Appeal decision

Appeal No. 2018-8105

Tochigi, Japan
Appellant Canon Medical Systems Corporation

Patent Attorney Toranomon Intellectual Property Office

The case of appeal against the examiner's decision of refusal of Japanese Patent Application No. 2013-206569, entitled "EXTRACTION METHOD AND GAMMA-RAY DETECTOR", [the application published on April 24, 2014, Japanese Unexamined Patent Application Publication No. 2014-74715] has resulted in the following appeal decision:

Conclusion

The appeal of the case was groundless.

Reason

No. 1 History of the procedures

The present application is an application filed on October 1, 2013 (priority claim under the Paris Convention: October 2, 2012 (H24), United States), and the history of the procedures is as follows.

As of September 25, 2017 : Written notice of reasons for refusal (date of dispatch: October 3 of the same year)
December 1, 2017 : Written opinion and written amendment
As of March 8, 2018 : Decision of refusal (date of delivery: March 13 of the same year)
June 13, 2018 : Written request for appeal
As of February 26, 2019 : Written notice of reasons for refusal
(the first notice, date of dispatch on March 5 of the same year)
April 24, 2019 : Written opinion and written amendment

In addition to the above, Appellant made a response to an inquiry from the body by telephone (as of May 15, 2019) by a fax transmitted on June 7, 2019.

No. 2 Outline of the notice of reasons for refusal as of February 26, 2019

The above-mentioned reasons for refusal notified by the body roughly include the following.

The statement of the detailed description of the invention of the present application is not described clearly and sufficiently to the extent that the invention according to Claim 1 can be carried out by a person skilled in the art, and, therefore, the present application does not meet the requirement stipulated in Article 36(4)(i) of the Patent Act.

No. 3 Judgment by the body

1 Recognition of the invention

The inventions according to Claims 1-13 of the present application are as described in Claims 1-13 amended by the written amendment submitted on April 24, 2019, and the invention according to Claim 1 thereof (hereinafter, referred to as "the Invention") is as follows.

"An extraction method for extracting, in a gamma-ray detector, light from a scintillator, the method comprising

a formation step of forming a roughened layer on a light-emitting surface of the scintillator, the roughened layer having either a pillar-shaped structural body, a column-shaped structural body, a cone-shaped structural body, or a pyramid-shaped structural body, wherein

the formation step comprises:

a first step of depositing, on the light-emitting surface of the scintillator, a first thin layer having a refraction index higher than a refraction index of the scintillator, the first thin layer including a thin film or a scattering particle; and

a second step of depositing, on the first thin layer, a second thin layer having a roughened surface."

2 Violation of enablement requirement regarding the Invention

The body judges that the statement of the detailed description of the invention of the present application does not satisfy the enablement requirement regarding the Invention. The reason is as follows.

(1) The statement of the detailed description of the invention and the drawings of the present application (hereinafter, referred to as "the Specification, etc.")

The Specification, etc. describes the following matters.

A "[Technical field]",

"The embodiments of the present invention relate to an extraction method and a gamma-ray detector." ([0001])

B "[Background Art]",

"In order to increase light yield, various methods have been used for the purpose of improving the inherent performance of scintillation materials. In addition, various methods have been used also for the purpose of increasing extraction of light by modification of the light-emitting surface of a scintillator. For example, optical output from a semiconductor laser and LED has been increased by performing roughening treatment of a light-emitting surface. Conventionally, in a scintillator, more light is extracted from a scintillator using a "roughened surface" obtained by performing lapping to the scintillator surface. Furthermore, methods of lithography have been used in order to extract more light from a scintillation material by fabricating a photonic crystal structure on the surface of the scintillation material." ([0006]),

"Conventionally, in order to bond a scintillator to a photo sensor (for example, PMT and a photo-diode), an optical adhesive agent is used. However, an optical adhesive agent does not have an appropriate refraction index, and, therefore, light emitted by a scintillator is reflected in part by total reflection, and is made to return to the scintillator. Accordingly, extraction of light from a scintillator becomes inefficient, and, because of this, rising-up of a detection signal pulse slows down, resulting in degradation of timing resolution." ([0007])

C "[Problem to be solved by the invention]",

"A problem to be solved by the present invention is to provide an extraction method and a gamma-ray detector that can efficiently improve extraction of light emitted by a scintillator." ([0009])

D "[Means for solving the problem]",

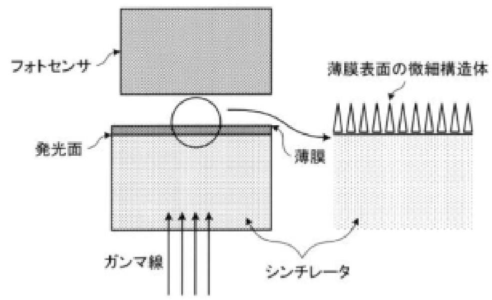
"An extraction method of an embodiment is a method for extracting, in a gamma-ray detector, light from a scintillator, and includes a formation step. In the formation step, a roughened layer having a pillar-shaped structural body, a column-shaped structural body, a cone-shaped structural body, or a pyramid-shaped structural body is formed on the light-emitting surface of a scintillator. The formation step includes a first step and a second step. In the first step, a first thin layer including a thin film or a scattering particle is deposited on the light-emitting surface of the scintillator. In the second step, on the first thin layer, a second thin layer having a roughened surface is deposited." ([0010])

E "[Brief description of drawings]",
"[FIG. 1] FIG. 1 is a diagram showing a layer that is a roughened layer fabricated on the light-emitting surface of a scintillator, which is a layer having a cone-shaped microscopic structural body in accordance with one aspect of the present embodiment.
[FIG. 2] FIG. 2 is a flow chart of a first method according to the present embodiment that is a method for improving extraction of light from a scintillator.
[FIG. 3] FIG. 3 is a flow chart of a second method according to the present embodiment that is a method for improving extraction of light from a scintillator.
[FIG. 4] FIG. 4 is a block diagram showing an example of a gamma-ray detector." ([0011])

F "[Description of Embodiments]",
"Hereinafter, referring to accompanying drawings, embodiments of an extraction method and a gamma-ray detector will be described in detail. The many embodiments described in the present specification and the advantages associated therewith can be understood deeper and can be easily grasped more perfectly by referring to the following detailed descriptions, when discussed together with the accompanying drawings." ([0012]),
"According to an embodiment, there is described a method for improving extraction of light from a scintillator in a gamma-ray detector, by forming, on the light-emitting surface of the scintillator, a roughened layer having a pillar-shaped structural body, a column-shaped structural body, a cone-shaped structural body, or a pyramid-shaped structural body." ([0013]),
"According to an embodiment, there is described a method for improving extraction of light from a scintillator in a gamma-ray detector, by depositing, on the light-emitting surface of the scintillator, a first thin layer including a thin film or a scattering particle, and depositing, on the first thin layer, a second thin layer having a roughened surface." ([0014]),
"According to an embodiment, there is described a method for improving extraction of light from a scintillator in a gamma-ray detector, by depositing, on the light-emitting surface of the scintillator, a first thin layer, and depositing, on the first thin layer, a second thin layer and applying roughening treatment to the second thin layer." ([0015]),

"According to an embodiment, a roughened layer is annexed onto a scintillator in a PET detector that is an example of the gamma-ray detector. By the above, a larger amount of light comes to be radiated from the scintillator at an early stage of radiation, and timing resolution of the detector is improved. If the timing resolution is improved in this way, the image quality of a PET image is improved, and it becomes easy to detect a small lesion, and to diagnose a patient of a large build." ([0016]),
"By the photonic crystal method, only part of a surface is roughened, and, therefore, extraction of light is not very efficient. Furthermore, since the photonic crystal method is accompanied by a lot of steps, the manufacturing cost becomes high." ([0017]),

G "According to an embodiment, a roughened layer having a microscopic structural body is formed on the light-emitting surface of a scintillator in order to extract more light from the scintillator." ([0018]),
"On the occasion of referring to drawings, similar reference numerals indicate identical or corresponding parts throughout a plurality of drawings. FIG. 1 is a diagram showing a roughened layer fabricated on the light-emitting surface of a scintillator according to an aspect of the present embodiment that is a layer having a cone-shaped microscopic structural body. In FIG. 1, an example of a roughened layer having a cone-shaped microscopic structural body fabricated on the light-emitting surface of a scintillator according to an aspect of the present embodiment is illustrated. In FIG. 1, "roughened layer" is indicated as "thin film". As shown in FIG. 1, the light-emitting surface is a surface in the opposite side of the incident surface to which gamma rays enter. As shown in FIG. 1, the light-emitting surface of a scintillator is situated in a manner facing the incident surface of a photo sensor to which light from the scintillator enters. On this light-emitting surface, a first thin film having a high refraction index and good permeability is deposited at a suitable temperature. According to an embodiment, the first thin film is, for example, fabricated from Al_2O_3, Si_xN_y, ZrO_2, TiO_2, ZnS, or ZnO, deposited at a temperature of 250-850 degrees C, has a refraction index of a range of 1.7-2.1, has optical permeability within the scintillation wavelength range of the scintillator, and has a thickness of a range of 0.3 μm to 15 μm." ([0019]),
[FIG. 1]

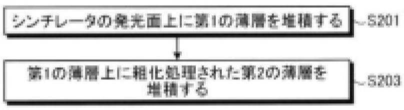


フォトセンサ	Photo sensor
発光面	Light-emitting surface
ガンマ線	Gamma ray
薄膜表面の微細構造体	Microscopic structural body of thin film surface
薄膜	Thin film
シンチレータ	Scintillator

"Next, a second thin film having a desired property is deposited. According to an embodiment, the second thin film fabricated from Al_2O_3, Si_xN_y, ZrO_2, TiO_2, ZnS, ZnO, or other suitable materials is deposited at a temperature of 250-850 degrees C, for example. According to an embodiment, the second thin film has a thickness of a range of 0.3-15 µm, is harmless, and is processed at a low temperature." ([0020]),
"According to an embodiment, the surface of a roughened layer obtained by the above processing has a pillar-shaped structural body, a column-shaped microscopic structural body, a cone-shaped microscopic structural body, or another similar microscopic structural body (for example, a pyramid-shaped microscopic structural body). In other words, in order to transmit light emitted by the scintillator from its light-emitting surface to a photo sensor efficiently, the surface of the roughened layer has an irregular shape so as to be able to avoid total reflection on the light-emitting surface. The first thin layer functions as a pedestal for roughening the second thin layer. According to an embodiment, by the function of the first thin layer, the second thin layer will grow at a different speed at a different location, and this results in the consequence that, after the growth, the second thin layer has a rough surface." ([0021])

H "Alternatively, the above microscopic structural body can be obtained afterward using a micro-fabrication method. According to an embodiment, the microscopic structural body can be obtained by applying chemical etching directly to the second thin layer. According to another embodiment, the microscopic structural body can be obtained by depositing scattering fine particles on the second thin layer so as to make it function as a mask, and, then, applying roughening treatment to the surface of the second thin layer by chemical etching and/or ion milling, or by another method that can remove an unnecessary material." ([0022])

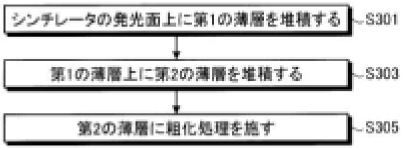
I "FIG. 2 is a flow chart of a method for improving extraction of light from a scintillator that is the first method according to the present embodiment." ([0023]),
[FIG. 2]



シンチレータの発光面上に第１の薄層を堆積する Deposit first thin layer on light-emitting surface of scintillator
第１の薄層上に粗化処理された第２の薄層を堆積する Deposit roughened second thin layer on first thin layer

"In step S201, the first thin layer is deposited on the light-emitting surface of a scintillator. The first thin layer is a layer having a high refraction index and good permeability. The first thin layer is deposited at a suitable temperature, for example, 250-850 degrees C. According to an embodiment, the first thin layer is fabricated from, for example, Al_2O_3, Si_xN_y, ZrO_2, TiO_2, ZnS, or ZnO. The first thin layer has a refraction index of a range of 1.7-2.1, has optical permeability within the scintillation wavelength range of the scintillator, and has a thickness of a range of 0.3 µm-15 µm." ([0024]),
"Alternatively, in step S201, small-sized particles may be deposited on the light-emitting surface of a scintillator. That is, in step S201, on the light-emitting surface, the first thin layer including a thin film or a scattering particle is deposited." ([0025]),
"In step S203, on the first thin layer, a roughened second thin layer having a desired property is deposited. This second thin layer is deposited at a suitable temperature of, for example, 250-850 degrees C. According to an embodiment, the second thin layer is fabricated from Al_2O_3, Si_xN_y, ZrO_2, TiO_2, ZnS, or ZnO, and is deposited at a temperature of 250-850 degrees C. The second thin layer has a thickness of a range of 0.3-15 µm, is harmless, and is processed at a low temperature." ([0026])

J "FIG. 3 is a flow chart of a method for improving extraction of light from a scintillator that is the second method according to the present embodiment." ([0027])
[FIG. 3]



シンチレータの発光面上に第１の薄層を堆積する　Deposit first thin layer on light-emitting surface of scintillator
第１の薄層上に第２の薄層を堆積する　Deposit second thin layer on first thin layer
第２の薄層に粗化処理を施す　Apply roughening processing to second thin layer

"In step S301, the first thin layer is deposited on the light-emitting surface of a scintillator." ([0028]),
"In step S303, the second thin layer is deposited on the first thin layer." ([0029]),
"In step S305, roughening treatment is applied to the second thin layer. The roughening treatment step can be conducted by a physical process, or a chemical process. The second thin layer after the roughening treatment has a pillar-shaped structural body, a column-shaped microscopic structural body, a cone-shaped microscopic structural body, or another similar microscopic structural body (for example, a pyramid-shaped microscopic structural body). This roughening treatment step can be conducted by a micro-fabrication method. According to an embodiment, this microscopic structural body can be realized by applying chemical etching directly to the second thin layer. According to another embodiment, the microscopic structural body can be realized by depositing scattering fine particles on the second thin layer so as to make them function as a mask, and, then, applying roughening treatment to the second thin layer surface by conducting at least one of chemical etching and ion milling. In the present embodiment, by forming "roughened layer" on the light-emitting surface by the first method or the second method, it is possible to prevent total reflection of light on the occasion of transmitting light from the inside of the scintillator to the photo sensor. As a result, in the present embodiment, it is possible to make light emitted by a

scintillator be incident on a photo sensor efficiently. Accordingly, in the present embodiment, extraction of light emitted by a scintillator can be improved efficiently." ([0030])

(2) Findings

It is recognized that the Invention is, as viewed from the specifying matters thereof, an invention that is described mainly in: [0018]-[0021] and FIG. 1 (the above (1)G); and [0023]-[0026] and FIG. 2 (the above (1)I) of the Specification, etc.

Then, according to each of the above descriptions, the following facts are acknowledged regarding the Invention.

A The "first thin layer" of the Invention includes "thin film" or "scattering particle". ([0025] and Claim 1)

B When "the first thin layer" of the Invention is composed of "thin film", that thin film is deposited on the light-emitting surface of a scintillator at a suitable temperature of 250-850 degrees C, for example. The thin film is fabricated from, for example, Al_2O_3, Si_xN_y, ZrO_2, TiO_2, ZnS, or ZnO. The thin film has a refraction index of a range of 1.7-2.1, has optical permeability within the scintillation wavelength range of the scintillator, and has a thickness of a range of 0.3 μm-15 μm. ([0019] and [0024])

C When the "first thin layer" of the Invention is composed of "scattering particles", small-sized particles are deposited on the light-emitting surface of a scintillator. ([0025])

D The "second thin layer" of the Invention is deposited on the first thin layer at a suitable temperature of, for example, 250-850 degrees C. The second thin layer is fabricated from Al_2O_3, Si_xN_y, ZrO_2, TiO_2, ZnS, or ZnO, and is deposited at a temperature of 250-850 degrees C, for example. The second thin layer has a thickness of a range of 0.3-15 μm, is harmless, and is processed at a low temperature. ([0020] and [0026])

E The "second thin layer" of the Invention is deposited on the first thin layer in a state that it has a desired property and has been roughened. That is, the first thin layer functions as a pedestal for roughening the second thin layer, and the second thin layer will grow at a different speed at a different location by the function of the first thin layer, resulting in the second thin layer having a rough surface after the growth. ([0021] and

[0026])

F　The surface of the roughened layer of the "second thin layer" of the Invention has a pillar-shaped structural body, a column-shaped microscopic structural body, a cone-shaped microscopic structural body, or another similar microscopic structural body (for example, a pyramid-shaped microscopic structural body).　That is, in order to transmit light emitted by a scintillator from the emitting surface to a photo sensor efficiently, the surface of the roughened layer has an irregular shape so as to be able to avoid total reflection on the light-emitting surface. ([0021])

(3) Judgment

A　As indicated in the above (2)E, the "second thin layer" of the Invention is a layer that is deposited on the first thin layer in a state of having a desired property and having been roughened.　Then, it is assumed that a mechanism to enable such deposit exists in the second thin layer growing at a different speed at a different location due to a function of the first thin layer.

B　However, in the Specification, etc., there is only an explanation that, when "the first thin layer" is composed of "thin film", a material such as Al_2O_3, Si_xN_y, ZrO_2, TiO_2, ZnS, or ZnO is deposited at a temperature of 250 degrees C to 850 degrees C and in a range of 0.3 μm-15 μm (the above (2)B).　Such thin film is positioned as a "film" in the Specification, etc., and, furthermore, it is deposited having a thickness of a range of 0.3 μm-15 μm that is a thickness sufficiently larger than a size of the order of atoms, and, therefore, it is not understood as there is non-uniformity of physical properties depending on a location.

Then, the Specification, etc. state that the "second thin layer" is a layer made by depositing a material such as Al_2O_3, Si_xN_y, ZrO_2, TiO_2, ZnS, or ZnO at a temperature of 250 degrees C-850 degrees C in a range of 0.3 μm-15 μm (the above (2)D).　Such "second thin layer" does not particularly differ from the "first thin layer" when the "first thin layer" is composed of "thin film".

In light of the above, even if the "second thin layer" is deposited on the "first thin layer", it is not understood that the second thin layer grows at a different speed at a different location.

In addition, although, in the Specification, etc., it is said that the "first thin film" may be "scattering particles" (the above (2)A and C), specific matters beyond that, such as a size, a material, a shape, and the like, are not disclosed.

Furthermore, the Specification, etc. do not disclose working examples at all.

C From the above, it can be concluded that, even by a person skilled in the art, it cannot be understood how to carry out the Invention.

D In contrast, Appellant alleges in the written opinion submitted on April 24, 2019 that, as viewed from [0030] of the Specification, etc., a subject that performs roughening treatment is a physical process or a chemical process.

However, the relevant description of [0030] is a description concerning "second method" ([0027]), and, hence, it is not recognized as being a description corresponding to the Invention.

The Appellant's allegation is not reasonable.

E Furthermore, Appellant alleges, in a FAX transmitted on June 7, 2019, in outline that

(i) the first thin layer is a layer that has proceeded up to the stage of "Island Formation" from "Nucleation" among general deposition processes to deposit a thin layer on a substrate, but has not proceeded to "Island Coalescence", and

(ii) the second thin layer is deposited under conditions different from the conditions on the occasion of depositing the first thin layer on a scintillator (for example, a temperature), and the former conditions are conditions for making each island of the second thin layer grow into a shape extending to the vertical direction, or into a conical shape.

(A) However, regarding (i), it is recognized that the Specification, etc. do not have such description. Rather, [0019] and [0024] of the Specification, etc. describe that the thickness of the "first thin layer" is of "a range of 0.3 μm-15 μm" that is a thickness sufficiently larger than a size of the order of atoms, and, therefore, it is difficult to think that, in such thickness, the "first thin layer" has not proceeded to "Island Coalescence". In addition, the Specification, etc. do not show a proof by a working example.

The Appellant's allegation is an allegation that does not have grounds in the descriptions of the Specification, etc.

(B) Regarding (ii), although the Specification, etc. describe material, a depositing temperature, and a thickness ([0020] and [0026]) as conditions for depositing the second thin layer, the Specification, etc. do not describe that these conditions are conditions for growing each island of the second thin layer into a shape extending to a vertical direction, or into a conical shape. In addition, from the descriptions of the Specification, etc., it is not clear whether the conditions for depositing the second thin layer are different from the conditions for depositing the first thin layer, either.

Rather, as mentioned in the above B, the "second thin layer" does not differ from the "first thin layer" in particular, and, furthermore, the thickness of the "second thin layer" is of a range of "0.3 μm-15 μm" that is a thickness sufficiently larger than a size of the order of atoms, and, hence, it is difficult to think that the second thin layer grows in a form of individual islands into a shape extending to the vertical direction, or into a conical shape. In addition, the Specification, etc. do not show proof by working examples.

The Appellant's allegation is an allegation that does not have grounds in the descriptions of the Specification, etc.

F Accordingly, the statements of the detailed description of the invention of the present application are not ones that have been described clearly and sufficiently to the extent that a person skilled in the art can carry out the Invention.

No. 4 Closing

As described above, the present application does not meet the requirement stipulated in Article 36(4)(i) of the Patent Act.

Accordingly, the present application should be rejected.

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

July 4, 2019

Chief administrative judge: MORI, Ryosuke
Administrative judge: YAMAMURA, Hiroshi
Administrative judge: SEGAWA, Katsuhisa