Description

BACKGROUND OF THE INVENTION

1. Field of the Invention.

This invention relates to electrolytic moisture sensing elements and more particularly to thin film moisture sensing elements and a process for the manufacture thereof.

2. Description of the Prior Art.

Various sensors for measuring the moisture content of a sample are known in the art. The various types of sensors and their basic principles of operation are described in a paper by Stanley Ronchinsky entitled "An Electrochemical Sensor for Trace Moisture in Gases," Moisture and Humidity, Measurement and Control in Science and Industry, 1985, pages 699 to 706. Of the different types of sensors described, the sensor type referred to as the "Electrolyzing Sensor" appears to be best suited for applications where continuous monitoring of moisture is required and for other industrial applications for the detection of trace amounts of moisture in samples.

Electrolytic sensors employ a moisture scavenger to trap the moisture in the sample and appropriate circuitry is provided to measure the amount of current required to electrolyze the resulting material. The operating principle of these sensors is Faraday's law of electrolysis in which the electrical charge required to electrolyze the material is a measure of the water content of the sample. Electrolysis is carried out by a pair or pairs of electrodes disposed in the body of the sensor.

The Keidel cell is an example of a moisture sensor operating on the electrolysis principle. Essentially the Keidel cell consists of a body which contains a pair of noble metal electrodes and which is packed with a suitable water scavenger such as phosphorous pentoxide. A sample stream is introduced into the body and the moisture is retained by the hygroscopic scavenger. The retained moisture is electrolyzed at the electrodes and the current required to electrolyze the moisture is measured. The Keidel cell and other forms of electrolytic sensors operating on the same principle require that the active area of the sensor be exposed to a constant flow of sample past the electrodes of the sensor. Variations in the sample flow rate can result in erroneous measurements and over time the hygroscopic scavenger tends to plug, causing a restriction in the flow of sample through the sensor, and terminating the usefulness of the sensor. An alternative to this is to introduce a known volume of sample into the sensor and measure the total current over time required to completely electrolyze the moisture in the known volume of sample. This is time consuming and does not lend itself to use for continuous monitoring. In addition, sensors of the type described have slow response times to changes in the moisture content of the sample due to their bulkiness and are not sensitive over a wide range of moisture content.

Accordingly, it would be highly desirable to provide a moisture sensor which retains the accuracy and reliability of the electrolytic sensors and which is sensitive over a wide range of moisture content. In addition, it would be desirable to provide a moisture sensor which measures the moisture content of a sample independent of the flow rate or volume of the sample to which the sensor is exposed, thus rendering the sensor more useful for the measurement of moisture contained in a solid as well as in a fluid.

US-A-4,707,244 (Harman, III et al) teaches a moisture sensing element having a structurally stable, nonporous, electrically insulating, substrate which can be made of silicon, quartz, alumina or sapphire. A single-layer of a noble metal is deposited directly onto the substrate to form electrodes.

US-A-4,280,855 (Savery) teaches a thin film device intended to "getter" moisture inside of packages containing moisture sensitive electronics. Layered electrodes are disposed on top of a silicon dioxide substrate. The electrode layer adjacent to the substrate is made of Cr or NiCr, about 1000 Angstroms thick and topped by a thin layer of gold.

According to the present invention there is provided a thin film moisture sensing sensor having a substantially planar surface of silicon dioxide; two electrodes selectively deposited to define an interelectrode gap therebetween; a hygroscopic material contacting the two electrodes; and means for electrically connecting the electrodes across a source of electrical potential and to electric current measuring instrumentation, the sensor being characterized by each electrode comprising an alloy layer formed of a binding metal alloyed with the silicon dioxide surface; and a noble metal layer, and the alloy layer consisting essentially of alloys of the silicon dioxide surface, the binding metal and the noble metal.

Silicon dioxide provides a preferred surface for the sensing element because of good insulating properties, lack of a moisture memory which would affect the element over time and its chemical inertness with respect to phosphoric acid, which is a product of a reaction between phosphorous pentoxide and water. Rhodium electrodes are indirectly bonded to the silicon dioxide surface by a titanium interface. Because titanium is subject to being corroded by phosphoric acid, however, the depth of the titanium interface is limited so that deposition of rhodium on top of the titanium results in a titanium-rhodium alloy at the surface of the substrate. Appropriate leads are then attached to the electrodes. Phosphoric acid is applied to the surface of the substrate over the electrodes and in the gaps between the electrodes. The acid is

then dried to form a phosphorous pentoxide layer over the surface of the substrate and the electrodes. The element is set in a housing. The housing permits communication between the gases to be sampled and the sensing element. A diffusion limiting screen limits the moisture pressure adjacent the sensing element to a known fraction of the moisture pressure in the sample gas.

In operation, a moisture bearing gas is passed through the housing. A fraction of the water molecules pass through the diffusion limiting screen. Virtually all water molecules passing the diffusion limiting screen react with the hygroscopic electrolytic material to form an aqueous solution of phosphoric acid. The solution is electrolyzed at the electrodes to hydrogen, oxygen and phosphorous pentoxide. Any change in the moisture content of the sample gas results in a change in the diffusion rate across the diffusion limiter. This produces an increase or decrease in the rate at which the water molecules are being electrolyzed at the electrodes. The current required to carry out electrolysis likewise increases or decreases. In accordance with Faraday's law of electrolysis, the current change is directly related to the change in the moisture content of the sample. The current will continue to change until equilibrium conditions are reestablished.

In accordance with the present invention, the sensor retains the convenience and reliability of conventional electrolytic sensors while exhibiting high sensitivity and rapid response to changes in moisture content of a sample. It is unnecessary to carefully control the flow of sample past the sensor and inaccuracies due to variations in the sample flow rate are avoided. By the same token, since the sensor of the invention does not require a continuous flow of sample to operate accurately, it is useful for the determination of moisture given off by solids and viscous fluids.

The advantages of a wide moisture range sensitivity and rapid response to changes in moisture content of a gas are obtained in part by radical reduction of the bulk mass of the sensing element. Such reduction in mass also increases the area to volume ratio of the element. Thin film metal deposition techniques developed for use in the fabrication of integrated circuits are adapted in the present invention for use in the fabrication of the sensing elements. The sensing elements fabricated are comparable in size to common integrated circuit dice.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross sectional view of a moisture sensor assembly incorporating the moisture sensing element constructed in accordance with the invention.

FIGS. 2A-H are cross sectional views of the sensing element in various stages of the process for the fabrication thereof.

FIG. 3 is a plan view of the sensing element illustrating the electrodes disposed thereon in an interdigititated pattern.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a moisture sensor assembly 10, comprising a substantially planar moisture sensing element 12. Moisture sensing element 12 is disposed within housing 14, which is preferably a conventional semiconductor or transistor can. Housing 14 is internally divided by diffusion limiting screen 24 into sample chamber 16 and sensing element chamber 22. Diffusion limiting screen 24 is preferably a stainless steel screen. A 1 to 100 micron screen can be selected to obtain diffusion limiting depending upon the application environment, the housing and the sensing element geometry. A moisture bearing gas is introduced to sample chamber 16 by way of inlet 18 and is exhausted from sample chamber 16 by way of outlet 20. Inlet 18 and outlet 20 are preferably formed of a corrosion resistant material, for example, nickel. Diffusion limiting screen 24 reduces the moisture partial pressure in sensing element chamber 22 by nearly two orders of magnitude as against the partial pressure in sample chamber 16. The probability of absorption of water molecules reaching sensing element chamber 22 by element 12 becomes nearly 100%. Accordingly, the amount of moisture vapor absorbed becomes substantially independent of temperature. Diffusion across screen 24 is a linear function of the partial pressure of water vapor in sample chamber 16.

Moisture sensing element 12 is constructed on a substantially planar substrate 26. An insulating layer 28, formed of silicon dioxide grown from silicon layer 27 underlies the sensing element. In an alternative embodiment, substrate 26 may be a planar quartz substrate. Interdigitated electrodes 32 and 34 are disposed on the face of insulating substrate layer 28. Layer 28 and electrodes 32 and 34 are covered with a layer 30 of a hygroscopic material. Typically, hygroscopic layer is a layer 30 of phosphorous pentoxide which reacts with water molecules to form an aqueous solution of phosphoric acid which may be electrolyzed into molecular hydrogen, oxygen and phosphorous pentoxide by a potential imposed across electrodes 32 and 34. Hygroscopic layer 30 bridges the interelectrode gap between electrodes 32 and 34. Electrodes 32 and 34 may be connected across outside potential source and current measuring apparatus 39 by way of leads 36 and 38 which pass through the walls of housing 14.

FIGS. 2A-2H illustrate the steps of fabricating a moisture sensing element 12. FIG. 2A illustrates a silicon wafer 25 after oxidation of the outside surfaces of the silicon wafer in a high temperature oven with an

oxidizing atmosphere. The oxidation step produces a wafer with a silicon substrate layer 27 and silicon dioxide layer 28 which is in the range of 8000-12,000 angstroms and is preferably about 10,000 angstroms thick.

FIG. 2B illustrates selection of one silicon dioxide layer 28 to provide an insulating surface 29 to support fabrication of the sensing element. A positive photoresist layer 40 is applied over insulating surface 29.

FIG. 2C illustrates the wafer after exposure and development to photoresist layer 40. Portions of photoresist layer 40 have been exposed to actinic radiation and developed, leaving openings in photoresist layer 40 exposing portions 42 of insulating layer 29. The pattern of exposed portions 42 define the location of electrodes which will be deposited on surface 29 of silicon dioxide layer 28.

FIG. 2D illustrates deposition of a binding layer 44 on silicon dioxide layer 28 in the pattern of the electrodes to be formed. Metal layer 44 is preferably a layer of titanium of between 40 and 80 angstroms in depth. Other metals which would be suitable include chromium and nickel or such other material as suitably adheres to silicon dioxide. An electron beam is used to evaporate the titanium. A quartz oscillator control balance is used to ensure that the thickness of the titanium layer is carefully controlled, preferably averaging 50 angstroms. A portion of the titanium deposition penetrates silicon dioxide layer 28 and forms an alloy therewith.

FIG. 2E illustrates deposition of metallic electrodes for the sensing element. Superior results are obtained if electrode layer 46 is deposited on titanium layer 44 immediately after deposition of layer 44. Electrode layer 46 is a noble metal, such as rhodium, platinum, or gold, but preferably rhodium. Rhodium electrodes 46 are in the range of 1,000-5,000 angstroms and average approximately 3,000 angstroms in depth. They are approximately 25 microns in width. Spacing between the interdigited finger of electrodes 46 is approximately 25 to 60 microns, with 40 microns being preferred. Deposition of rhodium electrodes 46 immediately after deposition of titanium binding layer 44 results in an alloy of the titanium and the rhodium. It is preferred that no pure titanium remain present, but that only blended alloys of titanium-rhodium and titanium-silicon exist after deposition of the rhodium electrodes 46. This protects the titanium in binding layer 44 from attack by the phosphoric acid eventually applied to the device.

FIG. 2F illustrates removal of the unexposed positive photoresist layer 30 by washing the silicon wafer in an acetone bath.

FIG. 2G illustrates application 48 of an aqueous solution of phosphoric acid to the surface of substrate layer 28, covering at least a portion of that layer and a plurality of electrode digits 32 and 34.

The aqueous solution is then dried, preferably by electrolysis, in a dry nitrogen atmosphere to form a phosphorous pentoxide layer 50 covering electrode digits 32 and 34 as illustrated in FIG. 2H and filling the interelectrode gap between digits 32 and 34.

FIG. 3 illustrates a plan view of sensing element 12 with interdigited electrodes 32 and 34. Electrodes 32 extend from pad 54 which is a part of rhodium deposition being of substantially greater width than electrode digits 32. Similarly pad 56 is a rhodiuum area of substantially greater width than digits 34. Rhodium pads 58 and 60 similarly extend from pads 54 and 56. Electrical leads may be attached to pads 54 or 58 and 56 or 60. Pads 54, 56, 58 and 60 define the active surface area of sensing element 12. Because rhodium is hydrophobic, an aqueous solution of phosphoric acid applied to insulating surface 29, remains within the lateral bounds of rhodium pads 54, 56, 58 and 60, if the width of the pads is sufficient. However, the width of electrode digits 32 and 34 is insufficient to prevent the spread of the aqueous solution across electrode digits 32 and 34.

In operation, the sensor assembly is connected across a voltage source and current measuring apparatus 39 by leads 36 and 38. Inlet tube 18 and outlet tube 20 may then be introduced to an environment to allow sampling of a gas to be analyzed for moisture content. As the moisture bearing gas enters chamber 16, its diffusion across stainless steel barrier 24 is limited as a function of the partial pressure of moisture in chamber 16. Moisture from the gas in chamber 22 is scavenged by the phosphorous pentoxide producing an aqueous solution of phosphoric acid in the interelectrode gaps between electrodigits 32 and 34. Current flow begins which may be measured and converted to an indication of water in terms of parts per million or billion by known mathematical relationships.

Thin film hygrometers constructed in accordance with the teachings of the present invention have proven capable of detecting moisture levels with a lower limit of 20 parts per billion in a sample gas. Actual devices have given accurate readings over temperature range of -30°C to +70°C. The need for and the complexity of temperature compensation is reduced because the output signal is independent of sample gas flow. Independence from flow results from limiting diffusion into the chamber wherein the sensing element is actually disposed. Such independence also can allow the device to be used with respect to stagnant atmospheres, allowing moisture measurement of solids or viscous fluids. Placing a solid or viscous fluid in a closed environment with a dry gas will result in an equilibrium moisture level developing into the environment. The assembly of the present invention can then measure moisture level in the environment to provide an indication of the moisture content of the solid. The reduced size of the devices controls antenna effects and reduces noise interference substan-

tially. Moisture level transistion response time has been shown to reach 63% of equilibrium in less than 5 minutes after the transition. This compares with a response time of an hour or more in prior art devices.

Claims

1. A thin film moisture sensing sensor (10) having a substantially planar surface of silicon dioxide (26,29); two electrodes (32,34) selectively deposited to define an interelectrode gap therebetween; a hygroscopic material (50) contacting the two electrodes (32,34); and means (36,38) for electrically connecting the electrodes (32,34) across a source of electrical potential and to electric current measuring instrumentation (39), the sensor (10) being characterized by each electrode comprising an alloy layer formed of a binding metal (44) alloyed with the silicon dioxide surface (26,29); and a noble metal layer (46), and the alloy layer (44) consisting essentially of alloys of the silicon dioxide surface (29), the binding metal and the noble metal (46).

2. The sensor (10) of claim 1 wherein the hygroscopic material (50) is disposed in at least a first continuous layer over a portion of the silicon dioxide surface (26,29) and over portions of the two electrodes (32,34).

3. The sensor (10) as defined in claim 1 wherein the alloy layer of each electrode is fabricated by depositing a binding layer of titanium (44) not exceeding 80 Angstroms in thickness onto the silicon dioxide surface (26,29) and immediately thereafter depositing rhodium onto the titanium.

4. The sensor (10) of claim 1 wherein each alloy layer comprises an initial layer of titanium (44) no more than 80 Angstroms thick and the noble metal layer (46) is at least 1000 Angstroms thick.

5. The sensor (10) of claim 1 further comprising:
a housing (14) defining an enclosed chamber (16,22);
a diffusion limiting screen (24) disposed within the enclosed chamber (16,22) and dividing the enclosed chamber (16,22) into a sample chamber (16) and a sensing element chamber (22), the silicon dioxide surface (26,29) and electrodes (32,34) being located in the sensing element chamber (22); and
inlet and outlet ports (18,20) through the housing (14) communicating with the sample chamber (16).

6. The sensor (10) defined in claim 1 wherein the binding metal (44) is selected from the group consisting of titanium, nickel and chromium.

7. The sensor (10) defined in claim 6 wherein the alloy layers are resistant to phosphoric acid attack.

8. The sensor (10) defined in claim 1 wherein the alloy layers are formed by depositing the binding metal (44) by electron beam.

9. The sensor (10) defined in claim 1 wherein the noble metal (46) is selected from the group consisting of rhodium, platinum and gold.

10. A process for making a thin film moisture sensor (10), the process comprising the steps of: depositing a photoresist layer (40) on top of a surface of silicon dioxide (26,29); exposing portions of the photoresist layer (40) to actinic radiation; developing the photoresist layer (40) to uncover at least a portion (42) of the silicon dioxide surface (26,29); the process being characterized by depositing a first layer of a metal (44) on top of at least a portion (42) of the uncovered silicon dioxide surface (26,29), wherein the metal (44) is selected from the group consisting of titanium, nickel and chromium; depositing a second layer of a metal (46) on top of the first metal layer (44), wherein the metal (46) is selected from the group consisting of rhodium, iridium, platinum and gold; removing the remaining photoresist layer (40) with a solvent; applying a solution of water and phosphoric acid on top of the silicon dioxide surface (26,29); and drying the sensor (10) to leave a layer of phosphorous pentoxide on top of at least a portion of the silicon dioxide surface (26,29) and the metal layer (46).

11. A process according to Claim 10 comprising the step of forming a silicon dioxide layer (28) on a silicon substrate (27) to provide the silicon dioxide surface (29).

Patentansprüche

1. Ein Dünnfilm-Feuchtigkeitserfassungssensor (10), der eine im wesentlichen ebene Oberfläche aus Siliziumdioxid (26, 29); zwei Elektroden (32, 34), die wahlweise angeordnet sind, um einen Elektrodenabstand zwischen diesen festzulegen; ein hygroskopisches Material (50), das die beiden Elektroden (32, 34) berührt; und Vorrichtungen (36, 38) zur elektrischen Verbindung der Elektroden (32, 34) über eine Quelle elektrischen Potentials und zum Meßinstrumentarium (39) für elektrischen Strom aufweist, wobei der Sensor (10) dadurch **gekennzeichnet**, ist, daß jede Elek-

tially. Moisture level transistion response time has been shown to reach 63% of equilibrium in less than 5 minutes after the transition. This compares with a response time of an hour or more in prior art devices.

Claims

1. A thin film moisture sensing sensor (10) having a substantially planar surface of silicon dioxide (26,29); two electrodes (32,34) selectively deposited to define an interelectrode gap therebetween; a hygroscopic material (50) contacting the two electrodes (32,34); and means (36,38) for electrically connecting the electrodes (32,34) across a source of electrical potential and to electric current measuring instrumentation (39), the sensor (10) being characterized by each electrode comprising an alloy layer formed of a binding metal (44) alloyed with the silicon dioxide surface (26,29); and a noble metal layer (46), and the alloy layer (44) consisting essentially of alloys of the silicon dioxide surface (29), the binding metal and the noble metal (46).

2. The sensor (10) of claim 1 wherein the hygroscopic material (50) is disposed in at least a first continuous layer over a portion of the silicon dioxide surface (26,29) and over portions of the two electrodes (32,34).

3. The sensor (10) as defined in claim 1 wherein the alloy layer of each electrode is fabricated by depositing a binding layer of titanium (44) not exceeding 80 Angstroms in thickness onto the silicon dioxide surface (26,29) and immediately thereafter depositing rhodium onto the titanium.

4. The sensor (10) of claim 1 wherein each alloy layer comprises an initial layer of titanium (44) no more than 80 Angstroms thick and the noble metal layer (46) is at least 1000 Angstroms thick.

5. The sensor (10) of claim 1 further comprising:
a housing (14) defining an enclosed chamber (16,22);
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inlet and outlet ports (18,20) through the housing (14) communicating with the sample chamber (16).

6. The sensor (10) defined in claim 1 wherein the binding metal (44) is selected from the group consisting of titanium, nickel and chromium.

7. The sensor (10) defined in claim 6 wherein the alloy layers are resistant to phosphoric acid attack.

8. The sensor (10) defined in claim 1 wherein the alloy layers are formed by depositing the binding metal (44) by electron beam.

9. The sensor (10) defined in claim 1 wherein the noble metal (46) is selected from the group consisting of rhodium, platinum and gold.

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11. A process according to Claim 10 comprising the step of forming a silicon dioxide layer (28) on a silicon substrate (27) to provide the silicon dioxide surface (29).

Patentansprüche

1. Ein Dünnfilm-Feuchtigkeitserfassungssensor (10), der eine im wesentlichen ebene Oberfläche aus Siliziumdioxid (26, 29); zwei Elektroden (32, 34), die wahlweise angeordnet sind, um einen Elektrodenabstand zwischen diesen festzulegen; ein hygroskopisches Material (50), das die beiden Elektroden (32, 34) berührt; und Vorrichtungen (36, 38) zur elektrischen Verbindung der Elektroden (32, 34) über eine Quelle elektrischen Potentials und zum Meßinstrumentarium (39) für elektrischen Strom aufweist, wobei der Sensor (10) dadurch **gekennzeichnet**, ist, daß jede Elek-

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trode eine Legierungsschicht, die aus einem Bindemetall (44) gebildet ist, das mit der Siliziumdioxid-Oberfläche (26, 29) legiert ist; und eine Edelmetallschicht (46) aufweist, und daß die Legierungsschicht (44) im wesentlichen aus Legierungen der Siliziumdioxid-Oberfläche (29), dem Bindemetall und dem Edelmetall (46) besteht.

2. Sensor (10) nach Anspruch 1, dadurch gekennzeichnet, daß das hygroskopische Material (50) in mindestens einer ersten durchgehenden Schicht über einen Abschnitt der Siliziumdioxid-Oberfläche (26, 29) und über Abschnitte der beiden Elektroden (32, 34) angeordnet ist.

3. Sensor (10) nach Anspruch 1, dadurch gekennzeichnet, daß die Legierungsschicht jeder Elektrode durch Aufbringen einer Bindeschicht aus Titan (44), die eine Stärke von 80 Angström nicht übersteigt, auf der Siliziumdioxid-Oberfläche (26, 29) und anschließende sofortige Aufbringung von Rhodium auf das Titan hergestellt ist.

4. Sensor (10) nach Anspruch 1, dadurch gekennzeichnet, daß jede Legierungsschicht eine Anfangsschicht aus Titan (44) aufweist, die nicht dicker als 80 Angström ist, und die Edelmetallschicht (46) mindestens 1000 Angström dick ist.

5. Sensor (10) nach Anspruch 1, dadurch gekennzeichnet, daß er weiterhin folgendes aufweist:
Ein Gehäuse (14), das eine geschlossene Kammer (16, 22) festlegt;
eine Diffusionsbegrenzungsscheibe (24), die innerhalb der geschlossenen Kammer (16, 22) angeordnet ist und die geschlossene Kammer (16, 22) in eine Probenkammer (16) und eine Erfassungselement-Kammer (22) teilt, wobei die Siliziumdioxid-Oberfläche (26, 29) und die Elektroden (32, 34) in der Erfassungselement-Kammer (22) angeordnet sind; und
Einlaß- und Auslaßöffnungen (18, 20) durch das Gehäuse (14), die mit der Probenkammer (16) in Verbindung stehen.

6. Sensor (10) nach Anspruch 1, dadurch gekennzeichnet, daß das Bindemetall (44) aus der Gruppe bestehend aus Titan, Nickel und Chrom ausgewählt ist.

7. Sensor (10) nach Anspruch 6, dadurch gekennzeichnet, daß die Legierungsschichten phosphorsäurebeständig sind.

8. Sensor (10) nach Anspruch 1, dadurch gekennzeichnet, daß die Legierungsschichten durch Aufbringen des Bindemetalls (44) durch Elektronenstrahlung ausgebildet sind.

9. Sensor (10) nach Anspruch 1, dadurch gekennzeichnet, daß das Edelmetall (46) aus der Gruppe bestehend aus Rhodium, Platin und Gold ausgewählt ist.

10. Ein Verfahren zur Herstellung eines Dünnfilm-Feuchtigkeitssensors (10), wobei das Verfahren die folgenden Schritte aufweist: Aufbringen einer lichtunempfindlichen Schicht (40) oben auf einer Siliziumdioxid-Oberfläche (26, 29); Abschnitte der lichtunempfindlichen Schicht (40) einer chemisch wirksamen Strahlung aussetzen; Entwickeln der lichtunempfindlichen Schicht (40), um zumindest einen Abschnitt (42) der Siliziumdioxid-Oberfläche (26, 29) freizulegen; wobei das Verfahren gekennzeichnet ist durch das Aufbringen einer ersten Metallschicht (44) oben auf zumindest einem Abschnitt (42) der freigelegten Siliziumdioxid-Oberfläche (26, 29), wobei das Metall (44) aus der Gruppe bestehend aus Titan, Nickel und Chrom ausgewählt ist; Aufbringen einer zweiten Metallschicht (46) oben auf der ersten Metallschicht (44), wobei das Metall (46) aus der Gruppe bestehend aus Rhodium, Iridium, Platin und Gold ausgewählt ist; Entfernen der restlichen lichtunempfindlichen Schicht (40) mit einem Lösungsmittel; Aufbringen einer Wasser-Phosphorsäure-Lösung oben auf die Siliziumdioxid-Oberfläche (26, 29); und Trocknen des Sensors (10), um eine Schicht Phosphorpentoxid oben auf zumindest einem Abschnitt der Siliziumdioxid-Oberfläche (26, 29) und der Metallschicht (46) zu belassen.

11. Verfahren nach Anspruch 10, dadurch gekennzeichnet, daß es den folgenden Schritt aufweist: Ausbildung einer Siliziumdioxid-Schicht (28) auf einem Siliziumsubstrat (27) zur Schaffung der Siliziumdioxid-Oberfläche (29).

Revendications

1. Capteur à couche mince (10) de détection d'humidité, comportant une surface essentiellement plane de dioxyde de silicium (26,29), deux électrodes (32,34) déposées sélectivement de manière à définir un espace interélectrode entre elles, une matière hygroscopique (50) en contact avec les deux électrodes (32,34) et des moyens (36,38) pour connecter électriquement les électrodes (32,34) aux bornes d'une source de tension électrique et à un appareil de mesure de courant électrique (39), le capteur (10) étant caractérisé en ce que chaque électrode comprend une couche d'alliage formée d'un métal liant (44) allié à la surface de dioxyde de silicium (26,29) et une couche de métal noble (46), et en ce que la

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couche d'alliage (44) se compose essentiellement d'alliages de la surface de dioxyde de silicium (29), du métal liant et du métal noble (46).

2. Capteur (10) selon la revendication 1, dans lequel la matière hygroscopique (50) est disposée en au moins une première couche continue sur une partie de la surface de dioxyde de silicium (26,29) et sur des parties des deux électrodes (32,34).

3. Capteur (10) selon la revendication 1, dans lequel la couche d'alliage de chaque électrode est fabriquée par dépôt d'une couche liante de titane (44), dont l'épaisseur ne dépasse pas 80 Å, sur la surface de dioxyde de silicium (26,29) et, immédiatement après, par dépôt de rhodium sur le titane.

4. Capteur (10) selon la revendication 1, dans lequel chaque couche d'alliage comprend une couche initiale de titane (44) dont l'épaisseur ne dépasse pas 80 Å, et en ce que la couche de métal noble (46) a une épaisseur d'au moins 1000 Å.

5. Capteur (10) selon la revendication 1, comprenant en outre:

un boîtier (14) qui définit une chambre fermée (16,22),

un écran de limitation de diffusion (24) disposé dans la chambre fermée (16,22) et divisant la chambre fermée (16,22) en une chambre d'échantillon (16) et une chambre d'élément détecteur (22), la surface de dioxyde de silicium (26, 29) et les électrodes (32,34) étant situées dans la chambre d'élément détecteur (22), et

des orifices d'entrée et de sortie (18,20) à travers le boîtier (44), en communication avec la chambre d'échantillon (16).

6. Capteur (10) selon la revendication 1, dans lequel le métal liant (44) est choisi dans le groupe constitué par le titane, le nickel et le chrome.

7. Capteur (10) selon la revendication 6, dans lequel les couches d'alliage sont résistantes à l'attaque par l'acide phosphorique.

8. Capteur (10) selon la revendication 1, dans lequel les couches d'alliage sont formées par dépôt du métal liant (44) par faisceau électronique.

9. Capteur (10) selon la revendication 1, dans lequel le métal noble (46) est choisi dans le groupe constitué par le rhodium, le platine et l'or.

10. Procédé de fabrication d'un capteur d'humidité à couche mince, comprenant les étapes consistant à: déposer une couche de vernis photosensible (40) sur une surface de dioxyde de silicium (25,29); exposer des parties de la couche de vernis photosensible (40) à un rayonnement actinique; développer la couche de vernis photosensible (40) pour mettre à nu au moins une partie (42) de la surface de dioxyde de silicium (26,29); le procédé étant caractérisé en ce qu'une première couche d'un métal (44) est déposée sur une partie (42) au moins de la surface de dioxyde de silicium (26,29) mise à nu, le métal (44) étant choisi dans le groupe constitué par le titane, le nickel et le chrome; en ce qu'une seconde couche d'un métal (46) est déposée sur la première couche de métal (44), le métal (46) étant choisi dans le groupe constitué par le rhodium, l'iridium, le platine et l'or; en ce que la couche de vernis photosensible restante (40) est éliminée par un solvant; en ce qu'une solution d'eau et d'acide phosphorique est appliquée sur la surface de dioxyde de silicium (26,29); et en ce que le capteur (10) est séché, pour laisser une couche de pentoxyde phosphoreux sur une partie au moins de la surface de dioxyde de silicium (26,29) et de la couche de métal (46).

11. Procédé selon la revendication 10, comprenant l'étape consistant à former une couche de dioxyde de silicium (28) sur un substrat de silicium (27) pour constituer la surface de dioxyde de silicium (29).