

12

EUROPEAN PATENT APPLICATION

21 Application number: **89306261.2**

51 Int. Cl.4: **G 21 K 4/00**

22 Date of filing: **21.06.89**

30 Priority: **21.06.88 JP 151123/88**

43 Date of publication of application:
27.12.89 Bulletin 89/52

84 Designated Contracting States: **DE GB NL**

71 Applicant: **KONICA CORPORATION**
No. 26-2, Nishishinjuku 1-chome Shinjuku-ku
Tokyo (JP)

72 Inventor: **Kano, Akiko**
c/o Konica Corporation 1, Sakuramachi
Hino-shi Tokyo (JP)

Nitta, Masaaki
c/o Konica Corporation 1, Sakuramachi
Hino-shi Tokyo (JP)

74 Representative: **Ellis-Jones, Patrick George Armine et al**
J.A. KEMP & CO. 14 South Square Gray's inn
London WC1R 5EU (GB)

54 **Radiation image storage panel.**

57 There is disclosed a radiation image storage panel which comprises a stimuable phosphor layer, a layer having a lower refractive index than a protective layer and the protective layer in this order on a support, characterized in that the above protective layer has a haze ratio of 3 % or less as defined according to JIS K6714.

Description

Radiation image storage panel

This invention relates to a radiation image storage panel having a stimuable phosphor layer, more particularly to a radiation image storage panel having excellent sharpness of image due to small spreading of stimulation excitation light by scattering of light within the protective layer.

A radiation image such as X-ray image has been frequently used for diagnosis of disease, etc.

For obtaining such X-ray image, it has been contrived to have an X-ray image storage method which takes out directly an image from the phosphor layer in place of a silver halide photosensitive material.

This method is a method in which radiation (generally X-ray) transmitted through an object to be photographed is absorbed onto a phosphor, and then the phosphor is excited by, for example, light or heat energy, thereby radiating the radiation energy accumulated in the phosphor by the above radiation absorption as the fluorescent light, and the fluorescent light is detected to form an image.

Specifically, for example, U.S. Patent No. 3,859,527 and Japanese Provisional Patent Publication No. 12144/1980 disclose radiation image storage methods with visible light rays or IR-rays as the stimulation excitation light by use of a stimuable phosphor.

This method comprises using a radiation image storage panel (hereinafter abbreviated as "storage panel") having a stimuable phosphor layer (hereinafter abbreviated as "stimuable layer") formed on a support, and radiation having transmitted through an object to be photographed is irradiated on the stimuable layer of the storage panel to form a latent image through accumulation of the radiation energy corresponding to the radiation transmittance at the respective portions of the object to be photographed, and thereafter the stimuable layer is scanned with a stimulation excitation light, thereby irradiate the radiation energy accumulated in the respective portions to convert it to light and obtain an image according to the optical signals depending on the intensity of the light.

The final image may be reproduced as a hard copy or reproduced on CRT.

The storage panel used in the radiation image storage panel releases the accumulated energy by scanning of the stimulation excitation light after accumulation of the radiation image information, and therefore accumulation of radiation image can be effected again after scanning, whereby repeated use is possible.

Accordingly, the above storage panel should desirably have the performance which can stand a large number of repeated uses for a long term without deterioration of the radiation image obtained. For that purpose, the stimuable layer of the above storage panel is required to be protected sufficiently from external physical or chemical stimulations.

In the storage panel of the prior art, there has

been employed the method of providing a protective layer for covering the stimuable layer surface on the support of the storage panel in order to solve the above problem. Such protective layer may be formed by coating directly a coating solution for protective layer on a stimuable layer or by adhering a protective layer previously formed separately on a stimuable layer, as disclosed in Japanese Provisional Patent Publication No. 42500/1984.

As the protective layer, a thin protective layer comprising an organic polymer is generally used. Such thin protective layer is used because lowering in sharpness of the storage panel should be prevented.

The relationship between sharpness and protective layer thickness of a storage panel having a stimuable layer is shown in Table 1 by use of MTF (modulation transfer function) at spatial frequency of 1 lp/mm and 2 lp/mm. In Table 1, PET is a polyethylene terephthalate film.

Table 1

Protective layer	Thickness (μm)	1 lp/mm (%)	2 lp/mm (%)
None	-	78	41
PET	8.5	74	39
PET	11	64	35
PET	25	59	29
PET	70	54	26
PET	175	48	24
Glass	550	43	20

As shown in Table 1, sharpness is lowered as the protective layer is thicker. As a cause for such tendency, it may be considered that the reflected scattered light of the incident stimulation excitation light against the stimuable layer surface is reflected against the protective layer-air interface to be reincident on the stimuable layer. The reflected scattered light will reach farther as the protective layer is thicker to entrain the information of the pixel other than the target pixel, whereby sharpness is lowered.

In the general type screen-film system to be used in X-ray photographing, MTF exhibits about 65 % in the case of 1 lp/mm and about 35 % in the case of 2 lp/mm, and therefore it is not preferred even in the storage panel that the MTF is inferior than the numerical value of the above screen-film system, and the thickness of the protective layer is desirably 10 μm or less if only.

However, the thin protective layer comprising an organic polymer conventionally used is permeable to some extent to water and/or humidity, and therefore the stimuable layer absorbs water to result in great lowering in radiation sensitivity of the storage panel or attenuation of the accumulated energy until receiving stimulation excitation light irradiation,

whereby variance and/or deterioration in image quality of the radiation image obtained is brought about.

For example, moisture permeability of PET with a thickness of 10 μm is about 60 ($\text{g}/\text{m}^2 \cdot 24 \text{ hr}$), and as much as 60 g of water permeates per unit area per day. In an oriented polypropylene (hereinafter abbreviated as "OPP") with a film thickness of 10 μm , it is about 15 ($\text{g}/\text{m}^2 \cdot 24 \text{ hr}$).

Thus, although the defect on account of thin thickness can be cancelled by making the protective layer thicker, sharpness will be lowered as described above. It has been desired to have improvements in aspects of humidity resistance, strength, impact resistance without impairing sharpness beyond such antagonistic phenomena.

As described above, in the storage panel by use of the stimuable phosphor of the prior art, when a thin protective layer is used in order to improve sharpness of the image, variance, deterioration, etc. of the radiation image obtained will be generated particularly by penetration of water or humidity from outside, and also there is involved the problem that breaking of stimuable layer, etc. may be caused by physical stimulation from outside. On the other hand, when a thick protective layer is used for the purpose of protection from such chemical and physical stimulations, there may sometimes occur lowering in image quality depending on the optical properties of the protective layer. More specifically, there is the problem that sharpness of the image is lowered, because the degree of expansion due to scattering of the excited light internally of the protective layer amplified is greater as the protective layer is thicker.

Accordingly, an object of the present invention is to provide a durable and use-resistant storage panel which can protect sufficiently the stimuable layer against physical stimulation and chemical stimulation, particularly water without impairing sharpness of the image at all, and can be used under good conditions while maintaining high sensitivity, high sharpness and high graininess of the stimuable layer for a long term.

The storage panel of the present invention has a stimuable phosphor layer, a low refractive index layer and a protective layer in this order on a support, characterized in that the above protective layer has a haze ratio of 3% or less as defined according to JIS K6714 (Japanese Industrial Standard, Methacryl resin plates for air plane, JIS K6714:1977, pp. 13 to 14).

Fig. 1 and Fig. 2 are schematic sectional views of the radiation image storage panels of the present invention and

Fig. 3 is an explanatory view of the radiation image storage method using the storage panel of the present invention.

The constructions of the storage panels A and B are to be described by referring to the accompanying drawings. Fig. 1 and Fig. 2 are schematic sectional views each showing an example of the storage panel of the present invention. The numerals in the drawings respectively show the following, namely 1 is a protective layer, 2 is a low refractive

index layer, 3 is a stimuable layer, 4 is a support and 5 is a protective layer supporting member.

The storage panel of the present invention, as shown in Fig. 1, has a stimuable layer 3, a low refractive index layer 2 and a protective layer 1 in this order on a support 4. Also, in the storage panel of the present invention, as shown in Fig. 2, it may also have its protective layer supporting member 5. One end of the protective layer supporting member 5 is adhered to the support 4, and the other end is adhered to the protective layer 1. The peripheral portion of the stimuable layer 3 and the protective layer supporting member 5 may be contacted with or apart from each other. Accordingly, in the case of a storage panel having the protective layer supporting member 5 as the constituent element, the low refractive index layer 2 is constructed under the state shielded from the outer atmosphere with the protective layer 1, the stimuable layer 3 (or stimuable layer 3 and support 4) and the protective layer supporting member 5.

The protective layer in the storage panel of the present invention has a haze ratio (haze value) as defined according to JIS K6714 of 3% or less, preferably 1% or less. When the haze ratio exceeds 3%, expansion of the stimulation excitation light becomes greater due to expansion of scattering of light internally of the protective layer, whereby sharpness of the image is lowered.

As the protective layer, it should otherwise have good light transmitting characteristic and also be moldable into a sheet. Further, the protective layer, for permitting transmission of stimulation excitation light and stimulation emission with good efficiency, preferably exhibits high transmittance over wide wavelength range, further preferably a transmittance of 80% or higher.

The thickness of the protective layer is determined as related to the haze ratio and the humidity preventive characteristic of the constituent material, but it is practically 10 μm to 4 mm, and preferably 100 μm or more for having a certain haze ratio and obtaining good humidity preventive characteristic. When the protective layer has a thickness of 500 μm or more, a storage panel with excellent durability and use resistance can be preferably obtained.

As the material for forming such protective layer, for example, plate glasses such as of quartz, borosilicate glass, chemically reinforced glass, etc., organic polymeric compounds such as PET, OPP, polyvinyl chloride, etc. may be included. Here, for example, an example of a borosilicate glass with a thickness of 500 μm has a haze ratio of 0.6% and exhibits a transmittance of 80% or higher within the wavelength range of 330 nm to 2.6 μm . An example of a quartz glass with a thickness of 500 μm has a haze ratio of 0.0% and exhibits higher transmittance even at shorter wavelength than in the case of the borosilicate glass.

The haze ratio will vary depending on the thickness of the protective layer and the surface treatment. If the protective layer is a plate glass, one having higher polishing grade has generally lower haze ratio. On the other hand, if it is a plastic film, one applied with lamination or one with the surface

subjected to matting working, embossing working has generally higher haze ratio.

As the material for forming the protective layer, the above-mentioned plate glass is preferred for excellent transmittance and humidity preventive characteristic along with haze ratio.

Also, provision of a reflection preventive layer such as MgF_2 , etc. is preferred for permitting transmission of stimulation excitation light and stimulation emission as well as for the effect of making lowering in sharpness smaller.

The refractive index of the protective layer is not particularly limited, but it is generally within the range of 1.4 to 2.0 in practical application.

The protective layer can be provided in two or more layers, if desired.

The low refractive index layer of the storage panel of the present invention is a layer comprising a material having lower refractive index than the protective layer. The material for constituting the low refractive index layer is not limited, provided that it has lower refractive index than the protective layer, but it is necessary to select suitably one more preferable for construction of the storage panel.

In a storage panel containing no protective layer supporting member, a low refractive index layer is possessed under the state shown in Fig. 1 between the protective layer and the stimuable layer.

The low refractive index layer can be made a layer comprising, for example, CaF_2 (refractive index: 1.23 - 1.26), Na_3AlF_6 (refractive index: 1.35), MgF_2 (refractive index: 1.38), SiO_2 (refractive index: 1.46), etc. As the method for forming the low refractive index layer, it is possible to apply the method in which it is formed according to the physical vapor deposition method such as vacuum deposition on the surface of the stimuable layer and the protective layer or the method in which a thin film formed previously according to similar method is laminated on the surface of the stimuable layer or the protective layer.

In the storage panel comprising the protective layer supporting member, the low refractive index layer exists under the state shielded with the protective layer supporting member from the external atmosphere. Thus, by use of a protective layer supporting member, the thickness of the protective layer can be made substantially thicker, whereby humidity preventive characteristic and durability of the storage panel can be further improved.

As the low refractive index layer, the same material as described above can be used, but when a protective layer supporting member is included, for example, it is preferably made in its constitution a layer comprising a liquid such as ethanol (refractive index: 1.36), methanol (refractive index: 1.33) and diethyl ether (refractive index: 1.35); or a layer comprising a gas and having a refractive index of substantially 1, such as air, nitrogen, argon, vacuum layer, etc.

The low refractive index layer of the storage panel including a protective layer supporting member is preferably a gas layer or vacuum layer for high effect of preventing lowering in sharpness.

The thickness of the low refractive index layer may

be practically from 0.05 μm to 3 mm.

In order to impart sufficiently the effect of making lowering in sharpness smaller to the low refractive index layer of the present invention, the low refractive index layer and the stimuable layer should be under the adhered state. Accordingly, when the low refractive index layer is a liquid layer, a gas layer and a vacuum layer, it may be as such, but when the low refractive index layer is formed on the surface of the protective layer with the above-mentioned CaF_2 , Na_3AlF_6 , MgF_2 , SiO_2 , etc., the stimuable layer and the low refractive index layer are adhered with the use of an adhesive, etc. In this case, the refractive index of the adhesive should be preferably approximate to that of the stimuable layer.

As the protective layer supporting member to be used in the storage panel of the present invention, any material capable of forming the low refractive index layer under the state shielded from the external atmosphere can be used without particular limitation, including glasses, ceramics, metals, plastics, etc.

The protective layer supporting member preferably has a moisture permeability of 10 ($\text{g}/\text{m}^2 \cdot 24 \text{ hr}$) or less. If the moisture permeability is too great, the stimuable phosphor will be undesirably deteriorated with the water penetrated from outside.

The thickness of the protective layer supporting member (a in Fig. 2) may be the thickness of the stimuable layer or thicker. That is, the thickness of the protective layer supporting member may be equal to or over the thickness of the stimuable layer.

The case where the protective layer and the stimuable layer have the same thickness is, for example, the case where the low refractive index layer is a vacuum layer. In this case, the low refractive index layer is sufficient if there exists a vacuum layer so as to be optically incontinuous between the stimuable layer and the protective layer, and therefore the two layers may be under the state contacted with each other.

When the thickness of the protective layer supporting member exceeds the thickness of the stimuable layer, the thickness of the low refractive index layer can be determined as related to the thickness of the low refractive index layer to be formed.

The width of the protective layer supporting member (b in Fig. 2) is determined as related to the humidity preventive characteristic (above-mentioned moisture permeability) of the adhered portions between the protective layer supporting member and the support and the protective layer, and may be preferably 1 to 30 mm. When the width of the protective layer supporting member is too small, it is not preferred for stability, strength and humidity preventive characteristic of the protective layer supporting member. On the other hand, if it is too large, the storage panel will be enlarged than is necessary so that it is not preferred. It is preferred that the moisture permeability of the portion between the protective layer supporting member and the support and the protective layer should be 10 ($\text{g}/\text{m}^2 \cdot 24 \text{ hr}$) or less.

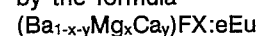
It is required that the protective layer supporting

member should be adhered to the support and the protective layer for imparting humidity preventive characteristic and for maintaining the layer thickness of the low refractive index layer constant. Here, for making the protective layer supporting member adhered to the support and the protective layer, for example, an adhesive, etc. may be employed and one having humidity preventive characteristic is preferred. Specifically, there can be employed organic polymeric adhesives such as epoxy resins, phenol type resins, cyanoacrylate resins, vinyl acetate resins, vinyl chloride resins, polyurethane resins, acrylic resins, ethylene-vinyl acetate resins, polyolefinic resins, chloroprene rubbers, nitrile rubbers, etc., or silicone adhesives. Among them, epoxy resins or silicone resins used for encapsulation of semiconductors or electronic parts may be preferred for excellent humidity resistance, particularly preferably epoxy resins for low moisture permeability.

Also, for the purpose of enhancing adhesion at the adhered portion between the protective layer supporting member and the support or between the protective layer supporting member and the protective layer, it is possible to provide a subbing layer or apply roughening treatment at the contact surface of the protective layer supporting member, the support and the protective layer with other layer.

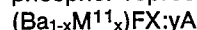
The stimutable phosphor constituting the stimutable layer in the storage panel of the present invention is a phosphor exhibiting stimulation emission corresponding to the irradiation dosage of the initial light or high energy radiation by optical, thermal, mechanical, chemical or electrical stimulation (stimulation excitation) after irradiation of the initial light or high energy radiation, and may be preferably a phosphor which exhibits stimulation emission by an excitation light of 500 nm or higher from practical aspect. Examples of such stimutable phosphors may include the phosphors as represented by $\text{BaSO}_4:\text{Ax}$ as disclosed in Japanese Provisional Patent Publication No. 80487/1973, $\text{SrSO}_4:\text{Ax}$ as disclosed in Japanese Provisional Patent Publication No. 80489/1973, $\text{Li}_2\text{B}_4\text{O}_7:\text{Cu,Ag}$, etc. as disclosed in Japanese Provisional Patent Publication No. 39277/1978, $\text{Li}_2\text{O} \cdot (\text{B}_2\text{O}_3)_x:\text{Cu}$ and $\text{Li}_2\text{O} \cdot (\text{B}_2\text{O}_3)_x:\text{Cu,Ag}$, etc. as disclosed in Japanese Provisional Patent Publication No. 47883/1979, $\text{SrS}:\text{Ce,Sm}$, $\text{SrS}:\text{Eu,Sm}$, $\text{La}_2\text{O}_3\text{S}:\text{Eu,Sm}$ and $(\text{Zn,Cd})\text{S}:\text{Mn,X}$ as disclosed in U.S. Patent No. 3,859,527.

Also, there may be included the $\text{ZnS}:\text{Cu,Pb}$ phosphor, the barium aluminate phosphor represented by the formula $\text{BaO} \cdot x\text{Al}_2\text{O}_3:\text{Eu}$, and the alkaline earth metal silicate type phosphor represented by the formula $\text{M}^{11}\text{O} \cdot x\text{SiO}_2:\text{A}$ as disclosed in Japanese Provisional Patent Publication No. 12142/1980. Further, there may be included the alkaline earth fluoride halide phosphor represented by the formula

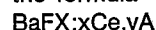


as disclosed in Japanese Provisional Patent Publication No. 12143/1980, the phosphor represented by the formula $\text{LnOX}:\text{xA}$ as disclosed in Japanese Provisional Patent Publication No. 12144/1980, the

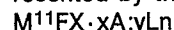
phosphor represented by the formula



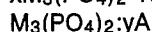
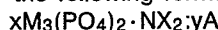
as disclosed in Japanese Provisional Patent Publication No. 12145/1980, the phosphor represented by the formula



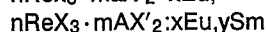
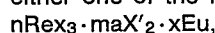
as disclosed in Japanese Provisional Patent Publication No. 84389/1980, the rare earth element activated divalent metal fluorohalide phosphor represented by the formula



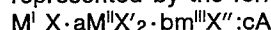
as disclosed in Japanese Provisional Patent Publication No. 160078/1980, the phosphors represented by the formulae $\text{ZnS}:\text{A}$, $(\text{Zn,Cd})\text{S}:\text{A}$, $\text{ZnS}:\text{A,X}$ and $\text{CdS}:\text{A,X}$, the phosphor represented by either one of the following formulae



as disclosed in Japanese Provisional Patent Publication No. 8278/1984, the phosphor represented by either one of the following formulae



as disclosed in Japanese Provisional Patent Publication No. 155487/1984 and the alkali halide phosphor represented by the formula



as disclosed in Japanese Provisional Patent Publication No. 72087/1986. Particularly, an alkali halide phosphor is preferred because a stimutable layer can be readily formed according to such method as vapor deposition, sputtering, etc.

However, the stimutable phosphor to be used in the storage panel of the present invention is not limited to the phosphors as described above, but any phosphor may be employed which can exhibit stimulation emission when stimulation excitation light is irradiated after irradiation of radiation.

The stimutable layer in the storage panel of the present invention may be one containing at least one kind of the stimutable phosphors as described above or a group of stimutable layers comprising two or more stimutable layers. Also, the stimutable phosphors contained in the respective layers may be the same or different.

The layer thickness of the stimutable layer of the storage panel may depend on the sensitivity of the desired storage panel to radiation, the kind of the stimutable phosphor, etc., but when no binder is contained, may be preferably selected from the range of 10 to 1000 μm , more preferably 20 to 800 μm , and when binder is contained, it may preferably selected from the range of 20 to 1000 μm , more preferably 50 to 500 μm .

The support to be used in the present invention may include various polymeric materials, glasses, ceramics, metals, etc.

Examples of polymeric materials may include films of cellulose acetate, polyester, polyethylene terephthalate, polyamide, polyimide, triacetate, polycarbonate, etc. As the metal, metal sheets or plates of aluminum, iron, copper, chromium, etc. or metal sheets or plates having coated layers of said metal oxides may be included. As the glass, chemically reinforced glasses and crystallized glasses may be

included. As the ceramics, sintered plates of alumina or zirconia may be included.

The layer thickness of these supports may differ depending on the material of the support used, but may be generally 80 μm to 5 mm, and preferably 200 μm to 3 mm for easiness in handling.

The surface of these supports may be smooth, or alternatively made matte for the purpose of improvement of adhesiveness with the stimuable layer. The surface of the support can be also made an uneven surface, or made to have a surface structure in which fine plates shaped in tile individually independent are densely arranged.

Further, on these supports, a subbing layer may be also provided on the surface of the support where the stimuable layer is provided for the purpose of improving adhesiveness with the stimuable layer.

For imparting further humidity preventive characteristic to the storage panel of the present invention, it is preferred to seal the side edge portion of the protective layer and the support or the peripheral portion of the protective layer supporting member. As the method for such sealing, the sealing method with glass fusion or the sealing method with an adhesive such as epoxy resin system may be applicable.

In the storage panel of the present invention, the protective layer can also function as the support. In that case, the support as mentioned in the present invention need not exhibit the function to support substantially the stimuable layer.

The storage panel of the present invention may be used in the radiation image storage method as shown schematically in Fig. 3.

More specifically, the radiation from the radiation generating device 41 is incident on the storage panel 43 through an object 42 to be photographed.

The incident radiation is absorbed by the stimuable layer of the panel 43, and its energy is accumulated to form the accumulated image of the radiation transmitted image.

Next, the accumulated image is excited with the stimulation excitation light from the stimulation excitation light source 44, and since the strength of the stimulation emission is proportional to the radiation energy quantity, the optical signal is converted photoelectrically by a photoelectric converting device 45 such as photomultiplier, etc. to reproduce it as an image by the image reproducing device 46 and display it by an image displaying device 47, whereby the radiation transmitted image of the object to be photographed can be observed.

The present invention is described by referring to the following examples.

Examples 1 to 4 and Comparative examples 1 and 2

On a crystallized glass support with a thickness of 1 mm, an alkali halide phosphor (RbBr: 0.0006Ti) was vapor deposited by a vacuum deposition device to a thickness of 300 μm to form a stimuable layer. Next, on the surface of each protective layer with the thickness and the haze ratio as shown in Table 2, CaF_2 (refractive index: 1.25) was vapor deposited to a thickness of 0.1 μm to provide a low refractive

index layer. Then, the above support and protective layer were adhered so that each stimuable layer was registered with the low refractive index layer with an epoxy resin type adhesive to obtain a storage panel.

Also, storage panels of Comparative examples were obtained in the same manner as in Examples.

Soda glasses (A) and (B) have the same composition, but are different in the extent of polishing. PET (a) is the transparent type, (b) is the commercially available standard type and (c) is the hazy type.

Table 2

	Protective layer	Haze ratio (%)
Example 1	Soda glass (A) 1.1 mm	0.1
Example 2	Borosilicate glass 500 μm	0.6
Example 3	PET (a) 550 μm	0.4
Example 4	PET (b) 550 μm	2.4
Comparative example 1	Soda glass (B) 1.1 mm	5.2
Comparative example 2	PET (c) 550 μm	17.5

The image storage panels obtained in these Examples and Comparative examples were vacuum dried under the conditions of 80 °C and 10^{-3} torr for one hour, and then the support and the side edge portion of the glass protective layer and the peripheral portion of the protective layer supporting member were sealed with an epoxy type adhesive to provide samples. For these samples, sharpness according to MTF was evaluated. Table 4 shows MTF at spatial frequencies of 1 lp/mm and 2 lp/mm.

Table 3

	MTF (%)	
	1 lp/mm	2 lp/mm
Example 1	60	28
Example 2	57	28
Example 3	59	29
Example 4	52	25
Comparative example 1	43	20
Comparative example 2	35	14

As is apparent from the Table, the storage panels of the present invention have excellent sharpness, but the storage panels of Comparative examples with great haze ratios of the protective layers have lower sharpness.

Examples 5 to 8 and Comparative examples 3 and 4

On a crystallized glass support with a thickness of 1 mm, an alkali halide phosphor (RbBr: 0.0006Ti)

was vapor deposited by a vapor deposition device to a thickness of 300 μm to form a stimuable layer. Next, on the support, a glass sheet with a width of 5 mm and a thickness of 1 mm was adhered with an epoxy resin type adhesive so as to surround the above stimuable layer. Then, vacuum drying was effected under the conditions of 80 °C and 10^{-3} Torr for one hour. Next, the other surface of the above glass sheet was adhered to each protective layer having a haze ratio as shown in Table 4 in the same manner as described above. By performing a series of the steps in conventional atmosphere, storage panels of the present invention were obtained with the low refractive index layer as the air layer.

Also, except for having different protective layers, storage panels of Comparative examples were obtained in the same manner as in Examples.

Table 4

	Protective layer	Haze ratio (%)
Example 5	Soda glass (A) 1.1 mm	0.1
Example 6	Borosilicate glass 500 μm	0.6
Example 7	PET (b) 1.5 mm	2.6
Example 8	OPP 1.5 mm	0.9
Comparative example 3	Soda glass (B) 1.1 mm	5.2
Comparative example 4	PET (c) 1.5 mm	18.0

By use of the image storage panels obtained in these Examples and Comparative examples, MTF at the spatial frequencies of 1 lp/mm and 2 lp/mm was measured as in Example 1. The results are shown in Table 5.

Table 5

	MTF (%)	
	1 lp/mm	2 lp/mm
Example 5	66	36
Example 6	65	34
Example 7	59	30
Example 8	65	33
Comparative example 3	50	25
Comparative example 4	38	17

As is apparent from Table 5, the storage panels of the present invention have excellent sharpness, but the panels of Comparative examples with great haze ratios of the protective layers have low sharpness.

The image storage panel of the present invention has excellent sharpness due to small expansion of stimulation excitation light by scanning of the light

within the protective layer.

Claims

5

1. A radiation image storage panel comprising a stimuable phosphor layer, a layer having a lower refractive index, than a protective layer and the protective layer in this order on a support, characterized in that the above protective layer has a haze ratio of 3 % or less as defined according to JIS K6714.

10

2. A radiation image storage panel according to Claim 1, wherein the haze ratio is 1 % or less.

15

3. A radiation image storage panel according to Claim 1 or 2, wherein the protective layer exhibits a transmittance of 80 % or higher.

4. A radiation image storage panel according to any of Claims 1 to 3, wherein the protective layer has a thickness of 10 μm to 4 mm.

20

5. A radiation image storage panel according to Claim 4, wherein the protective layer has a thickness of 100 μm or more.

6. A radiation image storage panel according to Claim 5, wherein the protective layer has a thickness of 200 μm or more.

25

7. A radiation image storage panel according to any of Claims 1 to 6, wherein the protective layer is composed of a material selected from the group consisting of a plate glass and an organic polymeric compound.

8. A radiation image storage panel according to Claim 7, wherein the glass plate is a quartz glass, a borosilicate glass or a chemically reinforced glass.

30

9. A radiation image storage panel according to Claim 7, wherein the organic polymeric compound is polyethylene terephthalate, oriented polypropylene or polyvinyl chloride.

10. A radiation image storage panel according to any of Claims 1 to 9, wherein the low refractive index layer is composed of at least one selected from the group consisting of CaF_2 , Na_3AlF_6 , MgF_2 and SiO_2 .

40

11. A radiation image storage panel according to any of Claims 1 to 9, wherein the low refractive index layer is composed of at least one liquid selected from the group consisting of methanol, ethanol and diethyl ether.

45

12. A radiation image storage panel according to any of Claims 1 to 9, wherein the low refractive index layer is composed of at least one gas selected from the group consisting of air, nitrogen and argon.

50

13. A radiation image storage panel according to any of Claims 1 to 12, wherein the low refractive index layer is a vacuum layer.

55

14. A radiation image storage panel according to any of Claims 1 to 13, wherein the low refractive index layer has a thickness of 0.05 μm to 3 mm.

60

15. A radiation image storage panel according to any of Claims 1 to 14, wherein the stimuable phosphor layer contains at least an alkali halide phosphor.

65

16. A radiation image storage panel according to any of Claims 1 to 15, wherein moisture permeability of the protective layer is $10.0 \text{ g/m}^2 \cdot 24 \text{ hr}$ according to JIS Z0208.

17. A radiation image storage panel according to Claim 16, wherein moisture permeability of

the protective layer is $5.0 \text{ g/m}^2 \cdot 24 \text{ hr}$ according to JIS Z0208.

18. A radiation image storage panel according to any of Claims 1 to 17, wherein the panel further comprises a protective layer supporting member.

5

10

15

20

25

30

35

40

45

50

55

60

65

FIG. 1

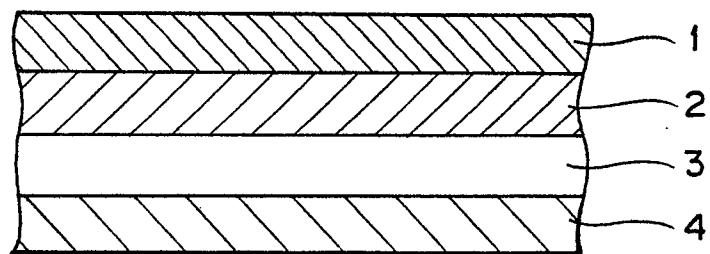


FIG. 2

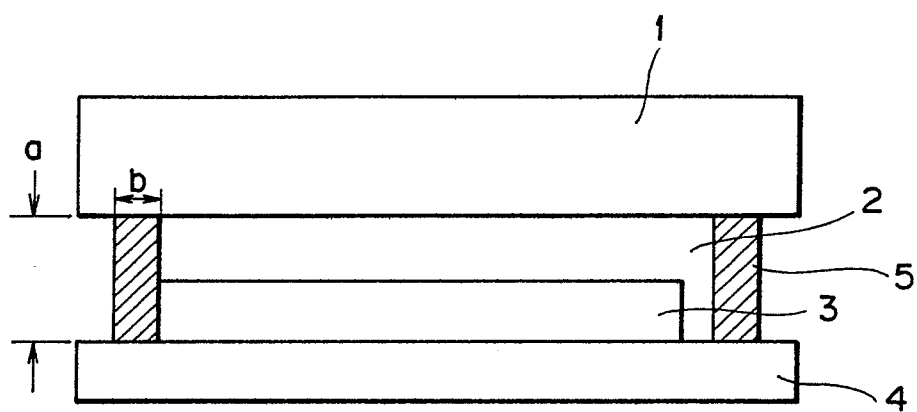


FIG. 3

