220 is detected by the diagnostic device 210, the integrated circuitry of the reusable slide 220 enables primary data reception from a set of sensor array. The sensor array of the reusable slide designed to accept various spectrum and variation of biomarkers. In an example embodiment, the sensor array may consist of field effect transistors, polymer composite sensors, and others. In each case the details may be different. The incorporation of sensor with the necessary circuitry is done to provide a normalized signal to the measurement device, as part of a glass reusable slide. Moreover, the sensor and associated circuitry will be manufactured on a silicon substrate; this substrate can easily be bonded to a standard glass slide. In an example embodiment, protection of the circuitry and wires connecting the sensor array to the circuitry and subsequently the circuitry output signals to the contact planes on the slide is achieved by bonding a plastic cover over the slide, exposing only the sensor array to the outside environment.

[0027] The biomarkers are used to determine the disease state of the subject by indicating the presence of biological agents such as viruses, bacteria, specific antibodies, antigens, etcetera etc. The presence or absence of chemical compounds can be used to infer the disease status of the sample, as some diseases cause the accumulation of specific chemical compounds, or to detect chemical deficiencies of the subject. The sample or biological sample can be selected from the group consisting of , blood, plasma, serum, gastrointestinal secretions, homogenates of tissues or tumors, synovial fluid, feces, saliva, sputum, cyst fluid, amniotic fluid, cerebrospinal fluid, peritoneal fluid, lung lavage fluid, semen, lymphatic fluid, tears, and prostatic fluid.

[0028] The detection of specific biomarkers or chemical compounds is performed by the binding of such to one or more specific binding substances which have been immobilized on a single sensor that can detect increases in volume, mass, surface tension, curvature, or other physical properties of the surface containing the binding substance. The number of specific biomarkers and chemical compounds that can be detected simultaneously inside the apparatus, as well as the accuracy of detection is increased by using an array of such sensors present in the reusable slide. The number of sensors being limited only by the cost of manufacturing of the array and the circuitry and processing power required to analyze the measurement data from the array.

[0029] Each individual sensor has a surface containing one or more specific binding substances immobilized by physical adsorption or by chemical binding. The one or more specific binding substances can be bound to their binding partners. The one or more specific binding substances or binding partners can be selected from the group consisting of nucleic acids, polypeptides, antigens, polyclonal antibodies, monoclonal antibodies, single chain antibodies (scFv), F(ab) fragments, F(ab').sub.2 fragments, Fv fragments, small organic molecules, cells, viruses, bacteria, polymers, protein solutions, peptide solutions, single- or double-stranded DNA solutions, RNA solutions, solutions containing compounds from a combinatorial chemical library and biological samples.

[0030] As the biomarker or chemical compound like protein, polypeptides, DNA from AIDS, TB, CANCER, HEPATITIS and other patients fluid samples viz. blood, sputam, slavia, serum, sperms and vaginal fluids from male/female etc. (binding partner) binds to a receptor (binding substance), the sensor associated with that receptor undergoes some physical change which can be detected by any of the known method. The rate of change, the extent of the change and the type of change of the sensor can be used to infer the concentration, the total amount, and the variation of the biomarker or chemical compound.

[0031] The type of sensors that can be used includes but is not limited to micro scale cantilevers, nano scale cantilevers, field effect transistors, thin film transistors, polymer-composite sensors, reflective and refractive arrays. The sensor arrays can be organized in one, two or three dimensions, in regular or irregular grids. Sensor arrays can contain sensors of the same type, or of different types depending on the application.

[0032] The dimension of the cantilever array is specifically designed where the array is capable of being used with various biomarker materials in spite of miniature size (specific strengthening technology is used). The cantilever used has very high sensitivity for static detection and are generally very soft, i.e. they have very small spring constant. Also, the cantilever used is ensured to have low spring constant while having high resonance frequency.

[0033] In one example embodiment, the array of cantilevers made up of silicon, having length of 500 micron, thickness of 1 micron and width of 150 micron. The width may not be relevant for measurements of sensitivity. To increase the stress sensitivity of the cantilever, the spring constant is reduced, while the overall surface of the cantilever determines the number of molecules that should attach to the surface to cause a resulting stress change. Further, the use of porous silicon and nano-particles enables further enhanced characteristics of cantilever array while further reducing their dimensions.

[0034] Physical changes that are measured include movement, bending, surface swelling, changes in refractive index, elasticity, changes in surface topography, temperature, resistance, mass, roughness, reflectivity, absorbance, and stress. These physical changes of each sensor individually or sensors collectively can be determined by measuring resistance, capacitance, resonance frequency, temperature, reflection, interference patterns, acoustic wave propagation, and etcetera. Physical change is measured dynamically (e.g. over time) in response to the presentation of the sample, or statically as a difference between before and after the presentation of the sample. The influence of external and environmental factors other than the binding of the biomarker or chemical compound onto the sensor receptor surface, such as ambient temperature, pressure, electro-magnetic fields, etcetera, is compensated for by the use of reference sensors dispersed throughout the array which react to these external factors in exactly the same way as the other sensors in the array, but do not bind any substances in the fluid. These reference sensors therefore contain information about the external factors affecting sensor readings. The measurement circuitry can use signals from these reference sensors as common mode signals for differential measurements of the signals from the active sensors.

[0035] The touch screen display 240 of the diagnostic device 210 provides or which helps in primary vie wig of the measurement results. The only requirement is that the interface is digital, requiring some kind of processing and conditioning of the signals from the sensors into a digital and serial form. This conversion and serialization is performed by a dedicated analog/digital circuit integrated into the sensor slide 220. Moreover, the integrated circuitry is capable of performing data acquisition, normalization and signal to noise enhancement which is required to achieve adequate measurement sensitivity.

[0036] In addition of the above, a simple packet serial data protocol may be used between the diagnostic device 210 and the reusable slide 220 is a protocol with error checking mechanisms such as cyclic redundancy check (CRC). Reusable slides will vary in sophistication and processing capacity. Some will have the ability to modify the measurement and/or data pre-processing parameters, in which case the protocol includes a simple command/response/handshake type data exchange. Other slides may only have simple data acquisition and data serialization capabilities, in which case the protocol is one way and the slide simply starts transmitting data as soon as it is powered on. In either case, the reusable slide can be the originator of the clock signal or the recipient, depending again on its functionality. The rest of the apparatus is capable of detecting the presence of a clock signal and/or determining the requirements of the slide based on a simple exchange of data, including the sensor ID, at power up. The serial bus and protocol can be either a low level industry standard such as I2C, or not. USB or other high level bus or networking standard such as Ethernet is at this moment cost prohibitive for single-use. However, as processing power reduces in cost eventually this will no longer be the case and it is envisioned that the communications between reusable slide and data devices will use an open standard to allow interchange of 3rd party sensors and data devices.

[0037] Moreover, each reusable slide has an identification (ID) (not shown in figure) consisting of some string of characters, numbers and/or symbols. This ID is created at manufacture and is guaranteed to be unique i.e. no other reusable slide can exist with the same ID. All data measured and reported by this sensor slide is tagged with the ID of the slide and the date and time of measurement. Additionally, the reusable slide ID contains information on the class and type of the sensor slide which informs the rest of the apparatus about the capabilities of, and data measured by the reusable slide. The ID is printed in text and as a barcode or other digital image onto the reusable slide as well, so-that it is readable by a human as well as a barcode or other reader.

[0038] The combining of multiple sensor types and measurement types in one sensor may also improve the accuracy and signal to noise ratio by using multiple approaches and designing the circuitry to support them. The biosensors are made detachable by incorporating the sensor array in the reusable slide.

[0039] Referring now to Figure 3, there is illustrated a method 300 for detecting biological state in a sample using biomarkers according to one embodiment of the invention. At step 310, the method receives a sample on a reusable slide for detecting the biological state using biomarkers. The reusable slide includes a sensor platform, where the sensor platform having a plurality of interaction cells, each of the interaction cells embedded with the biomarker, the reusable slide including an inlet for receiving the sample, and at least one sensor disposed in it, the sensor is capable of deflecting in response to chemical interaction between the biomarker and the sample.

[0040] At step 320, the reusable slide is washed to remove the excess sample using water or any other suitable agents. In an example embodiment, the detection of RNA may be performed using the array and silane based immobilization. Surface chemical modification is first performed. The coupling of biomolecules to silicon by silanization is performed. This involves the covalent binding of a silane molecule to the surface or to another silane molecule through a siloxane bond. Then the probe molecules are immobilized on the surface. The RNA would stick to the probe molecule, which is used for detection of RNA.

[0041] Various methods of sterilization of silicon may be used such as elevated and room-temperature organic phase, vapour phase, and chemical vapour deposition. For the detection various reagents and solutions are used. In an exemplary embodiment buffer solutions were prepared from DNase- and RNase- free analytical grade reagents and sterile deionised water. The buffer solution that may be used in the method are the 20mM MOPS, 100mM Nacl, pH 7.4 for the immobilization buffer. Further 20mM Tris-Hcl, 100mM NaCl, pH 7.4.

[0042] In another embodiment the detection of DNA and RNA using the array sensors and thiol based immobilization is performed. Thiols (SH groups) chemisorb on gold making it possible to achieve a high surface coverate of any type of molecules that have thiol groups. Examples of such molecules are alkanethoiols such as mercapto-hexane, proteins like cysteine, amino acids, or oligonucleotide chain modified with a thiol group. Using thiol modified oligonucleotides makes it possible to create moluecular layer on a gold surface, which can be used as a platform for hybridization detection in a biosensor.

[0043] At step 330, the method allows to insert the reusable slide into the diagnostic device for detecting biomarkers or chemical compounds in the sample. The biomarkers are used to determine the disease state of the subject by indicating the presence of biological agents such as viruses, bacteria, specific antibodies, antigens, etcetera etc. The presence or absence of chemical compounds can be used to infer the disease status of the subject, as some diseases cause the accumulation of specific chemical compounds, or to detect chemical deficiencies of the subject.

[0044] At step 340, the method streams the date received from the deflected sensors. As the biomarker or chemical compound (binding partner) binds to a receptor (binding substance), the sensor associated with the receptor undergoes some physical change which is detected. The number of specific biomarkers and chemical compounds that can be detected simultaneously inside the apparatus, as well as the accuracy of detection is increased by using an array of such sensors. The number of sensors being limited only by the cost of manufacturing of the array and the circuitry and processing power required to analyse the measurement data from the array. The received data are compared with the measurement of reference sensors for accurate analysis. The influence of external and environmental factors other than the binding of the biomarker or chemical compound onto the sensor receptor surface, such as ambient temperature, pressure, electro-magnetic fields, etcetera etc are balanced by the reference sensors. These reference sensors contain information about the external factors affecting sensor readings. By the use of the reference sensors measurements, the result attained by the device is accurate.

[0045] At step 350, the method analyse the responses of the sensors deflection due to chemical interaction between the biomarker and the sample.

[0046] At step 360, the method display the analyzed result on the touch screen display or it can also be transmitted to another remote location for further analysis.

[0047] Referring now to Figure 4, there is illustrated a system 400 for detecting biological state in a sample using biomarkers. The system 400 includes an apparatus 410, one or more network 460 and a server 440 with a database 450. The apparatus having a diagnostic device 420 for the analysis of a single or multiple analytes that originates from a biological sample. The apparatus also includes a reusable slide 430 having a sensor platform, an integrated circuitry and a pair of electrical contacts. In one operation of the system, the apparatus 410 coupled to one or more communication network for transmitting the detected data by way of passing the signals to different networks or one or more servers for further analysis.

[0048] The communication network 460 may be or may include one or more network selected from a group of networks consisting of a layer-2 networks, a metropolitan area network, a wide area network and the like. The communication channel 470 between the apparatus 410 and the server 440 through the network 460 is a uni-directional link or a bi-directional link or both. The apparatus 410 transmit or in communication with the server 440 through a network 460, where the server 440 receive signals (data) and stores in a secure database 450.

[0049] The server may be or may include, for example, a mobile phone, a cellular phone, a handheld device, a computing device, a computer, a mobile computer, a portable computer, a laptop computer, a handheld computer, a handheld device, a PDA device, a handheld PDA device, a mobile or portable device, or the like. According to some aspects, the server 440 may comprise a communication device connectable to one of the other devices/ network via a wired or wireless connection.

[0050] FIGS. 1-4 are merely representational and are not drawn to scale. Certain portions thereof may be exaggerated, while others may be minimized. FIGS. 1-4 illustrate various embodiments of the invention that can be understood and appropriately carried out by those of ordinary skill in the art.

[0051] In the foregoing detailed description of embodiments of the invention, various features are grouped together in a single embodiment for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed embodiments of the invention require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment. Thus, the following claims are hereby incorporated into the detailed description of embodiments of the invention, with each claim standing on its own as a separate embodiment.

[0052] It is understood that the above description is intended to be illustrative, and not restrictive. It is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined in the appended claims. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms “including” and “in which” are used as the plain-English equivalents of the respective terms “comprising” and “wherein,” respectively.

I CLAIM

1. An apparatus for detecting biological state of a sample using biomarkers, the apparatus comprising:

a reusable slide including,

a sensor platform comprising a plurality of interaction cells, each of the interaction cells embedded with the biomarker, the interaction cells including an inlet for receiving the sample, and at least one sensor disposed in it, the sensor is capable of deflecting in response to chemical interaction between the biomarker and the sample;

an integrated circuitry coupled to the reusable slide for performing the electronic measurements on the sensor platform, converting the signals to a digital representation and to exchange the data and other information with the apparatus; and

an electrical contact to receive power from the apparatus;

and

a diagnostic device having a slide inserting slot and an interface for accommodating the reusable slide.

2. The apparatus as claimed in claim 1, wherein the sensor includes micro scale cantilevers, nano scale cantilevers, field effect transistors, polymer-composite sensors, reflective and refractive arrays.

3. The apparatus as claimed in claim 1, wherein the physical changes of each sensor or sensors collectively determined by measuring resistance, capacitance,

resonance frequency, temperature, reflection, interference patterns, acoustic wave propagation, etcetera.

4. The apparatus as claimed in claim 1, wherein the integrated circuitry is an analog to digital converter circuit.

5. The apparatus as claimed in claim 1, wherein the slide having two contacts for the wired interface to allow serial transfer of data including a clock line and also to receive and/or transmit lines.

6. The apparatus as claimed in claim 1, wherein the diagnostic device comprising a display for displaying the measurement results.

7. The apparatus as claimed in claim 1, wherein the diagnostic device comprising an antenna for transmitting the various measurement to a remote location.

8. The apparatus as claimed in claim 1, wherein the interface of the diagnostic device is independent of the type of sensor array on the slide and the number of sensors on the slide.

9. The apparatus as claimed in claim 1, wherein the reusable slide has the capability to perform pre-processing or any conditioning of the measurement data before exchanging the data with the rest of the apparatus.

10. The apparatus as claimed in claim 1, wherein the reusable slide is made up of glass.

11. A method for detecting biological state in a sample using biomarkers, the method comprising the steps of:

providing the sample on a reusable slide, wherein the reusable slide is having the sensor platform;

washing off the excess sample using suitable agents;

inserting the reusable slide into a diagnostic device for detecting and reading data from the sensor on the slide; and

analyzing the responses of the sensors deflection due to chemical interaction between the biomarker and sample.

12. The method as claimed in claim 11, wherein the step of detecting comprising authenticating the reusable reusable slide and start exchanging of data with the diagnostic device, wherein the data includes slide identification code, capability and the requirements for initiating the process.

13. The method as claimed in claim 11, wherein the step of detecting further comprising:

transmitting the reusable slide ID and the serialized sensor data from the reusable reusable slide to the remote server.

14. The method as claimed in claim 11, wherein the step of analyzing further comprising:

streaming the data received from the deflected sensors and comparing the measurement with the reference sensors for accurate analysis.

15. The method as claimed in claim 11, further comprising:

displaying the data attained from the analysis of the sample.

16. A system for detecting biological state in a sample using biomarkers, the system comprising:

a reusable slide including,

a sensor platform comprising a plurality of interaction cells, each of the interaction cells embedded with the biomarker, the reusable slide including an inlet for receiving the sample, and at least one sensor disposed in it, the sensor is capable of deflecting in response to chemical interaction between the biomarker and the sample;

an integrated circuitry coupled to the reusable slide for performing the electronic measurements on the microcantilever platform, converting the signals to a digital representation and to exchange the data and other information with the apparatus; and

an electrical contact to receive power from the apparatus;

a diagnostic device having a slide inserting slot and an interface for accommodating the reusable slide, wherein the diagnostic device including a display and an antenna;

at least one communication network; and

at least one server including a database for storing the data received from the diagnostic device.

ABSTRACT

The invention relates to an apparatus and method for detecting biological state in a sample using biomarkers. In one embodiment, this is accomplished by a reusable slide having a sensor platform comprising one or more interaction cells, each of the interaction cells embedded with the biomarker, the interaction cells including an inlet for receiving the sample, and one or more sensor disposed in it, the sensor is capable of deflecting in response to chemical interaction between the biomarker and the sample. An integrated circuitry coupled to the reusable slide for performing the electronic measurements on the sensor platform, converting the signals to a digital representation and to exchange the data and other information with the apparatus, and an electrical contact to receive power from the apparatus. A diagnostic device having a slide inserting slot and an interface for accommodating the reusable slide.

Ref. FIG. 2