

Description

This invention relates to luminescence detecting devices and to luminescence sensitive members. Such devices and members are particularly, but not exclusively, suitable for use in a colour cathode ray tube of beam-index type, for detecting fluorescence from an index phosphor forming part of the phosphor screen of the cathode ray tube.

A reflex colour cathode ray tube arrangement of beam-index type previously proposed may include a flat glass envelope suitable for a colour television receiver of relatively small size. The beam-index reflex colour cathode ray tube has a front panel portion which permits coloured light to pass therethrough, and a screen panel portion which faces the front panel portion and is provided on its inner surface with a phosphor screen including a plurality of colour phosphor stripes of the three primary colours, and a plurality of index phosphor stripes. Colour images displayed on the phosphor screen are observed through the front panel portion, and the fluorescence from each of the index phosphor stripes, that is, the index fluorescence, is received by a photodetecting portion provided outward of the screen panel portion in relation to the phosphor screen.

Previously proposed structures of the type described are shown in Figures 1 to 4, inclusive, of the accompanying drawings. Figures 1 and 2 show an example of a beam-index reflex colour cathode ray tube arrangement which is provided with a flat glass envelope 19 comprising a front panel portion 11, a screen panel portion 13 facing the front panel portion 11, and a neck portion 17 which is connected through a funnel portion 15 to both the front panel portion 11 and the screen panel portion 13. The front panel portion 11 is of rectangular shape and allows coloured light to pass therethrough. The screen panel portion 13 is also of rectangular shape and is provided on its inner surface with a phosphor screen 21 extending in a rectangular pattern along the screen panel portion 13. The phosphor screen 21 includes a plurality of colour stripes of the three primary colours and a plurality of index phosphor stripes. In the neck portion 17, an electron gun assembly 23 is located to produce an electron beam modulated in accordance with colour video signals supplied thereto. When the phosphor screen 21 is scanned by the electron beam from the electron gun assembly 23 on the side facing the front panel portion 11, colour images are displayed on the phosphor screen 21 and are observed through the front panel portion 11.

As shown in Figure 3, the phosphor screen 21 is formed with a plurality of index phosphor stripes 29 which are fixed on the inner surface of the screen panel portion 13 and extend parallel to one

another at regularly spaced intervals. An inorganic layer 31 is fixed on the inner surface of the screen panel portion 13 and extends between each adjoining pair of the index phosphor stripes 29. A thin metallic layer 33 which covers the index phosphor stripes 29 and the inorganic layer 31, and a plurality of colour phosphor stripes of the three primary colours comprising green phosphor stripes 35G, red phosphor stripes 35R and blue phosphor stripes 35B are fixed on the thin metallic layer 33 in a predetermined arrangement. The green phosphor stripes 35G, the red phosphor stripes 35R and the blue phosphor stripes 35B extend parallel to each other adjacent to each of the index phosphor stripes 29 at regularly spaced intervals, and each adjacent pair of the green phosphor stripes 35G, the red phosphor stripes 35R and the blue phosphor stripes 35B is located between an adjacent two of the index phosphor stripes 29. Each of the index phosphor stripes 29 is made of a phosphor which emits fluorescence with a peak in the range of ultraviolet light in spectral characteristics, and has a short persistence characteristic, such, for example, as $Y_2SiO_5:Ce$.

At the outside of the screen panel portion 13 there is a luminescence sensitive receiving plate member 25 disposed to face and extend along the outer surface of the screen panel portion 13, and a fluorescence detector 27 containing a photosensitive device such as a photodiode is attached to one end of the luminescence receiving plate member 25. Fluorescence which is emitted by each of the index phosphor stripes 29, that is, index fluorescence, passes through the screen panel portion 13 and is operative to produce a secondary index fluorescence which is suitable for detection by the photosensitive device contained in the fluorescence detector 27. The luminescence receiving plate member 25 is formed, for example, of an acrylic resin in which a specific phosphor designed to absorb the index fluorescence from the index phosphor stripes 29 and emit a secondary index fluorescence is dispersed.

As shown in Figure 4, when index fluorescence Li from each of the index phosphor stripes 29 falls on the luminescence receiving plate member 25, the phosphor which is dispersed in the luminescence receiving plate member 25 is excited by the index fluorescence Li and emits fluorescence. Although a portion of the fluorescence indicated at 11 exits the luminescence receiving plate member 25 and another portion 12 of the fluorescence passes through the luminescence receiving plate member 25 in the opposite direction to the fluorescence detector 27, the remainder 13, of the fluorescence proceeds directly or with total reflections at the opposite surfaces of the luminescence receiving plate member 25 towards the fluorescence detector

27 to be handled the same as a secondary index fluorescence.

The fluorescence detector 27 produces an output signal from the secondary index fluorescence appearing in the luminescence receiving plate member 25, and this output signal or a signal reformed on the basis of the detection output signal is used as an index signal for causing the electron beam emitted from the electron gun assembly 23 to be modulated with a colour video signal supplied to the electron gun assembly 23 in response to the instantaneous scanning positions of the electron beam on the phosphor screen 21.

The conversion of the index fluorescence from each of the index phosphor stripes 29 into secondary index fluorescence produced in the luminescence receiving plate member 25 is required because the wavelength of the index fluorescence from each of the index phosphor stripes 29 themselves is not appropriate to match the wavelength sensitive characteristics of the photosensitive device contained in the fluorescence detector 27. For example, the index fluorescence emitted by each of the index phosphor stripes 29 when made of the phosphor $Y_2SiO_5:Ce$ has a peak level at a specific wavelength of about 400 nm, and extends broadly to wavelengths on both sides of the specific peak. Since the time period of the index fluorescence obtained successively from the index phosphor stripes 29 when the phosphor screen 21 is scanned by the electron beam from the electron gun assembly 23 is very short, and therefore the frequency of the detection output signal obtained from the fluorescence detector can be as high as 5 MHz, the index fluorescence does not match the characteristics of a silicon PIN diode used as the photosensitive device, since ordinarily a PIN diode has a wavelength-sensitive characteristic in which its peak occurs for light having a wavelength of about 900 nm. Accordingly, the luminescence receiving plate member 25 is operative to receive the index fluorescence from each of the index phosphor stripes 29 with a peak specific wavelength of about 400 nm, and must produce a secondary index fluorescence having a peak with a specific wavelength close to about 900 nm.

In the previously proposed luminescence receiving plate member 25, only a portion of the band of the index fluorescence from the index phosphor stripes 29 is effective to produce the secondary index fluorescence, and therefore the efficiency of conversion of index fluorescence from the index phosphor stripes 29 into secondary index fluorescence is undesirably low. Moreover, it is difficult as a practical matter to convert the index fluorescence from the index phosphor stripes 29 directly into a secondary index fluorescence which has a peak level close to 900 nm, so the secondary

index fluorescence is not sufficiently close to 900 nm. This results in a low conversion efficiency and a possibility that the detection output signal from the secondary index fluorescence is insufficient to actuate the fluorescence detector 27 properly, and, as a result, the colour images are not displayed properly on the phosphor screen.

European patent specification EP-A2-0 049 515 discloses a device having features similar to those of the pre-characterizing parts of claims 1 and 6.

According to the present invention there is provided a luminescence detecting device comprising:

a luminescence sensitive member on which incident luminescence is to fall; and
luminescence sensing means disposed in proximity to said luminescence sensitive member and capable of detecting fluorescence in the wavelength range emitted by said luminescence sensitive member;

said luminescence sensitive member being composed of a transparent fluorescent material; and
said fluorescent material being excitable by the incident luminescence falling thereon and absorbing luminescence in a first wavelength range which overlaps the range of wavelengths of said incident luminescence, and emitting fluorescence in a second wavelength range overlapping the longer wavelength portion of said incident luminescence; characterized in that:

said fluorescent material contains at least two types of organic phosphor dispersed therein;

the first type of organic phosphor is excitable by the incident luminescence falling thereon and absorbing luminescence in said first wavelength range and emitting fluorescence in said second wavelength range;

the second type of organic phosphor is excitable by fluorescence in a third wavelength range overlapping at least a part of said second wavelength range and emitting fluorescence in a fourth wavelength range overlapping the longer wavelength portion of said third wavelength range; and

said luminescence sensing means is capable of detecting at least fluorescence in the fourth wavelength range emitted by said luminescence sensitive member to produce an output signal in response to the fluorescence detected thereby.

According to the present invention there is also provided a luminescence sensitive member subject in use to impingement by incident fluorescent radiation in a predetermined band of wavelengths and comprising:

a plate composed of a transparent resin having phosphor dispersed therein, the excitation of said plate causing emission of fluorescence from said phosphor in a higher wavelength band than in said

determined band of incident radiation; characterized in that:

said phosphor comprises at least first and second phosphors;

said first phosphor is excitable over a range of wavelengths which overlaps said predetermined band of wavelengths at the higher end thereof; and said second phosphor is excitable over a range of wavelengths which overlaps the range of wavelengths emitted by excitation of said first phosphor at the higher end thereof;

whereby excitation of said plate causes emission of fluorescence from said first phosphor and excitation of said second phosphor by fluorescence emitted by said first phosphor.

In an embodiment of luminescence detecting device according to the present invention, when the index fluorescence from the phosphor stripes falls on the luminescence receiving member, the first organic phosphor absorbs at least a part of the luminescence in the first wavelength range and emits a first fluorescence in the second wavelength range in response to the luminescence absorbed thereby. The second organic phosphor absorbs at least a portion of the first fluorescence emitted by the first organic phosphor in the third wavelength range and emits a second fluorescence in a fourth wavelength range in response to the fluorescence absorbed thereby. A portion of the first fluorescence which is not absorbed by the second organic phosphor and the second fluorescence are directed to the luminescence sensing portion to be detected as secondary luminescence which is suitable for detection by the luminescence sensing portion. An output signal is thus obtained from the luminescence sensing portion in response to the secondary luminescence detected thereby.

With a conversion of the luminescence falling on the luminescence receiving member into a second luminescence caused by the conversion of luminescence falling on the luminescence receiving member into the first fluorescence produced by the first phosphor and the conversion of the first fluorescence into the second fluorescence by means of the second phosphor, partial components of the luminescence falling on the luminescence receiving member which exist in a relatively broad wavelength range are used for producing the secondary luminescence and therefore the luminescence falling on the luminescence receiving member is converted into the second luminescence which is suitable for detection by the luminescence sensing portion with improved conversion efficiency. Moreover, the second fluorescence emitted by the second phosphor can be selected so as to have a peak level with a specific wavelength which is the most preferable for detection by the luminescence sensing portion. Consequently, the output

signal from the luminescence sensing portion is obtained at a sufficiently high level.

In the case where such a luminescence detecting device is used in a beam-index colour cathode ray tube for detecting index fluorescence, such fluorescence is detected with a high sensitivity by the luminescence sensing portion, and a detection output signal of the index fluorescence is obtained at a relatively large level from the luminescence sensing portion which generates the index signal. This results in the control operation for modulating the electron beam emitted from the electron gun by the signals obtained by the momentary scanning positions of the electron beam on the phosphor screen to be quite stable, and therefore stabilized colour images are displayed on the phosphor screen. In addition, the dark electron current in the colour cathode ray tube is decreased to lower the black level of colour images on the phosphor screen, so that colour purity and the contrast characteristic of the colour images are improved.

The invention will now be described by way of example with reference to the accompanying drawings, throughout which like parts are referred to by like references, and in which:

Figure 1 is a somewhat schematic side elevational view, partly in cross-section, of a previously proposed beam-index reflex colour cathode ray tube;

Figure 2 is a schematic plan view including a partial sectional view of the cathode ray tube of Figure 1;

Figure 3 is a cross-sectional view showing a portion of the cathode ray tube of Figures 1 and 2;

Figure 4 is an illustration used for explaining the detection of index fluorescence in the cathode ray tube of Figures 1 and 2;

Figure 5 is a schematic perspective view illustrating an embodiment of luminescence detecting device according to the present invention;

Figure 6 is a graph for explaining the operation of a luminescence receiving member in the embodiment of Figure 5;

Figure 7 is an illustration used for explaining measurements on the luminescence detecting operation of the embodiment of Figure 5; and

Figure 8 is a graph for explaining the results of measurements on the luminescence detecting operation of the embodiment of Figure 5.

Figure 5 shows an embodiment of luminescence detecting device according to the present invention and including a luminescence receiving plate member 25 and the fluorescence detector 27 as shown in Figures 1 and 2 used in a beam-index reflex colour cathode ray tube arrangement as in Figures 1 and 2.

The example of Figure 5 comprises a lumines-

luminescence receiving member 30 shaped into a curved rectangular plate with a fluorescence detector 32 attached to one side of the luminescence receiving member 30. The luminescence receiving member 30 is made, for example, by injection moulding a transparent acrylic resin in which two types of organic phosphors, designated PSa and PSb, are dispersed, and the plate is shaped to have a pair of opposite surfaces each extending along the outer surfaces of a screen panel portion. The panel portion forms a part of a glass envelope of a beam-index colour cathode ray tube arrangement such as shown in Figures 1 and 2, and is provided with a phosphor screen on the inner surface thereof.

The organic phosphors PSa and PSb have emission spectrum characteristics as indicated by the curves Sa and Sb, respectively, in Figure 6. The vertical axis represents the normalized level (I) and the horizontal axis represents wavelength. In Figure 6, the emission spectrum characteristic of the phosphor $Y_2SiO_5:Ce$ used for forming the index phosphor stripes of the type shown in Figures 1 and 2 is indicated by a curve Si.

As apparent from Figure 6, the index phosphor PSi emits fluorescence having a peak level at a specific wavelength of about 400 nm and extends broadly in a range of wavelengths exceeding the specific wavelength at which the peak level appears. The organic phosphor PSa emits fluorescence having a peak level at a specific wavelength of about 500 nm and overlaps the wavelength range emitted by the index phosphor PSi extending to the longer wavelength side. The organic phosphor PSb emits fluorescence at a peak level of about 600 nm, and is excitable within a wavelength range existing at the longer wavelength end of the wavelength range of the fluorescence emitted by the organic phosphor PSa. The organic phosphor PSa absorbs fluorescence in a wavelength range Qa shown in Figure 6, which overlaps with the wavelength range of the fluorescence emitted by the index phosphor PSi. The organic phosphor PSb absorbs fluorescence in a wavelength range Qb shown in Figure 6, and overlaps with the wavelength range of the fluorescence emitted by the organic phosphor PSa.

The organic phosphors PSa and PSb are the same types of phosphors as used in light-collecting resins assuming a green colour and a red colour respectively, and are supplied under the trade name 'LISA-Plastics' by the Bayer Company in West Germany.

On the sides of the luminescence receiving member 30 in which the organic phosphors PSa and PSb are dispersed, a thin metallic layer 34 is provided, for example, by the vacuum deposition of aluminium on the perimeter of the luminescence receiving member 30, except that portion to which

the fluorescence detector 32 is attached. The fluorescence emitted in the luminescence receiving member 30 is directed towards the sides of the luminescence receiving member 30, and is reflected at the thin metallic layer 34 towards the inside of the luminescence receiving member 30.

The fluorescence detector 32 contains, for example, a silicon PIN diode as a photosensitive element, and receives the fluorescence emitted in the luminescence receiving member 30 and directed to the portion of the sides of the luminescence receiving member 30 on which the thin metallic layer 34 is not provided. The fluorescence detector 32 produces an output signal in response to the fluorescence from the luminescence receiving member 30 at an output terminal 32a.

When the luminescence detecting device thus constituted receives the index fluorescence emitted by the index phosphor stripes with the spectrum indicated by curve Si of Figure 6, the organic phosphor PSa dispersed in the luminescence receiving member 30 absorbs a part of the index fluorescence in the wavelength range Qa shown in Figure 6 and emits fluorescence in the wavelength range which extends to the longer wavelength side of the wavelength range of the index fluorescence in accordance with the emission spectrum characteristics identified by curve Sa in Figure 6. Then, the organic phosphor PSb also dispersed in the luminescence receiving member 30 absorbs a part of the index fluorescence and a part of the fluorescence emitted by the organic phosphor PSa in the wavelength range Qb shown in Figure 6 and is excited thereby. It emits fluorescence in the wavelength range which extends to the longer wavelength side of the wavelength range of the fluorescence emitted by the organic phosphor PSa, in accordance with the emission spectrum characteristics indicated by the curve Sb in Figure 6.

In the luminescence receiving member 30, the index fluorescence from the index phosphor stripes is converted substantially into fluorescence emitted by the organic phosphor PSb which has a peak level at a specific wavelength close to 900 nm at which the silicon PIN diode has a peak in sensitivity. The fluorescence emitted by the organic phosphor PSb is the main component of the secondary index fluorescence. In the conversion of the index fluorescence into secondary index fluorescence by the luminescence receiving member 30, partial components of the index fluorescence extending in a relatively broad wavelength range and the fluorescence emitted by the organic phosphor PSa are utilized for the production of the second index fluorescence.

The secondary index fluorescence thus obtained in the luminescence receiving member 30 is directed to the fluorescence detector 32 to be

ected by the silicon PIN diode contained in the detector 32 and an output signal is obtained in response to the secondary index fluorescence detected by the silicon PIN diode at the output terminal 32a of the fluorescence detector 32. This output signal serves as a detection output signal of the index fluorescence.

Experimental measurements of the detection output signal of the index fluorescence have been conducted with a measuring arrangement shown in Figure 7. It utilizes a beam-index colour cathode ray tube 50 of the type shown in Figures 1 and 2. The luminescence receiving member 30 was disposed at the outside of the screen panel portion 13 of the beam-index colour cathode ray tube 50 and an operational voltage source and signal supplier 40 was connected to the cathode ray tube 50 as shown in Figure 7. In this measuring arrangement, the cathode ray tube 40 was four inches (about 10 cm) in size and the luminescence receiving member 40 was 100 mm in length, 100 mm in width and 3 mm in thickness. The detection output signal obtained at the output terminal 32a of the fluorescence detector 32 was amplified by a band-pass amplifier 42, and then measured by means of a level meter 44. The experimental measurements were done with several luminescence receiving members 30 which were different from each other in density of the organic phosphors PSa and PSb dispersed therein.

Comparative measurements of the detection output signal of the index fluorescence have also been conducted with several plates each made of a transparent acrylic resin in which only the organic phosphor PSa was dispersed with different densities and formed in the same size as the luminescence receiving member 30. Each sample was used instead of the luminescence receiving member 30 shown in the measuring arrangement of Figure 7.

Figure 8 shows the results of the measurements mentioned above in the form of a graph wherein the axis of the ordinates represents the normalized level (X) of the detection output signal, and the axis of the abscissae represents density (C) of the organic phosphors in percent in the luminescence receiving member 30. In the graph of Figure 8, the results of experimental measurements conducted with the luminescence receiving members 30 differing from each other in the density of the organic phosphors dispersed therein are indicated by a curve R30, and the results of comparative measurements conducted with plates of transparent acrylic resin differing from each other in density of the organic phosphor PSa dispersed therein are indicated with a curve r30.

As apparent from Figure 8, when the luminescence receiving member 30 is used and the den-

sity of the organic phosphors PSa and PSb is equal to one or more percent, the detection output signal having a level of 1.2 to 1.4 times as much as that of the detection output signal obtained where only the organic phosphor PSa was dispersed is obtained. A detection output signal with a sufficient level could be obtained by using luminescence receiving members 30 in which the density of the organic phosphors PSa and PSb was from 1 to 5%. Thus, it will be understood that in the case where the index fluorescence from the index phosphor stripes in the cathode ray tube 40 is converted into secondary index fluorescence by the organic phosphors, the detection output signal of the index fluorescence is obtained at a level substantially higher than the signal obtained in the case where the index fluorescence is converted into secondary index fluorescence using only the organic phosphor PSa.

As described above, with the embodiment shown in Figure 5, the detection output signal of the index fluorescence was obtained with a relatively large level from the fluorescence detector 32. Consequently, the control operation for modulating the signal supplied to the electron gun assembly 23 in response to the momentary scanning positions of the electron beam was carried out under stable conditions and stabilized colour images were displayed on the phosphor screen. Since the electron beam for exciting each of the index phosphor stripes in the cathode ray tube 50 can be decreased in density, a dark electron current in the cathode ray tube 50 was decreased to lower the black level of the colour images on the phosphor screen, and the colour purity and contrast characteristics of the colour images were improved.

As a result of the measurement of the contrast ratio of the colour images on the phosphor screen conducted under the preferred condition set out above, a contrast ratio of more than 1.5 times that obtained with the use of the transparent acrylic resin containing only the organic phosphor PSa in a concentration of 5% has been obtained.

Although the above described embodiment is for a beam-index reflex cathode ray tube as shown in Figures 1 and 2, it is to be understood that embodiments of luminescence detecting device according to the present invention can be used for detecting various other luminescence.

Claims

1. A luminescence detecting device comprising: a luminescence sensitive member (30) on which incident luminescence is to fall; and luminescence sensing means (32) disposed in proximity to said luminescence sensitive member (30) and capable of detecting fluorescence



ected by the silicon PIN diode contained in the detector 32 and an output signal is obtained in response to the secondary index fluorescence detected by the silicon PIN diode at the output terminal 32a of the fluorescence detector 32. This output signal serves as a detection output signal of the index fluorescence.

Experimental measurements of the detection output signal of the index fluorescence have been conducted with a measuring arrangement shown in Figure 7. It utilizes a beam-index colour cathode ray tube 50 of the type shown in Figures 1 and 2. The luminescence receiving member 30 was disposed at the outside of the screen panel portion 13 of the beam-index colour cathode ray tube 50 and an operational voltage source and signal supplier 40 was connected to the cathode ray tube 50 as shown in Figure 7. In this measuring arrangement, the cathode ray tube 40 was four inches (about 10 cm) in size and the luminescence receiving member 40 was 100 mm in length, 100 mm in width and 3 mm in thickness. The detection output signal obtained at the output terminal 32a of the fluorescence detector 32 was amplified by a band-pass amplifier 42, and then measured by means of a level meter 44. The experimental measurements were done with several luminescence receiving members 30 which were different from each other in density of the organic phosphors PSa and PSb dispersed therein.

Comparative measurements of the detection output signal of the index fluorescence have also been conducted with several plates each made of a transparent acrylic resin in which only the organic phosphor PSa was dispersed with different densities and formed in the same size as the luminescence receiving member 30. Each sample was used instead of the luminescence receiving member 30 shown in the measuring arrangement of Figure 7.

Figure 8 shows the results of the measurements mentioned above in the form of a graph wherein the axis of the ordinates represents the normalized level (X) of the detection output signal, and the axis of the abscissae represents density (C) of the organic phosphors in percent in the luminescence receiving member 30. In the graph of Figure 8, the results of experimental measurements conducted with the luminescence receiving members 30 differing from each other in the density of the organic phosphors dispersed therein are indicated by a curve R30, and the results of comparative measurements conducted with plates of transparent acrylic resin differing from each other in density of the organic phosphor PSa dispersed therein are indicated with a curve r30.

As apparent from Figure 8, when the luminescence receiving member 30 is used and the den-

sity of the organic phosphors PSa and PSb is equal to one or more percent, the detection output signal having a level of 1.2 to 1.4 times as much as that of the detection output signal obtained where only the organic phosphor PSa was dispersed is obtained. A detection output signal with a sufficient level could be obtained by using luminescence receiving members 30 in which the density of the organic phosphors PSa and PSb was from 1 to 5%. Thus, it will be understood that in the case where the index fluorescence from the index phosphor stripes in the cathode ray tube 40 is converted into secondary index fluorescence by the organic phosphors, the detection output signal of the index fluorescence is obtained at a level substantially higher than the signal obtained in the case where the index fluorescence is converted into secondary index fluorescence using only the organic phosphor PSa.

As described above, with the embodiment shown in Figure 5, the detection output signal of the index fluorescence was obtained with a relatively large level from the fluorescence detector 32. Consequently, the control operation for modulating the signal supplied to the electron gun assembly 23 in response to the momentary scanning positions of the electron beam was carried out under stable conditions and stabilized colour images were displayed on the phosphor screen. Since the electron beam for exciting each of the index phosphor stripes in the cathode ray tube 50 can be decreased in density, a dark electron current in the cathode ray tube 50 was decreased to lower the black level of the colour images on the phosphor screen, and the colour purity and contrast characteristics of the colour images were improved.

As a result of the measurement of the contrast ratio of the colour images on the phosphor screen conducted under the preferred condition set out above, a contrast ratio of more than 1.5 times that obtained with the use of the transparent acrylic resin containing only the organic phosphor PSa in a concentration of 5% has been obtained.

Although the above described embodiment is for a beam-index reflex cathode ray tube as shown in Figures 1 and 2, it is to be understood that embodiments of luminescence detecting device according to the present invention can be used for detecting various other luminescence.

Claims

1. A luminescence detecting device comprising: a luminescence sensitive member (30) on which incident luminescence is to fall; and luminescence sensing means (32) disposed in proximity to said luminescence sensitive member (30) and capable of detecting fluorescence



in the wavelength range emitted by said luminescence sensitive member (30);
said luminescence sensitive member (30) being composed of a transparent fluorescent material; and

said fluorescent material being excitable by the incident luminescence falling thereon and absorbing luminescence in a first wavelength range which overlaps the range of wavelengths of said incident luminescence, and emitting fluorescence in a second wavelength range overlapping the longer wavelength portion of said incident luminescence;

characterized in that:

said fluorescent material contains at least two types of organic phosphor (PSa, PSb) dispersed therein;

the first type of organic phosphor (PSa) is excitable by the incident luminescence falling thereon and absorbing luminescence in said first wavelength range and emitting fluorescence in said second wavelength range;

the second type of organic phosphor (PSb) is excitable by fluorescence in a third wavelength range overlapping at least a part of said second wavelength range and emitting fluorescence in a fourth wavelength range overlapping the longer wavelength portion of said third wavelength range; and

said luminescence sensing means (32) is capable of detecting at least fluorescence in the fourth wavelength range emitted by said luminescence sensitive member (30) to produce an output signal in response to the fluorescence detected thereby.

2. A device according to claim 1 wherein said luminescence sensitive member (30) has a thin metallic layer (34) at the sides thereof and partially surrounding said member (30).

3. A device according to claim 1 or claim 2 wherein said luminescence sensitive member (30) is a rectangular shaped plate having opposed parallel planar surfaces.

4. A luminescence detecting device according to claim 1, claim 2 or claim 3 wherein said luminescence sensing means (32) includes a photosensitive element responsive to said fluorescence in the fourth wavelength range emitted by said luminescence sensitive member (30).

5. A luminescence detecting device according to claim 4 wherein said photosensitive element is a silicon PIN diode.

6. A luminescence sensitive member subject in use to impingement by incident fluorescent radiation in a predetermined band of wavelengths and comprising:

a plate (30) composed of a transparent resin having phosphor dispersed therein, the excitation of said plate (30) causing emission of fluorescence from said phosphor in a higher wavelength band than in said predetermined band of incident radiation;

characterized in that:

said phosphor comprises at least first and second phosphors (PSa, PSb);

said first phosphor (PSa) is excitable over a range of wavelengths which overlaps said predetermined band of wavelengths at the higher end thereof; and

said second phosphor (PSb) is excitable over a range of wavelengths which overlaps the range of wavelengths emitted by excitation of said first phosphor (PSa) at the higher end thereof; whereby excitation of said plate (30) causes emission of fluorescence from said first phosphor (PSa) and excitation of said second phosphor (PSb) by fluorescence emitted by said first phosphor (PSa).

Revendications

1. Dispositif de détection de luminescence comprenant :

un élément (30) sensible à la luminescence sur lequel arrive une luminescence d'incidence ; et

des moyens (32) de détection de luminescence, disposés à proximité du dit élément (30) sensible à la luminescence et susceptible de détecter la fluorescence dans une gamme de longueurs d'onde émises par ledit élément (30) sensible à la luminescence ;

ledit élément (30) sensible à la luminescence étant composé d'un matériau fluorescent transparent ; et

ledit matériau fluorescent étant excitable par la luminescence incidente qui y tombe et étant capable d'absorber la luminescence dans une première gamme de longueurs d'onde qui recouvre la gamme des longueurs d'onde de ladite luminescence incidente, et émettant une fluorescence dans une deuxième gamme de longueurs d'onde recouvrant la plus grande partie des longueurs d'onde de ladite luminescence incidente ;

caractérisé en ce que :

ledit matériau fluorescent contient au moins deux types de phosphores organiques (PSa, PSb) qui y sont dispersés ;

le premier type de phosphore organique



(PSa) est excitable par la luminescence incidente qui y tombe, et absorbant la luminescence dans ladite première gamme de longueurs d'onde et émettant de la fluorescence dans ladite seconde gamme de longueurs d'onde ;

le second type de phosphore organique (PSb) est excitable par la fluorescence dans une troisième gamme de longueurs d'onde recouvrant au moins une partie de la seconde gamme de longueurs d'onde et émettant une fluorescence dans une quatrième gamme de longueurs d'onde recouvrant la plus grande partie des longueurs d'onde de ladite troisième gamme de longueurs d'onde ; et

lesdits moyens (32) sensibles à la luminescence sont capables de détecter au moins la fluorescence de la quatrième gamme de longueurs d'onde émise par ledit élément (30) sensible à la luminescence pour produire un signal de sortie en réponse à la fluorescence qui y est détectée.

2. Dispositif selon la revendication 1, dans lequel ledit élément (30) sensible à la luminescence comporte une fine couche métallique (34) à ses côtés et entourant partiellement ledit élément (30).

3. Dispositif selon la revendication 1 ou 2, dans lequel ledit élément sensible à la luminescence (30) est une plaque de forme rectangulaire ayant des surfaces planes parallèles opposées.

4. Dispositif de détection de luminescence selon la revendication 1, 2 ou 3, dans lequel lesdits moyens de détection de luminescence (32) comportent un élément photosensible sensible à ladite fluorescence dans la quatrième gamme de longueurs d'onde émise par ledit élément sensible à la luminescence (30).

5. Dispositif de détection de luminescence selon la revendication 4, dans lequel ledit élément photosensible est une diode au silicium PIN.

6. Élément sensible à la luminescence destiné à être utilisé pour recevoir le rayonnement de fluorescence incidente dans une bande prédéterminée de longueurs d'onde et comprenant :

une plaque (30) composée d'une résine transparente ayant du phosphore qui y est dispersé, l'excitation de ladite plaque (30) provoquant l'émission de fluorescence par ledit phosphore dans une bande de longueurs d'onde plus élevées que dans ladite bande prédéterminée de rayonnement incident ;

caractérisé en ce que :

ledit phosphore comporte au moins des

premier et second phosphores (PSa, PSb) ;

ledit premier phosphore (PSa) est excitable sur une gamme de longueurs d'onde qui recouvre ladite bande prédéterminée de longueurs d'onde à son extrémité supérieure ; et

ledit second phosphore (PSb) est excitable sur une gamme de longueurs d'onde qui recouvre à son extrémité supérieure la gamme de longueurs d'onde émise par l'excitation du dit premier phosphore ;

de façon à ce que l'excitation de ladite plaque (30) provoque l'émission de fluorescence par ledit premier phosphore (PSa) et l'excitation du dit second phosphore (PSb) par la fluorescence émise par ledit premier phosphore.

Patentansprüche

1. Vorrichtung zur Detektion von Lumineszenz, die aufweist:
ein lumineszenzempfindliches Teil (30), auf das die einfallende Lumineszenz fällt; und eine Lumineszenzsensoreinrichtung (32), die in der Nähe des lumineszenzempfindlichen Teils (30) angeordnet ist und in der Lage ist, Fluoreszenz in dem Wellenlängenbereich, der von dem lumineszenzempfindlichen Teil (30) emittiert wird, zu detektieren;
wobei das lumineszenzempfindliche Teil (30) aus einem, transparenten, fluoreszierenden Material besteht; und das fluoreszierende Material durch die einfallende Lumineszenz, die darauf fällt, anregbar ist, und die Lumineszenz in einem ersten Wellenlängenbereich absorbiert, der mit dem Wellenlängenbereich der einfallenden Lumineszenz überlappt, und das Fluoreszenz in einen zweiten Wellenlängenbereich emittiert, der mit dem langwelligen Bereich der einfallenden Lumineszenz überlappt, dadurch gekennzeichnet, daß das fluoreszierende Material zumindest zwei Arten von organischem Leuchtstoff (PSa, PSb) enthält, die darin dispergiert sind; wobei die erste Art von organischem Leuchtstoff (PSa) durch die einfallende Lumineszenz, die darauf fällt, anregbar ist und Lumineszenz in dem ersten Wellenlängenbereich absorbiert und Fluoreszenz in dem zweiten Wellenlängenbereich emittiert; wobei die zweite Art von organischen Leuchtstoff (PSb) durch die Fluoreszenz in einem dritten Wellenlängenbereich anregbar ist, der zumindest mit einem Teil des zweiten Wellenlängenbereichs überlappt, und Fluoreszenz in einem vierten Wellenlängenbereich emittiert, der mit dem langwelligen Teil des dritten Wel-



Wellenlängenbereichs überlappt, emittiert und die Lumineszenzsensoreinrichtung (32) in der Lage ist, zumindest Fluoreszenz in dem vierten Wellenlängenbereich zu detektieren, der durch das lumineszenzempfindliche Teil (30) emittiert wird, um in Abhängigkeit von der dabei detektierten Fluoreszenz ein Ausgangssignal zu erzeugen.

2. Vorrichtung nach Anspruch 1, wobei das lumineszenzempfindliche Teil (30) eine dünne metallische Schicht (34) an seinen Seiten aufweist, das teilweise das Teil (30) umgibt.

3. Vorrichtung nach Anspruch 1 oder Anspruch 2, wobei das lumineszenzempfindliche Teil (30) eine rechteckig geformte Platte ist, die gegenüberliegende parallele planare Oberflächen aufweist.

4. Vorrichtung zur Detektion von Lumineszenz nach Anspruch 1, Anspruch 2 oder Anspruch 3, wobei die Lumineszenzsensoreinrichtung (32) ein photosensitives Element aufweist, das auf die Fluoreszenz in dem vierten Wellenlängenbereich reagiert, die von dem lumineszenzempfindlichen Teil (30) emittiert wird.

5. Vorrichtung zur Detektion von Lumineszenz nach Anspruch 4, wobei das photosensitive Element eine Silizium PIN Diode ist.

6. Lumineszenzempfindliches Teil, das beim Betrieb dem Auftreffen einfallender Fluoreszenzstrahlung in einem vorstimmten Wellenlängenband ausgesetzt ist und das aufweist: eine Platte (30), die aus einem lichtdurchlässigen Harz mit darin dispergiertem Leuchtstoff gebildet ist, wobei die Anregung der Platte (30) die Emission von Fluoreszenz des Leuchtstoffs in einem Wellenlängenband höher als das vorbestimmte Band der einfallenden Strahlung bewirkt,

dadurch gekennzeichnet,

daß der Leuchtstoff zumindest einen ersten und zweiten Leuchtstoff (PSa, PSb) aufweist; wobei der erste Leuchtstoff (PSa) über einen Wellenlängenbereich hinweg anregbar ist, der mit dem vorbestimmten Wellenlängenband an dessen höherem Ende überlappt; und wobei der zweite Leuchtstoff (PSb) über einen Wellenlängenbereich hinweg anregbar ist, der mit einem Wellenlängenbereich an dessen höherem Ende überlappt, der durch die Anregung des ersten Leuchtstoffs (PSa) emittiert

wird;

wobei die Anregung der Platte (30) die Emission von Fluoreszenz von dem ersten Leuchtstoff (PSa) und die Anregung des zweiten Leuchtstoffs (PSb) durch die von dem ersten Leuchtstoff (PSa) emittierte Fluoreszenz bewirkt.