Appeal Decision

Appeal No. 2016-11754

USA
Appellant 3M INNOVATIVE PROPERTIES COMPANY

Tokyo, Japan
Patent Attorney HASEGAWA, Yoshiki

Tokyo, Japan
Patent Attorney SHIMIZU, Yoshinori

Tokyo, Japan
Patent Attorney YANAGI, Yasuki

Tokyo, Japan
Patent Attorney IKEDA, Naruto

Tokyo, Japan
Patent Attorney ABE, Hiroshi

The case of appeal against an examiner's decision of refusal for Japanese Patent Application No. 2013-531611, titled "SENSOR ELEMENT, METHOD OF MAKING THE SAME, AND SENSOR DEVICE INCLUDING THE SAME" [International Publication on April 19, 2012 as WO2012/050686; National Publication on November 21, 2013 as National Publication of International Patent Application No. 2013-542422] has resulted in the following decision.

Conclusion
The appeal of the case was groundless.

Reason
No. 1 Prosecution History
The application is an application with an international filing date of September 7, 2011 (claiming priority recognized under the Paris Convention with a priority date of September 30, 2010 in the United States), for which a notice of reason for refusal was issued on May 27, 2015, and a written opinion and the written amendment were submitted on November 20, 2015, followed by issuance of an examiner's decision of refusal on March 31, 2016. In response, a notice of appeal was filed on August 4, 2016, together with a written amendment on the same date. Thereafter, the body issued a reason for refusal on June 1, 2017 (hereinafter referred to as "reason for refusal by the body"), and a written argument and a written amendment were submitted on September 5, 2017.

No. 2 The Present Invention

The inventions according to Claims 1 to 3 of the present application should be specified in the matters recited in Claims 1 to 3 of the Claims that have been amended by the written amendment on September 5, 2017. The invention according to Claim 1 (hereinafter referred to as "the present invention") is set forth as below:

Note that the present invention is segmented by the body as set forth below and the headings A) to G) are added.

"[Claim 1] A)G) A sensor element, comprising B) a first conductive electrode having a first conductive member electrically coupled, C) an absorptive dielectric layer comprising a polymer of intrinsic microporosity, D) a thermally-deposited second conductive electrode having a second conductive member electrically coupled, wherein E) said thermally-deposited second conductive electrode comprises at least one kind of noble metal, and said thermally-deposited second conductive electrode has the same width as a main surface of said absorptive dielectric layer and has a thickness of 4 to 8 nm, and has a permeability to at least one kind of organic vapor, and wherein F) said absorptive dielectric layer is at least partially disposed between said first conductive electrode and said thermally-deposited second conductive electrode."

No. 3 Cited documents, Cited inventions, etc.

1 Regarding Cited Document 1

(1) Matters described in Cited Document 1

Japanese Unexamined Patent Application Publication No. 2002-328110 (hereinafter referred to as "Cited Document 1"), which is a publication published before the priority date of the present application cited in the reasons for refusal by the body, refers to the following matters together with drawings (underlines provided by the body, the same shall apply hereinafter).

(Citation 1a) "[0002]

[Conventional Technique] Moisture detection sensors using a polymer film as a moisture-sensitive material fall roughly into two categories of measuring capacitance and electrical resistance. Among them, a type of measuring capacitance to detect moisture has good humidity sensitivity and low hysteresis loss and low dependency of moisture-sensitive properties on moisture, and has a characteristic of a broad range of measurable humidity/temperature.

[0003] This type of sensor generally has the following structure. Specifically, on one surface of a substrate laid are a thin lower side electrode, a polymer film having an electric insulating property and moisture-sensitive properties, and a thin upper side electrode with a porous structure, in this order to form a sensor main body, with a lead wire being drawn respectively from the lower side electrode and the upper side electrode. In that case, an insulation material with an electric insulating property and sufficient strength is used as a substrate to ensure the strength of the overall sensor.

[0004] Therefore, in this sensor structure, the above sensor main body formed on the substrate has a parallel plate-type capacitor structure. This sensor detects ambient moisture on the basis of the following working principle. <u>If the above sensor is placed in an environment with a certain relative humidity, an ambient steam gas (water molecule) transmits through the upper side electrode of porous structure and reaches the surface of the polymer film located beneath the electrode, and is further absorbed inside</u>

the polymer film.

...

[0006] Therefore, when each of the lead wires drawn from the upper side electrode and the lower side electrode is connected to an impedance analyzer to detect an output signal with respect to the capacitance of the sensor main body, the output signal may be converted into an absorption amount of steam gas into the polymer film; i.e., ambient relative humidity. Further, the actual moisture is detected as in the following.

...

[0008] Further, the actual moisture is detected. Specifically, this sensor is placed in a target environment for the measurement of humidity to detect an output signal at the time. Given the output signal to be Cn, the measurement device should read the relative humidity in an environment for measurement as Xn. This detection type may be applicable to polar molecules other than steam, including, for example, formaldehyde, acetone, and alcohol."

(Citation 1b) "[0012]
[Means for solving problem] The inventors have considered the cause of generating drift deterioration in a capacity-measurement type humidity detection sensor in the process of study to achieve the above goal as set forth below.
(1) In general, a polymer film is composed of a skeleton part formed in the condensation of polymer, and a free volume part that is distributed three-dimensionally in the form of micropores within said skeleton part. Further, the absorption phenomenon of steam gas into a polymer film may be construed as a phenomenon where steam gas is captured by the aforementioned free volume part."

(Citation 1c) "[0018]
[Mode for carrying out the Invention] The capacitance sensor of the present invention is illustrated hereinafter with an example of moisture detection sensor. First, the sensor A is illustrated. First, one example A1 of sensor A of the present invention is shown in Figure 1. This sensor A1 is configured to have a sensor main body 2 having a parallel-plate capacitor structure in which a lower side electrode 2A, a polymer film 2B, and an upper side electrode 2C having a porous structure or a network structure are laid in this order, so that the sensor main body may be disposed on a substrate 1 having a frame shape, at the center of which one penetration hole 1A is formed penetrating through a thickness direction, in a manner that may blocks the upper opening of the aforesaid penetration hole 1A. Further, the edge parts of the lower side electrode 2A and the upper side electrode 2C are respectively connected, for example, to lead wires 3a and 3b by use of conductive adhesives.

...

[0020] First, as shown in Figure 2, an electrode material is applied on the substrate 1 with a prescribed shape by use of, e.g., vacuum deposition and a sputtering method to form the lower side electrode 2A. The substrate 1 may be any substrate consisting of an electric insulating material, including, for example, glass; quartz; silicon; ceramics such as silicon nitride, aluminum nitride, zirconia, and sialon; and sapphire. From them, glass substrate is preferable in terms of price and workability, which will be described later, of substrate.

...

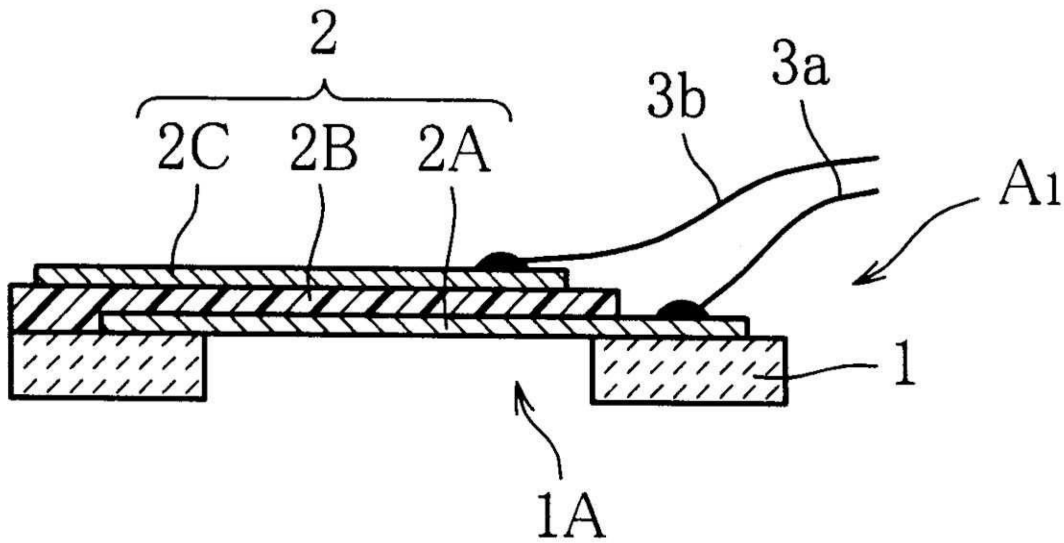
[0022] The thickness of this lower side electrode 2A is not particularly limited, but may be usually about 0.02 to 1 μm. Subsequently, as shown in Figure 3, the polymer film 2B is formed by embedding the lower side electrode 2A. The material of this polymer film 2B may be anything so long it has an electric insulating property and a moisture-sensitive properties, including, for example, an organic polymer material such as polyimide, polysulfone, polyethersulfone, polyetherimide, polyether, polyamidoimide, polyphenyleneoxide, polycarbonate, polymethyl methacrylate, polybutyleneterephthalate, polyethyleneterephthalate, polyethyletherketone, polyetherketone, cellulose butyl acetate, and cellulose acetate, and a crosslinking polymer material.

...

[0025] Subsequently, as shown in Figure 4, on a polymer film 2B there is formed an upper side electrode 2C with a porous structure or a network structure by the application of, e.g., vacuum adhesion or a sputtering method to form a sensor main body 2 with a capacitor structure. Electrode material used for the formation of upper side electrode 2C may include, for example, Cr, Au, Pt, Nb, Ru, Ti, Ta, Al, W, C, Si, Ni, Ag, Pd, and Cu. Among them, Cr is preferable due to its anticorrosive properties as well as the generation of fine cracks in the formation of electrodes, which tends to form a porous structure and thereby boosts the detection responsiveness of sensors.

[0026] Excessive thickness of this upper side electrode 2C results in a decrease of response rate to ambient humidity change, whereas insufficient thickness results in a decrease of conductivity as an electrode due to an electrode surface becoming similar to an island structure. Thus the thickness is usually set to about 10 to 300 nm."

(Citation 1d) Figure 1 is the following.



(2) Matter that could be recognized from the description of Cited Document 1

A "Vacuum adhesion" disclosed in the paragraph [0025] of (Citation 1c) is obviously a typo of "vacuum deposition" in view of paragraph [0020]. Thus it is read as "vacuum deposition".

(3) Invention described in Cited document 1

Taking into account the matters of the underlined parts of the above (Citation 1a) to (Citation 1c) together with the matter of the above item (2), in summary, Cited Document 1 discloses the following invention (hereinafter referred to as "cited invention").

Note that the corresponding paragraph numbers, etc. are added on the ground of the finding of the cited invention.

"A sensor main body 2 having a parallel plate-type capacitor structure in which a lower side electrode 2A, a polymer film 2B, and an upper side electrode 2C with a porous structure are laid in this order on a substrate ([0018]),

wherein if the above sensor is placed in an environment with a certain relative humidity, ambient steam (a water molecule) transmits through the upper side electrode of porous structure and reaches the surface of the polymer film located beneath the electrode, and is further absorbed inside the polymer film ([0004]),

wherein a polymer film is composed of a skeleton part formed in the condensation of polymer and a free volume part that is distributed three-dimensionally in the form of micropores within said skeleton part, wherein the absorption phenomenon of steam into a polymer film may be construed as a phenomenon where steam is captured by the aforementioned free volume part ([0012]),

wherein detecting an output signal with respect to the capacitance of the sensor main body, the output signal may be converted into an absorption amount of steam into the polymer film ([0006]),

wherein electrode material used for the formation of the upper side electrode 2C with porous structure may include Au, Pt, and Pd ([0025]),

wherein the upper side electrode 2C with a porous structure is formed into a film by the application of a vacuum deposition method ([0025], the above item (2)A),

wherein excessive thickness of this upper side electrode 2C results in a decrease of response rate to ambient humidity change, whereas insufficient thickness results in the decrease of conductivity as an electrode due to an electrode surface becoming similar to an island structure, and thus the thickness is usually set to about 10 to 300 nm ([0026]),

wherein this detection type may be applicable to polar molecules other than steam, including, for example, formaldehyde, acetone, and alcohol ([0008])."

2 Cited Document 2

International publication No. 2009/045733 (hereinafter, referred to as "Cited Document 2".), which was accessible to the public via a telecommunication line before the priority date of the present application and cited in the reasons for refusal by the body, describes the following matters together with drawings (Japanese translation is prepared by the body in reference to National Publication of International Patent Application No. 2010-540966, a patent family of Cited Document 2.).

(Citation 2a) "These discussions will refer to both Fig. 1, which depicts an exemplary sensing element based on the general configuration of a parallel plate capacitor, and Figs. 2, 2a, and 3, which depict exemplary sensing elements based on the general configuration of an interdigitated capacitor." (page 6, lines 15 to 18)

(Citation 2b) "In one embodiment, the analyte-responsive dielectric material is chosen from the family of materials comprising so-called 'polymers of intrinsic microporosity' (hereafter called PIMs)."
(page 7, lines 17 to 19)

(Citation 2c) "PIMs have the advantage of possessing microporosity that is not significantly dependent on the thermal history of the material. PIMs thus may offer advantages in terms of being reproducibly manufacturable in large quantities, and in terms of not exhibiting properties that change upon aging, shelf life, etc." (page 8, lines 7 to 10)

(Citation 2d) "In this context, the terms "microporous" and "microporosity" mean that the material has a significant amount of internal, interconnected pore volume, with the mean pore size (as characterized, for example, by sorption isotherm procedures) being less than about 100 nm. Such microporosity provides that molecules of organic analyte (if present) will be able to penetrate the internal pore volume of the material and take up residence in the internal pores. The presence of such analyte in the internal pores can alter the dielectric properties of the material such that a change in the dielectric constant (or any other suitable electrical property) can be observed. Without being limited by theory or mechanism, the applicant considers that the disclosed sensing element 1/101, relying on a microporous dielectric material, may have advantageous properties with regard to the sensing of an organic analyte, in that a measurable change in an electrical property of the dielectric material may be caused by the presence of the analyte molecules in the pores. Thus, it may be possible to detect the analyte without the analyte molecules being required to be solubilized in the polymeric material itself to a sufficient extent to cause a change in a property of the polymeric material such as swelling and/or expansion (although such a phenomenon may also occur and may also contribute to a measurable electrical response). Such a microporous nature of the analyte-responsive dielectric material may contribute to increased sensitivity of the dielectric material to small amounts of organic analyte." (page 8, lines 11 to 28)

(Citation 2e) "In general, the edges of the various layers can be aligned flush with each other (as depicted in the exemplary embodiment of Fig. 1)." (page 16, lines 3 to 4)

(Citation 2f) Figure 1 is in the following.

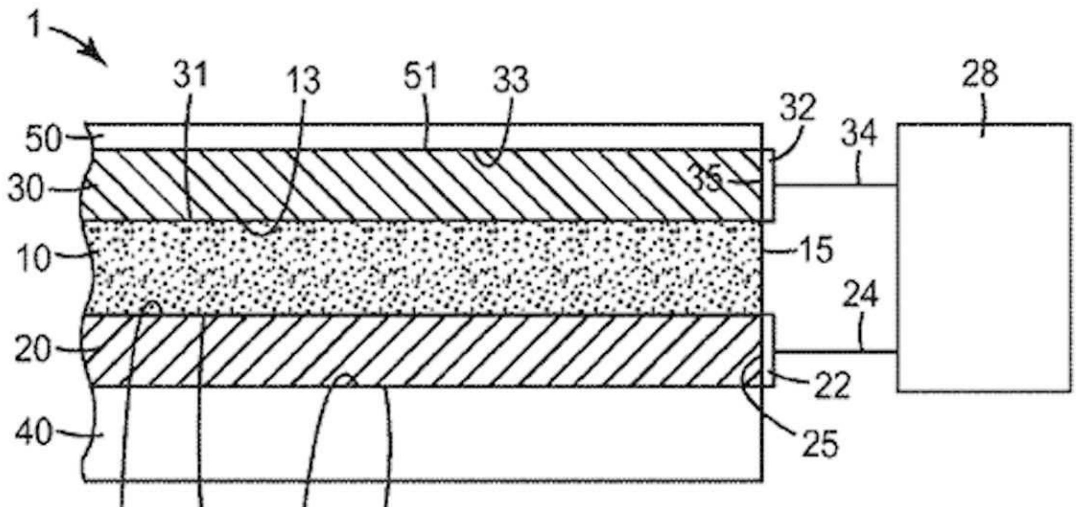


FIG. 1

No. 4 Judgment by the body
1 Comparison
(1) Regarding items A) and G)

"Sensor main body 2" of the Cited Invention corresponds to "sensor device" of the present invention.

(2) Regarding item B)

"The lower side electrode 2A" of the cited invention obviously comprises an electrically-coupled conductive member, since it is an electrode. Thus it corresponds to "a first conductive electrode having a first conductive member electrically coupled" of the present invention.

(3) Regarding item C)

The "polymer film 2B" of the cited invention functions as a dielectric layer for a parallel plate-type capacitor, and has "a free volume part that is distributed three-dimensionally in the form of micropores", and it is a layer in which an "absorption phenomenon" that "captures" "gas" in a "free volume part" takes place. Thus "polymer film 2B" of the cited invention and "an absorptive dielectric layer comprising a polymer of intrinsic microporosity" of the present invention have in common that they are both "absorptive dielectric layers comprising a polymer of porosity".

(4) Regarding item D)

"The upper side electrode 2C" "formed into a film by the application of vacuum deposition" of the cited invention obviously comprises an electrically-coupled conductive member, since it is an electrode. Further, "vacuum deposition method" is obviously a deposition method comprising the step of heating a material; i.e., a thermal deposition method. Thus it corresponds to "a thermally-deposited second conductive electrode having a second conductive member electrically coupled" of the present invention.

(5) Regarding item E)

A Regarding "said thermally-deposited second conductive electrode comprises at least one kind of noble metal"

"Electrode material used for the formation of the upper side electrode 2C formed into a film by the application of vacuum deposition method may include Au, Pt, and Pd" of the cited invention corresponds to "said thermally-deposited second conductive electrode comprises at least one kind of noble metal" of the present invention.

B Regarding "has permeability to at least one kind of organic vapor"

The "upper side electrode with a porous structure" in the "sensor main body 2 with a parallel plate-type capacitor structure" of the cited invention causes "ambient steam (water molecule)" to "penetrate". The "sensor main body 2" of the cited invention is also "applicable to" organic vapor such as "polar molecules other than steam, including, for example, formaldehyde, acetone, and alcohol". Therefore, the "upper side electrode 2C with a porous structure" in such sensor main body 2 obviously at least has permeability to organic vapor such as formaldehyde, acetone, and alcohol.

Therefore, the "upper side electrode 2C with a porous structure" in the "sensor main body 2 with a parallel plate-type capacitor structure" "applicable to polar molecules other than steam, including, for example, formaldehyde, acetone, and alcohol " of the cited invention corresponds to "the second conductive electrode" having "permeability to at least one kind of organic vapor" of the present invention.

C Regarding item E), Summary

In view of the above items A to B, the "electrode material used for the formation of the upper side electrode 2C that is formed into a film by the application of a vacuum deposition method may include Au, Pt, and Pd" and "the upper side electrode 2C" "formed into a film by the application of vacuum deposition method" is the "upper side electrode 2C with a porous structure" in the "sensor main body 2 with a parallel plate-type capacitor structure" "applicable to polar molecules other than steam, including, for example, formaldehyde, acetone, and alcohol" of the cited invention and "said thermally-deposited second conductive electrode comprises at least one kind of noble metal, and said thermally-deposited second conductive electrode has the same width as a main surface of said absorptive dielectric layer and has a thickness of 4 to 8 nm, and has permeability to at least one kind of organic vapor" of the present invention have in common that "said thermally-deposited second conductive electrode comprises at least one kind of noble metal, and said thermally-deposited second conductive electrode has permeability to at least one kind of organic vapor".

(6) Regarding item F)

"The lower side electrode 2A, the polymer film 2B, and the upper side electrode 2C with a porous structure are laid in this order" of the cited invention means that "polymer film 2B" is disposed between "the lower side electrode 2A" and "the upper side electrode 2C with porous structure". Thus it corresponds to "said absorptive dielectric layer is at least partially disposed between said first conductive electrode and said thermally-deposited second conductive electrode" of the present invention.

(7) In view of the above items (1) to (6), the present invention and the cited invention

have the following common points and the following differences:

<Common Points>
"A sensor device, comprising:

a first conductive electrode having a first conductive member electrically coupled;

an absorptive dielectric layer comprising a porous polymer; and

a thermally-deposited second conductive electrode having a second conductive member electrically coupled,

wherein said thermally-deposited second conductive electrode comprises at least one kind of noble metal, and said thermally-deposited second conductive electrode has permeability to at least one kind of organic vapor,

wherein said absorptive dielectric layer is at least partially disposed between said first conductive electrode and said thermally-deposited second conductive electrode."

<Differences>
(Difference 1) Regarding "an absorptive dielectric layer comprising a polymer of porosity", the present invention is a polymer of "intrinsic microporosity", whereas the cited invention "is composed of a skeleton part formed in the condensation of polymer and a free volume part that is distributed three-dimensionally in the form of micropores within said skeleton part".

(Difference 2) The present invention has a second conductive electrode "having the same width as a main surface of the absorptive dielectric layer", whereas the cited invention does not definitely specify the width.

(Difference 3) Regarding the thickness of the second conductive electrode when a noble metal is used, the present invention specifies "4 to 8 nanometers", whereas the cited invention specifies that "the upper side electrode 2C with a porous structure is formed into a film by application of a vacuum deposition method. Excessive thickness of this upper side electrode 2C results in a decrease of response rate to ambient humidity change, whereas insufficient thickness results in a decrease of conductivity as an electrode due to an electrode surface becoming similar to an island structure. Thus the thickness is usually set to about 10 to 300 nm".

2 Judgment
(1) Difference 1

In view of (Citation 2a) to (Citation 2d), Cited Document 2 discloses the technical matter of achieving an advantage of being reproducibly manufacturable in a large quantities, and contributing to increased sensitivity to a small amount of organic analyte without showing a property of being changed upon aging and shelf life, etc. by adopting polymers of intrinsic microporosity (PIMs) as an analyte-responsive dielectric material that changes its dielectric coefficient with an organic analyte molecule penetrating the internal pore volume of the material and taking up residence in the internal pores when it is disposed between the first electrode and the second electrode in the parallel plate capacitor-type sensor main body.

Further, the "polymer film" of the cited invention and a layer of "polymer of intrinsic microporosity" of Cited Document 2 are both dielectric layers used for a parallel plate capacitor-type organic vapor sensor main body. It is obvious that the change of dielectric coefficient due to absorption of a gas molecule into a free volume part inside the polymer film as described in paragraphs [0002] to [0008] of (Citation 1a) and paragraph [0012] of (Citation 1b) of Cited Document 1 and the change of dielectric coefficient due to its penetrating into an inner gap volume inside the polymers of intrinsic microporosity and taking up residence in an inner pore as described in (Citation 2d) of Cited Document 2 are based on similar physiochemical principles.

Therefore, there is sufficient motivation to adopt a "polymer of intrinsic microporosity" having the above advantage disclosed in Cited Document 2 in place of the "polymer film" of the cited invention. Thus a person skilled in the art could have easily conceived of adopting a "polymer of intrinsic microporosity" of Cited Document 2 in place of "polymer film" of the cited invention.

(2) Difference 2

In view of (Citation 2a), (Citation 2e), and (Citation 2f), Cited Document 2 discloses one in which the upper side electrode is formed in a manner that may have the same width as a main surface of absorptive dielectric layer in a parallel plate capacitor-type sensor main body.

In the cited invention, a person skilled in the art could have easily conceived of adopting a parallel plate capacitor-type electrode shape as disclosed in Cited Document 2 with respect to the positional relationship between the above parallel plate capacitor-type upper side electrode and an absorptive dielectric layer.

(3) Difference 3

The thickness of the "upper side electrode 2C" of the cited invention is designed by taking into account the following fact that "excessive thickness of this upper side electrode 2C results in a decrease of response rate to ambient humidity change, whereas insufficient thickness results in a decrease of conductivity as an electrode due to an electrode surface becoming similar to an island structure".

Further, it is obvious to a person skilled in the art that the specific upper limit value and the lower limit value of the film thickness of the upper side electrode when noble metal is used as its material may vary depending on various conditions such as specific material of noble metal, a material and a surface nature of a surface to be deposited, and vacuum deposition condition.

Consequently, it falls within the ordinary inventive ability of those skilled in the art to optimize through experiments as necessary in view of the above matter. As a result, a person skilled in the art would have set thickness to 4 to 8 nm.

Further, the numerical range of "the thickness is usually set to about 10 to 300 nm" of the cited invention only exemplifies the thickness of "upper side electrode" to be designed in various ways. The range does not become a disincentive to set thickness to 4 to 8 nm.

(4) Regarding the effects of the present invention

The effect of the present invention could be envisaged by a person skilled in the art from the cited invention and technical matters described in Cited Document 2, and is thus not particular.

(5) Summary

In view of the above items (1) to (4), a person skilled in the art could have easily conceived of the present invention on the basis of the inventions described in Cited Invention 1 and technical matters described in Cited Document 2.

No. 5 Conclusion

For the above reasons, the present invention is not patentable under the provision of Article 29(2) of the Patent Act, and thus the present application should be rejected without making a determination on other remaining claims.

Therefore, the appeal decision shall be made as described in the Conclusion.

October 16, 2017

Chief administrative judge: ITO, Masaya
Administrative judge: MATSUOKA, Tomoya
Administrative judge: TAKAMI, Shigeo