Appeal decision

Appeal No. 2015- 2958

Osaka, Japan
Appellant PANASONIC INTELLECTUAL PROPERTY MANAGEMENT CORPORATION

Osaka, Japan
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The case of appeal against the examiner's decision of refusal of Japanese Patent Application No. 2012-531914, entitled "Method for Producing Photovoltaic Cell and Method for Producing Photovoltaic Cell Module" (international publication on March 8, 2012, International Publication WO 2012/029847; the number of claims (5)) has resulted in the following appeal decision.

Conclusion

The examiner's decision is revoked.

The invention of the present application shall be granted a patent.

Reason

No. 1 History of the procedures

The present application was filed on August 31, 2011 as an International Patent Application (priority claim: August 31, 2010). A notice of reasons for refusal was issued on June 9, 2014, and a written opinion and a written amendment were submitted on July 29, 2014. However, an examiner's decision of refusal was issued on November 27, 2014, and in response to this decision, an appeal against the examiner's decision of refusal was made and a written amendment was submitted on February 17, 2015.

Thereafter, a notice of reasons for refusal was issued on January 19, 2016, by the body, and a written opinion and a written amendment were submitted on February 19, 2016.

No. 2 The Invention

The Invention is as follows, as specified by the matters described in Claims 1 to 5, which have been amended by the procedures of amendment as of February 19, 2016 (hereinafter, the inventions according to these Claims are referred to as "the Invention 1" and the like in correspondence with the Claim numbers).

"[Claim 1]

A method for producing a photovoltaic cell,

the photovoltaic cell comprising a rectangular photoelectric conversion part with

four planed-off corners, and an electrode positioned on one main surface of the photoelectric conversion part,

wherein the one main surface comprises an insulating layer with an opening formed on the surface of a semiconductor substrate and an electrode formed on the opening,

the method comprising a step of forming a texture structure on the surface of the semiconductor substrate,

a step of forming a resin layer using a photo- or heat-curable resin which is on the texture structure and has a predetermined viscosity,

a step of covering the opening and concave and convex portions of the texture structure with the resin layer to form the insulating layer having concave and convex portions,

and a step of forming the electrode in the opening by a plating method,

wherein the step of forming the insulating layer comprises a step of making the difference in height between the highest point of the convex portion and the lowest point of the concave portion of the insulating layer smaller than the difference in height between the highest point of the convex portion and the lowest point of the concave portion of the texture structure.

[Claim 2]

The method for producing a photovoltaic cell according to Claim 1,

wherein the step of forming the resin layer comprises coating the surface with the resin.

[Claim 3]

The method for producing a photovoltaic cell according to Claim 1 or 2,

wherein the resin is a photo-curable resin, and the step of forming an insulating layer comprises selectively irradiating light to a predetermined part of the resin layer to cure the resin.

[Claim 4]

The method for producing a photovoltaic cell according to any one of Claims 1 to 3,

wherein the step of forming an insulating layer comprises a step of partially removing the resin layer with an organic solvent.

[Claim 5]

A method for producing a photovoltaic module which comprises a step in the method for producing a photovoltaic cell according to any one of Claims 1 to 4."

No. 3 Judgment by the body for reasons for refusal stated in the examiner's decision

1. Examiner's decision

(1) Outline of reasons for refusal notified by the examiner

The outline of reasons for refusal notified by the examiner is as follows.

"The inventions according to Claims 1 to 7 of this application could have been easily invented by a person skilled in the art before the application based on the inventions described in distributed publications 1 to 7 described below or an invention available to the public through electric telecommunication lines in Japan or abroad before the application, and thus cannot be granted a patent in accordance with the provisions of Article 29(2) of the Patent Act.

Note

1. Japanese Unexamined Patent Application Publication No. S60-10790
2. Japanese Unexamined Patent Application Publication No. 2000-58885
3. Japanese Unexamined Patent Application Publication No. 2001-267597
4. Japanese Unexamined Patent Application Publication No. H07-86554
5. Japanese Unexamined Patent Application Publication No. H02-231783
6. Japanese Unexamined Patent Application Publication No. 2004-153214
7. Japanese Unexamined Patent Application Publication No. 2004-200328

[Remarks]

• Claims 1 to 4 and 7

It is the commonly used means to facilitate a step of patterning by using a photocurable resin (for example, see Cited Documents 5 to 7). It is, therefore, a matter easily conceived of by a person skilled in the art to apply such commonly used means to the method for producing a photovoltaic cell as described in Cited Documents 1 and 2.

In addition, it is also nothing but a well-known finding to use a resin as an insulating layer (for example, see Cited Documents 3 and 4).

• Claims 5 and 6

The texture structure is acknowledged to be a structure which can be constructed by a person skilled in the art as desired."

(2) Outline of the examiner's decision

"This application should be rejected based on the reasons described in the notice for reasons for rejection issued on June 9, 2014.

We examined contents of the written opinion and the written amendment, but sufficient grounds for overturning the reasons for refusal were not found.

[Remarks]

As described in the notice for reasons for rejection, the following matters are added.

• Claims 1 to 5

The configuration of "making the difference in height between the highest point of the convex portion and the lowest point of the concave portion of the resin layer smaller than the difference in height between the highest point of the convex portion and the lowest point of the concave portion of the texture structure" can be acknowledged as a naturally obtained configuration by selecting "resin" as a material for the insulating layer.

Therefore, "the step of forming the insulating layer using the resin layer" comprises "the step of making the difference in height between the highest point of the convex portion and the lowest point of the concave portion of the resin layer smaller than the difference in height between the highest point of the convex portion and the lowest point of the concave portion of the texture structure."

In the written opinion, its effect is stated, but when the Detailed Description of the Invention ([0046] to [0047]) is taken into consideration, it is reasonable to read "the

thickness" of the insulating layer in the convex portion to be more important. As well, it is also acknowledged that its effect is already obtained by the configuration of using a photosensitive resin. Moreover, the extent of such effect is neither known nor verified.

Accordingly, the assertion in the written opinion cannot be accepted.

The invention according to Claim 1 which has been amended is acknowledged to comprise a configuration in which an insulating layer having an opening is not formed on the texture structure as well, so that, in view of this, the assertion in the written opinion cannot be recognized as an assertion of the effect obtained by the invention according to Claim 1."

2. The Invention 1

(1) Cited Documents, Described matters in Cited Documents, and Cited Inventions

A. Japanese Unexamined Patent Application Publication No. S60-10790 cited in reasons for refusal stated in the examiner's decision (hereinafter, referred to as "Cited Document 1") describes the following matters (underlines added by the body).

(A) "3. The Detailed Description of the Invention

[Technical Field]

The present invention relates to a method for forming an electrode for an nPP$^+$ or nP type photovoltaic cell by electroless nickel plating.

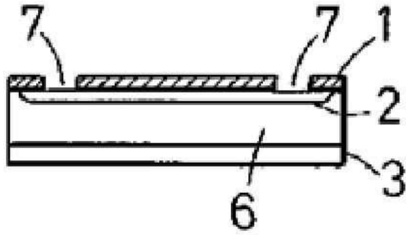
[Background Art]

In the formation of an electrode for a photovoltaic cell by electroless nickel plating, deposition amount of nickel plating is different between an n layer and a P layer (less nickel is deposited on the P layer), and it is very difficult to control the conditions of electrode formation in an npp$^+$ type photovoltaic cell. Fig. 1 to Fig. 5 show conventional methods for forming an electrode.

In the Figures, (6) represents a P type substrate, (2) represents an n$^+$ layer formed on the P type substrate (6), (3) represents a P$^+$ layer formed on the back surface of the P type substrate (6), and (1) represents an antireflection film on the n$^+$ layer (2). Reference numeral (4) represents a nickel electrode mounted on the n$^+$ layer (2) via a window (7) in the antireflection film (1). Reference numeral (8) denotes a nickel electrode mounted on the back surface of the P$^+$ layer. In addition, (4)' and (8)' are nickel electrodes formed on the nickel electrodes (4) and (8) by a second plating. Reference numeral (9) represents solder mounted on the nickel electrode (4) (note of Appeal decision: "(4)" is found to be an error of (4)'"). The thickness of the plating layer (4) formed on the n$^+$ layer (2) in the first plating of the first step significantly affects the properties; when it is too thick, disruption of the pn bonding occurs in the sintering process of the second step shown in Fig. 3, and when it is too thin, peeling of the plating layer (4) occurs in the second plating in the third step. Thus, an appropriate thickness (up to about 0.25 μm) of the plating layer is required to be formed, but the deposition amount of plating is different between the n side and the P side, so that peeling of the plating layer occurs in the P side in the third step of the second plating even if an appropriate amount of plating is deposited on the n side." (page 1, lower left column, line 10 to page 2, upper left column, line 2)

(B) Fig. 1

第 1 図



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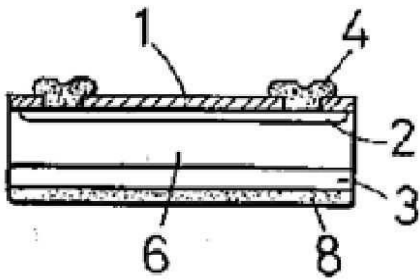
"

(C) Fig. 2

第 2 図



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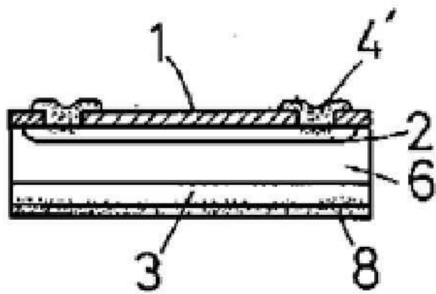
(D) Fig. 3

第 3 図



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(E) Fig. 4

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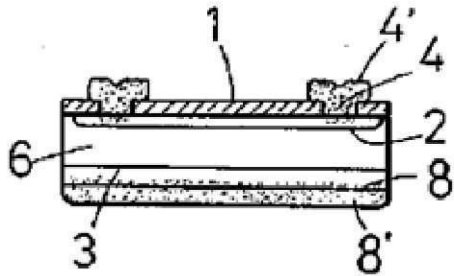

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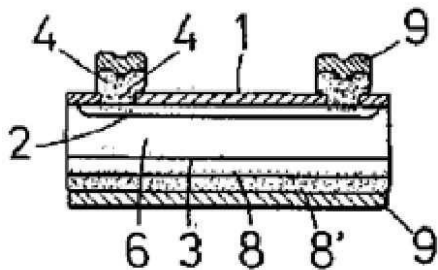
(F) Fig. 5



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From the above (A) to (F), it is acknowledged that Cited Document 1 discloses the following invention (hereinafter, referred to as "Cited Invention").

"A method for forming an electrode for a photovoltaic cell having a P type substrate (6), an n^+ layer (2) formed on the surface of the P type substrate, a P^+ layer (3) formed on the back surface of the P type substrate (6), and an antireflection film (1) on the n^+ layer (2),

wherein the method comprises a first step of forming a nickel electrode (4) mounted on the n^+ layer (2) via a window (7) in the antireflection film (1) in the first plating,

and the photovoltaic cell further comprises nickel electrodes (4)' and (8)' formed on the nickel electrodes (4) and (8) by the second plating, and solder (9) mounted on the nickel electrodes (4)' and (8)'."

The steps of performing plating by nickel plating, etc. on the n^+ layer (2) after forming an oxidized film (10), which is used as a mask, in the invention of Cited Document 1 is similar to the Background Art, and thus the Background Art is recognized as Cited Invention.

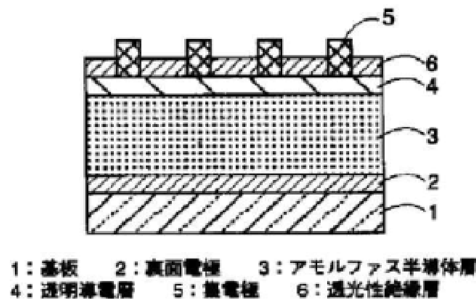
B. Japanese Unexamined Patent Application Publication No. 2000-58885 cited in reasons for refusal stated in the examiner's decision (hereinafter, referred to as "Cited Document 2") describes the following matters (underlines added by the body).

(A) "[0001]
[Technical Field of the Invention] The present invention relates to a photovoltaic cell having excellent properties and a method for producing the same, and in particular, to a technology of the structure of a surface side collector electrode and a method for producing the same."

(B) "[0028] Metal materials formed by electroless plating include Ni-B or Cu other than Ni-P described above. In view of adhesiveness and membrane stress, Ni-P is superior. In addition, by using electrolytic plating, Cu, Cr, Zn, Sb, Ag, and the like can be formed other than Ni.
(Examples)
In Examples of the present invention, the photovoltaic cell shown in Fig. 1 was produced by the below-mentioned processes.
[0029] First, on a stainless substrate 1, the surface of which was insulation coated with SiO_2, a back electrode 2 comprising about 1 μm thickness of Ag was formed using a sputtering method. With a plasma CVD method, an n type a-Si layer with about 200 Å thickness, an i type a-Si layer with about 3000 Å thickness, and a p type a-SiC layer with about 100 Å thickness were sequentially laminated on the back electrode 2 to form an amorphous semiconductor layer 3.
[0030] Then, using a sputtering method, a transparent conductive layer 4 comprising ITO with about 700 Å thickness was formed on the amorphous semiconductor layer 3. On this transparent conductive layer 4, liquid silicon oxide agent was applied by a screen printing method, and sintered for 30 to 90 minutes at a temperature of about 200°C and cured to form a translucent insulating layer 5 (note of Appeal decision: "5" is found to be an error of "6") with the state that surface parts of the transparent conductive layer 4 on which a collector electrode is to be formed are exposed.
[0031] Furthermore, the surface of the translucent insulating layer 5 (note of Appeal decision: "5" is found to be an error of "6") was degreased and cleansed, treated with ammonium citrate, immersed in a catalyst solution containing palladium chloride and stannous chloride as main components, activated using an acidic solution, and immersed in sodium hypophosphite-containing nickel sulfate at a temperature of about 40°C for 7 minutes to form a first collector electrode with about 200 nm thickness composed of Ni-P metal on the surface of the transparent conductive layer 4 exposed from the translucent insulating layer 5.
[0032] Subsequently, electrolytic plating was performed in a plating bath of a mixture solution comprising nickel sulfate, nickel chloride, and boric acid to form a second collector electrode composed of Ni with about 10 μm thickness in 15 minutes."

(C) Fig. 1
"

【図１】



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１：基板　1: Substrate
２：裏面電極　2: Back electrode
３：アモルファス半導体層　3: Amorphous semiconductor layer
４：透明導電層　4: Transparent conductive layer
５：集電極　5: Collector electrode
６：透光性絶縁層　6: Translucent insulating layer

C. Japanese Unexamined Patent Application Publication No. 2001-267597 cited in reasons for refusal stated in the examiner's decision (hereinafter, referred to as "Cited Document 3") describes the following matters (underlines added by the body).

"[0044] Example 4

As shown in Fig. 3, the resin substrate 18 was used as a sealing member for the incident side, and the transparent electrode layer 19 and the photoelectric conversion layer 20 composed of a semiconductor layer and an electrode layer were laminated on the substrate 18. Then, a photoelectric conversion element was obtained by covering the overall surface of the photoelectric conversion layer 20 with the resin layer 21 comprising polyaryl ether ketone.

[0045] Moreover, as shown in Fig. 4, overall the substrate 22 and the photoelectric conversion layer 23 was covered with the resin layer 24 comprising polyaryl ether ketone, and laminated on the second substrate 25 to produce a photoelectric conversion element. The resin layer 24 functions as an antireflection layer as well as an adhesive onto the second substrate 25. In addition, such a photoelectric conversion element can enhance the mechanical strength, and the like, as an element, by providing a metallic (e.g., zinc-applied steel plate) substrate member under the substrate 22. Furthermore, it is also possible to produce a photoelectric conversion element by laminating a second resin substrate, a light scattering layer, a photoelectric conversion layer, and an antireflection layer in this order on the first resin substrate. The application methods which can be used include extremely lower cost processes such as a dipping method and an air gun method."

D. Japanese Unexamined Patent Application Publication No. H07-86554 cited in reasons for refusal stated in the examiner's decision (hereinafter, referred to as "Cited Document 4") describes the following matters (underlines added by the body).

"Additionally, a part or the whole of the end face 16 may be covered with one or

two or more insulating films such as SiO_2 and Al_2O_3, or protection films, reflection films, and non-reflection films comprising resin, and the like. Only slight light needs to reach the light-emitting output detection part in detecting the light-emitting output. Furthermore, a part or the whole of the current constriction layer 6, the contact layer 5, and the cladding layer 4 positioned between the light-emitting part 9 and the temperature detection parts 10 and 20 may be removed for more carrying out complete electrical separation of the electrodes 11, 12, and 22."

E. Japanese Unexamined Patent Application Publication No. H02-231783 cited in reasons for refusal stated in the examiner's decision (hereinafter, referred to as "Cited Document 5") describes the following matters.

"Next, a method for producing a semiconductor laser according to this invention shown in Fig. 1 is described with reference to Figs. 2 (a) to (h).

First, to a laser chip in a state of wafer in which the isolated mesa 11 is incorporated (Fig. 2(a)), a polyimide film 12 is formed by coating, and then prebaked (Fig. 2(b)). Next, the laser chip was exposed to light and developed to expose the electrode surface, and baked at 200 to 250°C to stabilize the polyimide film 12 (Fig. 2(c)). The following steps are the same as conventional examples; a step of prebaking after coating of the resist 13 (Fig. 2(d)), a step of exposing the electrode surface by light exposure and development (Fig. 2(e)), a step of depositing overall the solder material 8 (Fig. 2 (f)), steps of removing the solder material other than on the n-side electrode 7, cleaving, coating, and chip separation (Fig. 2(g)), and a step of assembling to the heat sink 10 (Fig. 2(h)). Thereby, the semiconductor laser according to this invention can be obtained." (page 3, upper left column, line 8 to upper right column, line 2)

F. Japanese Unexamined Patent Application Publication No. 2004-153214 cited in reasons for refusal stated in the examiner's decision (hereinafter, referred to as "Cited Document 6") describes the following matters.

"[0035]

After producing a mesa portion, a polyimide solution dissolving photosensitive polyimide in an organic solvent is applied over the entire mesa portion, and the resultant structure is baked to form a photosensitive polyimide layer 19 with about 1 μm thickness. Then, the photosensitive polyimide layer 19 in the current injection region above the mesa portion is removed by a photolithography technique. A p-side electrode 20 which comprises Ti/Pt/Au and is in contact with the cap layer 18, and an n-side electrode 21 which comprises AuGe/Ni/Au and is on the back surface of the substrate 11 are formed by coating with an electrode metal by a deposition method, followed by heat treatment."

G. Japanese Unexamined Patent Application Publication No. 2004-200328 cited in reasons for refusal stated in the examiner's decision (hereinafter, referred to as "Cited Document 7") describes the following matters.

"[0029]

For processing such as patterning of a benzocyclobutene resin film 11, plasma

etching using fluorine can be adopted, which comprises using a photoresist or an insulating film such as a silicon oxide film and a silicon nitride film as a mask after curing treatment. However, in the present invention, it is more preferable to use, as a coating liquid, a photosensitive benzocyclobutene resin composition which enables patterning by exposure and development, in view of convenience of the production process and avoiding damage to the semiconductor surface caused by plasma etching.
[0030]

Next, an insulating inorganic compound film 12 is formed by a plasma CVD method or a sputtering method on the benzocyclobutene resin film 11. Then, by wet etching or dry etching using a photoresist as a mask, the insulating inorganic compound film 12 in the electrode portion is removed to form a second protection film, the insulating inorganic compound film 12."

(2) Comparison / Judgment
A. Comparison

The invention 1 and Cited Invention are compared.

(A) "The P type substrate (6)", "the window (7)", "the nickel electrode (4)", "the method for forming an electrode for a photovoltaic cell" and "the first plating" in Cited Invention correspond to "the semiconductor substrate", "the opening", "the electrode", "the method for producing a photovoltaic cell", and "the plating method" in the Invention 1, respectively.

(B) "A P type substrate (6), an n^+ layer (2) formed on the P type substrate, and a P^+ layer (3) formed on the back surface of the P type substrate (6)" in Cited Invention correspond to "the photoelectric conversion part" in the Invention 1, and "the surface " in Cited Invention corresponds to "the one main surface" in the Invention 1.

(C) Since it is obvious that "the antireflection film (1)" in Cited Invention is an insulating layer, to have "the window (7) of the antireflection film (1)" in Cited Invention corresponds to "comprise" "an insulating layer with an opening" in the Invention 1.

(D) "A method for forming an electrode for a photovoltaic cell having a P type substrate (6), an n^+ layer (2) formed on the surface of the P type substrate, a P^+ layer (3) formed on the back surface of the P type substrate (6), and an antireflection film (1) on the n^+ layer (2), wherein the method comprises a first step of forming a nickel electrode (4) mounted on the n^+ layer (2) via a window (7) in the antireflection film (1)" in Cited Invention 1 is in correspondence with "a method for producing a photovoltaic cell, wherein the one main surface comprises an insulating layer with an opening formed on the surface of a semiconductor substrate and an electrode formed on the opening," and "the method comprises a step of forming the electrode in the opening by a plating method" in the Invention 1.

From the above (A) to (D), the Invention 1 and Cited Invention are in correspondence in the following points.

"A method for producing a photovoltaic cell,

the photovoltaic cell comprising a photoelectric conversion part, and

an electrode positioned on one main surface of the photoelectric conversion part,

wherein the one main surface comprises an insulating layer with an opening formed on the surface of a semiconductor substrate and an electrode formed on the opening,

and the method comprises a step of forming the electrode in the opening by a plating method."

And the Invention 1 and Cited Invention differ in terms of the following different features 1 to 4.

<The different feature 1>

In the Invention 1, the shape of "the photoelectric conversion part" is rectangular with four planed-off corners, while in Cited Invention, the shape is not clearly defined.

<The different feature 2>

The Invention 1 comprises "a step of forming a texture structure on the surface of the semiconductor substrate, a step of forming a resin layer using a photo- or heat-curable resin which is on the texture structure and has a predetermined viscosity, and a step of covering the opening and concave and convex portions of the texture structure with the resin layer to form the insulating layer having a concave and convex portions", while Cited Invention does not comprise a step of forming a texture structure on "the P type substrate (6)".

<The different feature 3>

The Invention comprises "a step of making the difference in height between the highest point of the convex portion and the lowest point of the concave portion of the insulating layer smaller than the difference in height between the highest point of the convex portion and the lowest point of the concave portion of the texture structure", while Cited Invention does not comprise such a step.

B. Judgment

First, in view of the case, the different features 2 and 3 will be discussed.

In a method for producing a photovoltaic cell, although it is a well-known art to form a texture structure, there is no motivation for forming a texture structure on "the P type substrate (6)" and "the n^+ layer (2)" before forming "a window (7) in the antireflection film (1)" used for "forming the nickel electrode (4) in the first plating" in Cited Invention.

Suppose that a texture structure is formed on "the P type substrate (6)" and "the n^+ layer (2)" in Cited Invention, and an insulating layer is formed using a resin layer as "the antireflection film (1)" "on the n^+ layer (2)" in Cited Invention and "the difference in height between the highest point of the convex portion and the lowest point of the concave portion of the insulating layer is made smaller than the difference in height between the highest point of the convex portion and the lowest point of the concave portion of the texture structure." That is, a texture structure is adopted on "the P type substrate (6)" and "the n^+ layer (2)" in Cited Invention, and a resin layer which counteracts the texture structure is selected as "the antireflection film (1)". However, by selecting such a resin layer, the film thickness of "the antireflection film (1)" in the convex portion of the texture structure becomes smaller than the film thickness of "the

antireflection film (1)" in the concave portion of the texture structure, so that the optical path length of "the antireflection film (1)" in the convex portion of the texture structure becomes smaller than the optical path length of "the antireflection film (1)" in the concave portion of the texture structure. In that case," the antireflection film (1)" does not sufficiently work as an antireflection film.

Then, in Cited Invention, there is a disincentive in forming a texture structure on "the P type substrate (6)" and "the n^+ layer (2)", and selecting a resin layer which counteracts the texture structure as "the antireflection film (1)".

In addition, Cited Documents 2 to 7 do not describe forming of a texture structure.

Accordingly, it cannot be said that even a person skilled in the art would have easily conceived of the configuration according to the different features 2 and 3 described above from the content of disclosure in Cited Invention.

Therefore, without examining the different feature 1, it cannot be concluded that the Invention 1 would have been easily made by a person skilled in the art based on the matters described in Cited Invention and Cited Documents 2 to 7.

3. The Inventions 2 to 5

The Inventions 2 to 5 are those further limited by citing the Invention 1, and accordingly it cannot be concluded that the Inventions 2 to 5 would have been easily made by a person skilled in the art based on the matters described in Cited Invention and Cited Documents 2 to 7 as in the Invention 1.

4. Summary

As described above, it cannot be concluded that the Inventions 1 to 5 would have been easily made by a person skilled in the art based on the matters described in Cited Invention and Cited Documents 2 to 7.

No. 4 Judgment by the body as to reasons for refusal notified by the body

1. Summary of the notice for reasons for refusal by the body

"The description of the scope of claims for patent of this application does not meet the requirement stipulated in Article 36(6) (ii) of the Patent Act in the following points.

Note

(1) In Claim 1, the relationship among a plurality of ‘openings’ is obscure.
(2) In Claim 1, it is unclear what reactivity is meant by ‘reactive with light and heat’.
(3) In Claim 1, the relationship between ‘a step of forming the opening in the resin layer’ and ‘a step of covering the opening and concave and convex portions of the texture structure with the resin layer to form the insulating layer having a concave and convex portions’ is unclear.
(4) Claims which depend from Claim 1 are also the same.

Accordingly, inventions according to Claim 1 to 5 are not clear."

2. Respond by demandant to reasons for refusal notified by the body

Claims 1 and 2 were amended by the procedures of amendment dated February 19, 2016 as follows.

The description of Claim 1 was amended as follows; "an opening" is formed on "the surface of a semiconductor substrate", "a texture structure" is "on the surface of a semiconductor substrate", "a resin" is "photo- or heat-curable", and "the electrode" is formed in "the opening".

The description of Claim 2 was amended as follows; "the resin" is coated on "the surface" of "the semiconductor substrate."

3. Judgment by the body

By the above "2", the inventions according to Claims 1 to 5 became clear, and the reasons for refusal by the body were eliminated.

No. 5 Closing

As described above, the application cannot be refused by the reasons for refusal stated in the examiner's decision and the reasons for refusal by the body.

No other reasons for refusal were found.

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

April 18, 2016

Chief administrative judge: KAWABATA, Osamu
Administrative judge: IGUCHI, Naoji
Administrative judge: TSUCHIYA, Tomohisa