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A2

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(54) **One-surface light-sensitive silver halide photographic material.**

(57) A one-surface light-sensitive silver halide photographic material having, on a support, at least one of green sensitive layer, characterized in that the relative blue light sensitivity of the light-sensitive photographic material is controlled to be 45 or less to the green light sensitivity which is made as 100.

According to the present invention, a one-surface light-sensitive material with high sensitivity and yet excellent graininess, and also with little dye remained after development can be obtained.

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One-surface light-sensitive silver halide photographic material

BACKGROUND OF THE INVENTION

This invention relates, firstly, to a nega-type light-sensitive silver halide photographic material for photographing CRT (Cathode Rays Tube) image, particularly to a one-surface light-sensitive material including a CRT sensitive material capable of obtaining a good image with high sensitivity and without roughening and therefore reproducing faithfully the CRT display image and, secondly, to a one-surface light-sensitive photographic material capable of obtaining a photograph which is of high sensitivity and is excellent in graininess and sharpness, in a system using a fluorescent sensitizing paper or a fluorescent plate during X-ray photographing, etc., more particularly a one-surface light-sensitive photographic material most suitable for bosom photographing, limb bone photograpning, etc. for which high sharpness, high quality are demanded.

In recent years, medical electronic techniques have been remarkably developed, and marked progresses have been achieved by novel diagnostic methods by means of ME instruments such as CT (computed tomography), US (ultrasonic diagnosis), RI (nuclear medicine), thermography, etc.

In these diagnostic methods which are different from the method in which photographing is directly performed with X-ray on a light-sensitive photographic material for X-ray of the prior art, various measured inputs are processed by use of a computer to give a display on CRT and perform diagnosis while seeing this display. However, when diagnosis is conducted practically by a physician, not only CRT display is used, but also it is frequently practiced to take a photograph on a light-sensitive photographic material for X-ray and perform diagnosis or re-diagnosis after development in other places or timings. Accordingly, it has been desired to have a CRT sensitive material capable of reproducing faithfully the CRT display.

In such situation, as the method for enhancing the sensitivity of conventional light-sensitive silver halide photographic materials, there have been practiced the method to enlarge the grain size of the silver halide contained in the silver halide emulsion layer or the method to effect spectral sensitization with the use of a sensitizing dye as the most general methods. However, enlargement of the grain size of the silver halide will result in lowering in the maximum density or contrast at the same level of silver coated, and also encounters the problem of worsening in graininess. On the other hand, improvement of graininess by use of a sensitizing dye also has the problems such as lowering in sensitivity or remaining of dye, if an amount exceeding a certain limit is used. Nevertheless, the techniques for improvement of sensitivity and graininess in these light-sensitive silver halide photographic materials have been reported in a considerable number and with considerable effects.

In contrast, concerning the techniques for improvement of sensitivity and graininess during photographing CRT picture surface, only a few reports can be found, and the CRT sensitive material of the prior art can give only an image with substantially roughened image quality. More specifically, in the light-sensitive material having color sensitivity from blue light to green light or blue light to red light, for example, when the CRT [containing two phosphors of ZnS:Ag and ZnCdS:Ag] image is photographed by Sakura Imaging Camera M.M. [produced by Konishiroku Medical Co.], graininess will be deteriorated particularly when the blue light sensitivity is higher relative to the green light sensitivity.

Techniques for improving graininess of such CRT sensitive material to be used when photographing CRT picture surface are disclosed in, for example, Japanese Unexamined Patent Publications Nos. 214845/1984 and 224843/1984, but when sensitized with the use of sensitizing dyes of the prior art, graininess is poor, or problems are involved such as sensitivity lowering or dye remaining, etc. even if graininess may be improved. Thus, sensitivity and graininess are not yet sufficiently improved, and further improvement thereof has been desired.

On the other hand, as the film for direct X-ray photographing by use of a sensitizing paper, the techniques as disclosed in Japanese Patent Publication No. 14030/1969 or Japanese Unexamined Patent Publication No. 31228/1976 have been frequently used.

Whereas, in the fluorescent sensitizing paper emitting green and blue colors to be used together with such film, one employing two or more kinds of phosphor particles as a mixture is more deteriorated in graininess than the sensitizing paper by use of a single phosphor. Particularly, in a film for X-ray photography with one-surface emulsion, graininess was deteriorated to great extent, whereby there ensued a new poblem which had been no problem in the both-surface emulsion film.

In view of this point, the present inventors have made various studies and consequently found that graininess can be improved to great extent by controlling the relative blue light sensitivity of the light-sensitive material to be 45 or less, to the green light sensitivity which is made as 100.

Further, it has been found that when the relative blue light sensitivity is within the range of 20 to 45, more preferably, 25 to 35, further greater improvement can be effected to give sufficiently satisfactory graininess simultaneously with improvement of sensitivity.

Also, it has been found that good sharpness and graininess can also be obtained during X-ray photographing by use of a fluorescent sensitizing paper.

Therefore, the present invention has been carried out based on the above findings.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide a one-surface light-sensitive material which has high sensitivity and yet can suppress roughening of image quality, also without remaining of dye, can reproduce faithfully the image of a CRT display and, also during X-ray photographing, is capable of giving a photograph with high sensitivity and excellent graininess and sharpness.

The above object has been accomplished by controlling the relative blue light sensitivity of the light-sensitive material to be 45 or less, preferably, 20 to 45, more preferably, from 25 to 35, to the green light sensitivity which is made as 100.

More specifically, the present invention relates to a one-surface light-sensitive silver halide photographic material having, on a support, at least one of green sensitive layer, characterized in that the relative blue light sensitivity of the light-sensitive photographic material is controlled to be 45 or less, preferably, 20 to 45, more preferably from 25 to 35, to the green light sensitivity which is made as 100.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows the relative sensitivity of emission spectrum of the CRT which is a subject to be photographed by use of CRT light-sensitive material of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the one-surface light-sensitive photographic material of the present invention, for the purpose of controlling the relative blue light sensitivity of the material to be 45 or less, preferably, 20 to 45, more preferably from 25 to 35, to the green light sensitivity which is made as 100, the light-sensitive photographic material contains one or more of dyes in an amount by far more than the dye amount used in conventional light-sensitive silver halide photographic materials.

Namely, in one preferred embodiment of the present invention, the light-sensitive photographic material contrains single kind of sensitizing dye in an amount enough to control the relative blue light sensitivity to the above desired range.

In another preferred embodiment of the present invention, the light-sensitive photographic material contains single kind of sensitizing dye and a dye other than a sensitizing dye in combination with each other in an amount enough to control the relative blue light sensitivity to be the desired range.

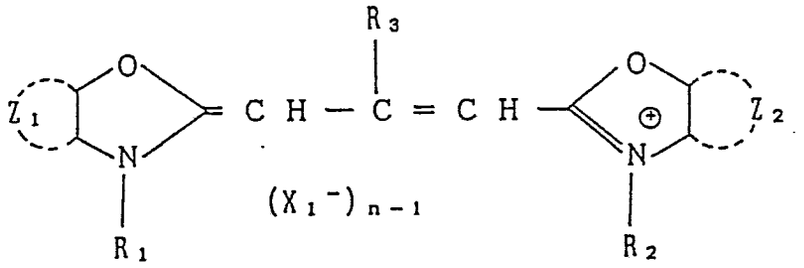
In still another preferred embodiment of the present invention, the light-sensitive photographic material contains two kinds of sensitizing dyes in combination with each other in an amount enough to control the relative blue light sensitivity to be the desired range.

Next, more detailed descriptions of the present invention will be given.

When single kind of sensitizing dye is used for the purpose of controlling the relative blue light sensitivity, the sensitizing dye may be used in an amount ranging from 200 to 2000 mg, more preferably, from 250 to 1500 mg, per 1 mol of silver halide. The one-surface light-sensitive material thus obtained becomes to have sufficiently satisfactory sensitivity and graininess.

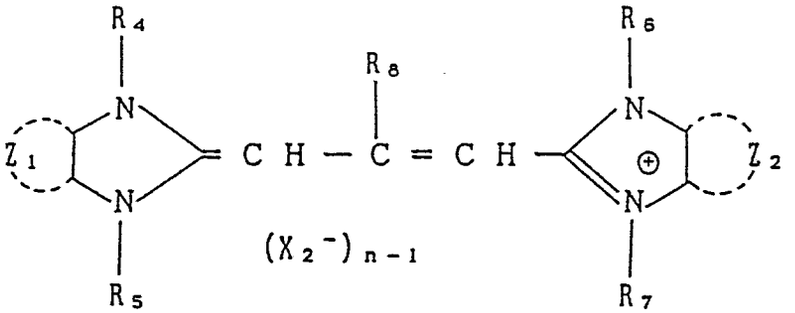
The sensitizing dye to be used for praparing the present one-surface light-sensitive material is not particularly limited, however, as preferable sensitizing dyes, there will be given compounds represented by the formula [I] or the formula [II] as shown below.

Formula [I]



wherein R_1 and R_2 each represent a substituted or unsubstituted alkyl group, alkenyl group or aryl group, and at least one of R_1 and R_2 represents a sulfoalkyl group or a carboxyalkyl group; R_3 represents a hydrogen atom, an alkyl group having 1 to 3 carbon atoms or an aryl group; X_1^- represents an anion; Z_1 and Z_2 each represent a group of nonmetallic atoms necessary for the completion of a substituted or unsubstituted benzene ring; and n represents 1 or 2 (with proviso that n is 1 when an intramolecular salt is formed), and

Formula [II]



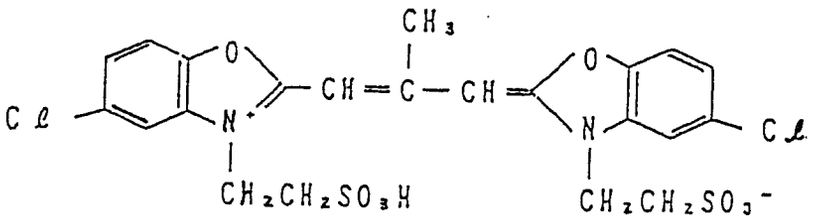
wherein R_4 and R_6 each represent a substituted or unsubstituted lower alkyl group; R_5 and R_7 each represent a lower alkyl group, a hydroxyalkyl group, a sulfoalkyl group or a carboxylalkyl group; R_8 represents a hydrogen atom or an alkyl group having 1 to 3 carbon atoms; X_2^- represents an anion; Z_1 and Z_2 each represent a group of nonmetallic atoms necessary for the completion of a substituted or unsubstituted benzene ring; and n represents 1 or 2 (with proviso that n is 1 when an intramolecular salt is formed).

In the following, some of particularly preferable compounds represented by the formula [I] as the sensitizing dyes to be used in the one-surface light-sensitive material of the present invention are set forth, but the present invention is not limited by the exemplary compounds.

Sensitizing dyes represented by the formula [I]:

Exemplary compound:

(1)



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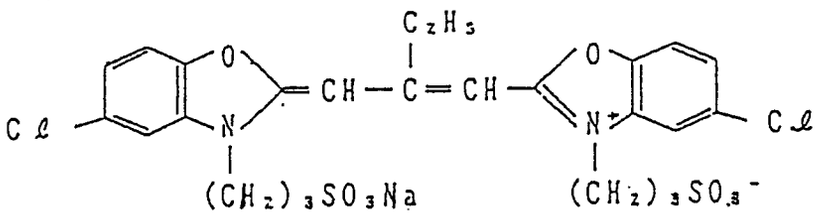

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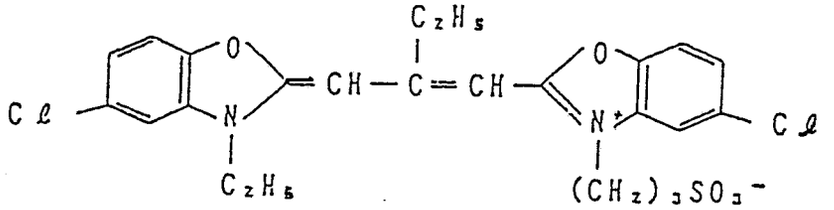

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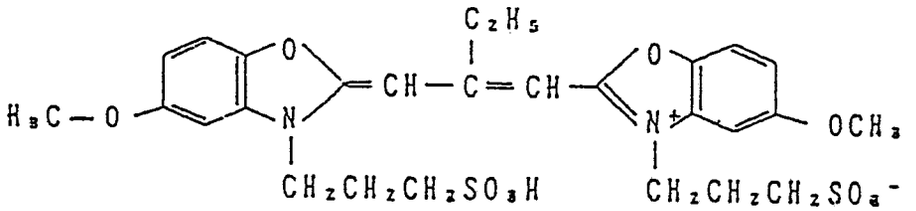

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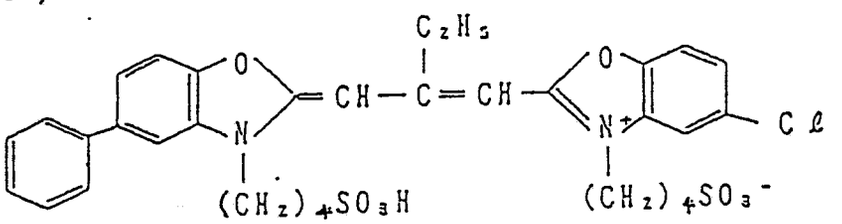

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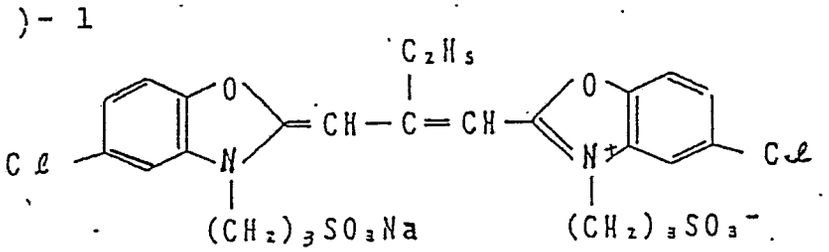

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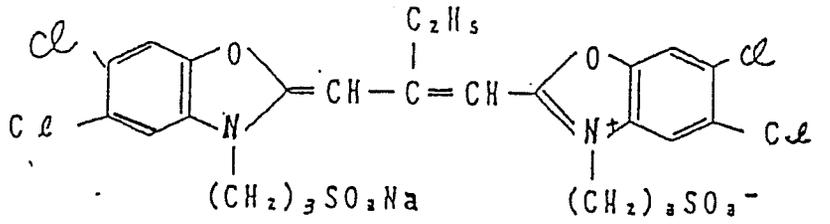

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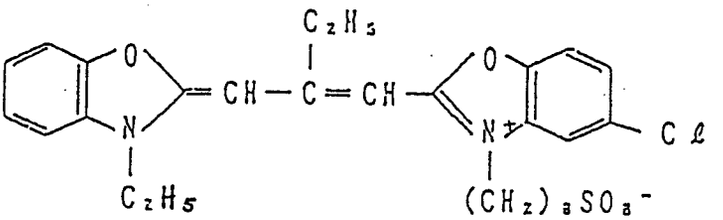

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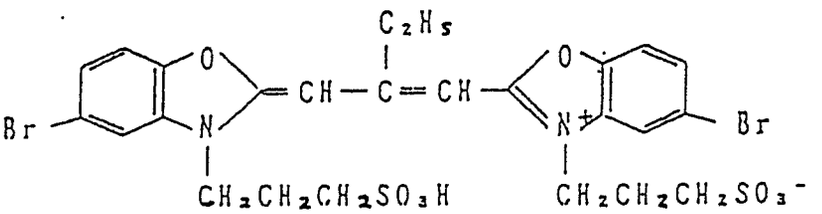

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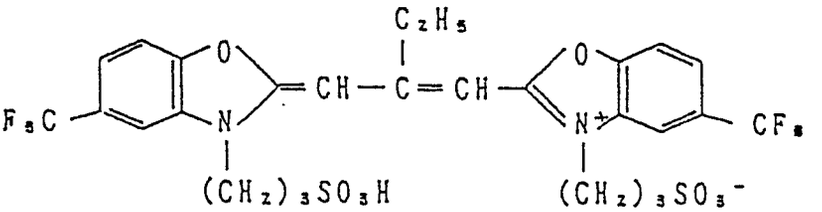

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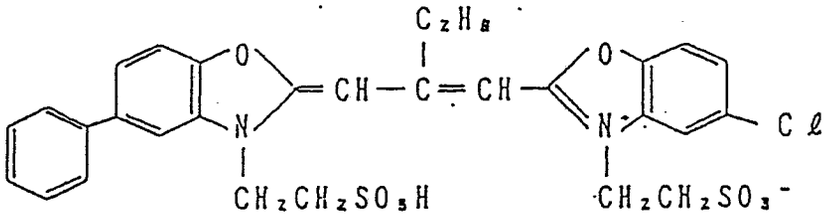

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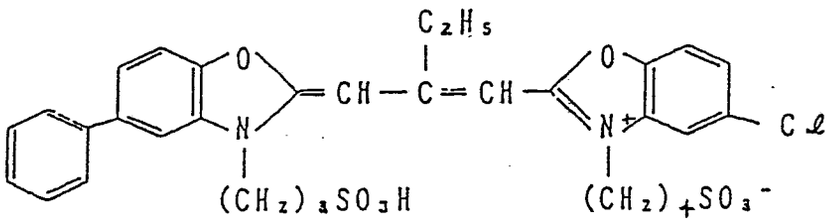

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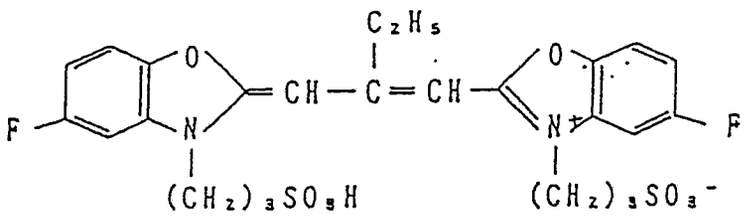

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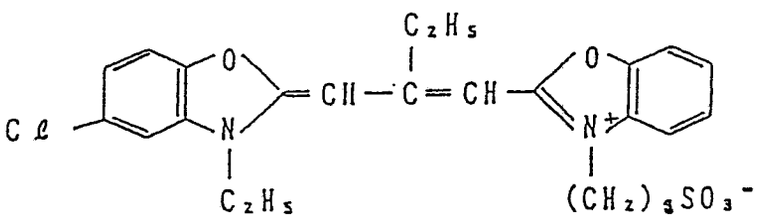

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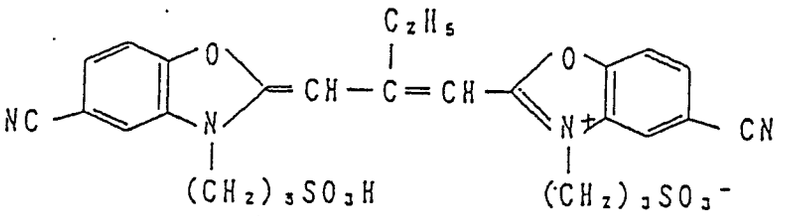

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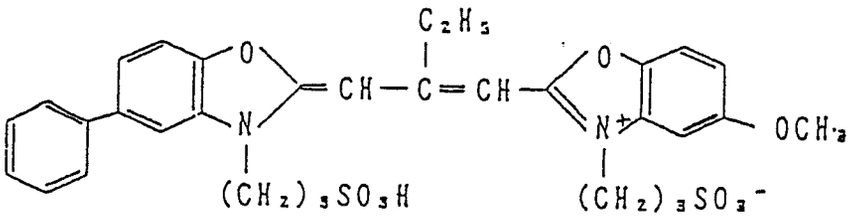

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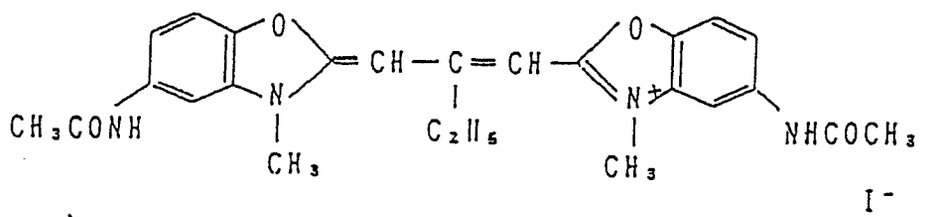

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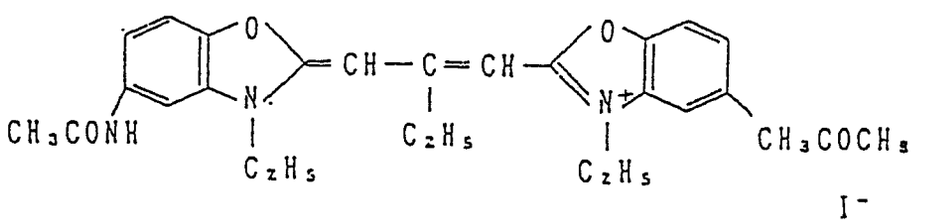

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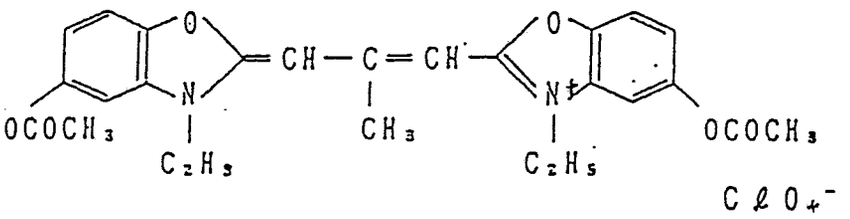

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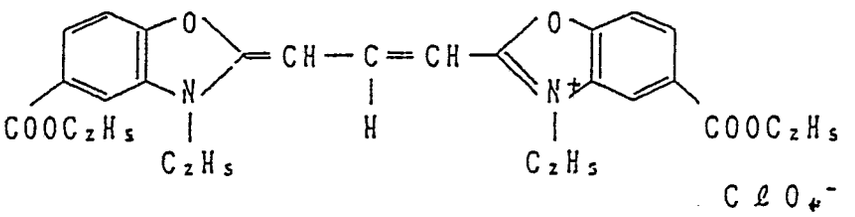

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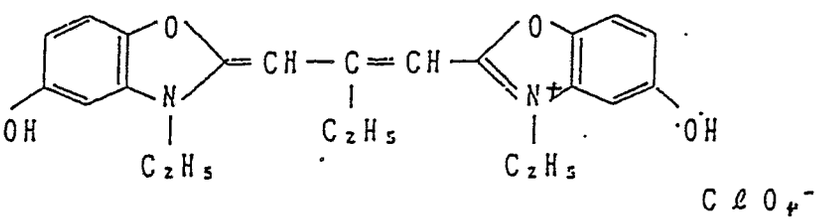

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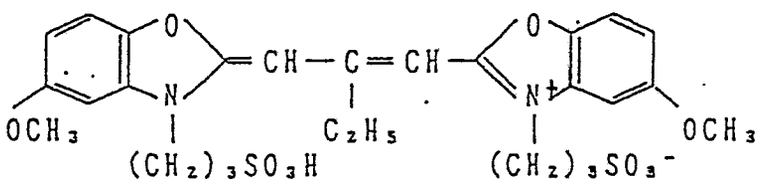

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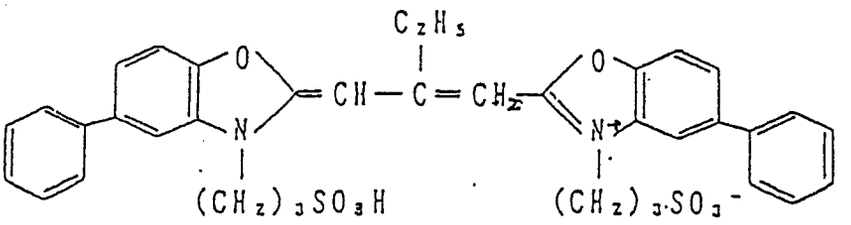

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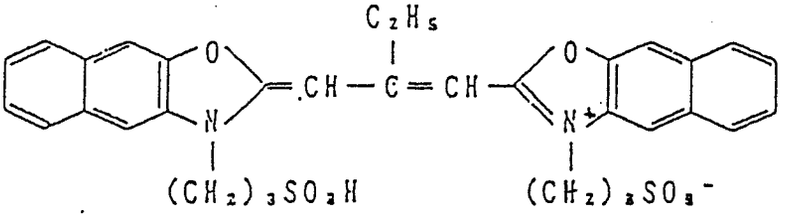

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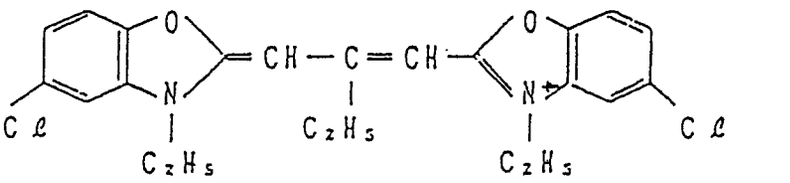

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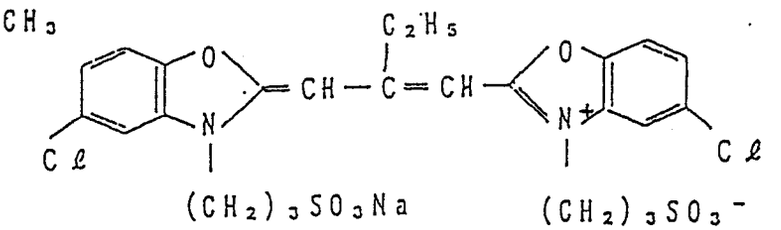

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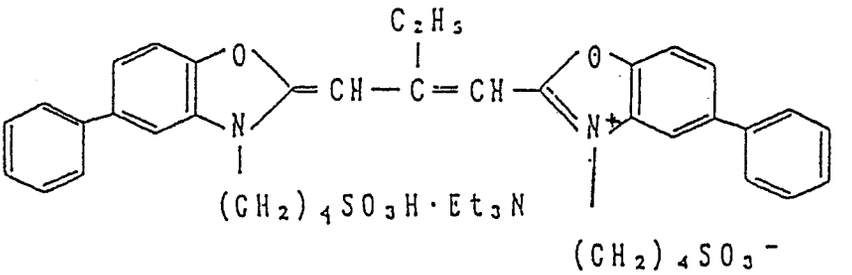
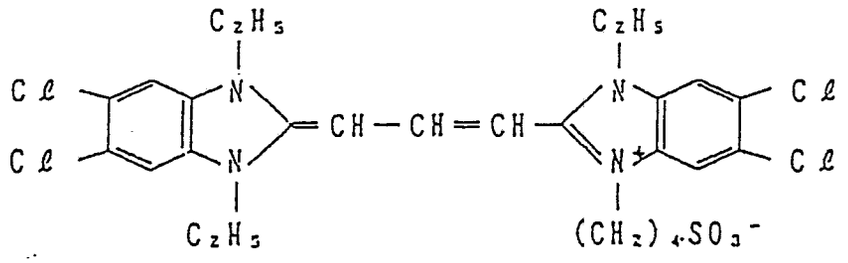


Next, preferable specific examples of the compounds represented by the formula [II] as the sensitizing dyes are set forth, but the present invention is not limited by the exemplary compounds.

Sensitizing dyes represented by the formula [II]:

(2 7)



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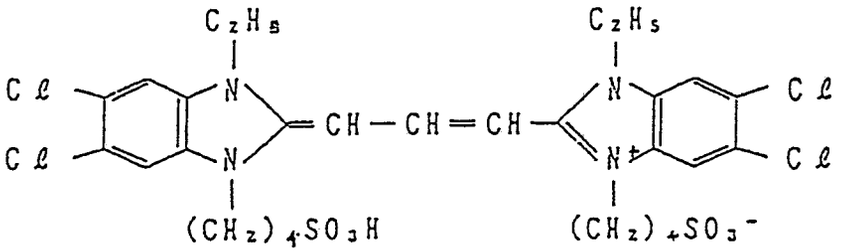

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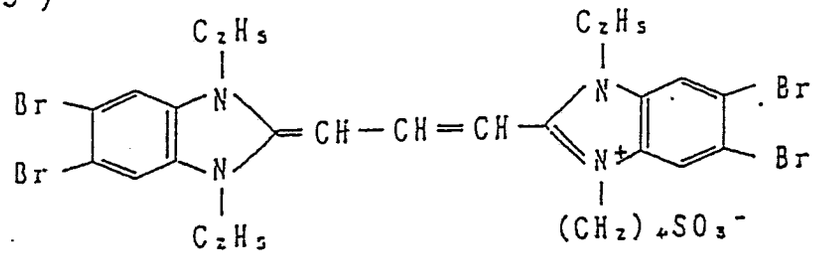

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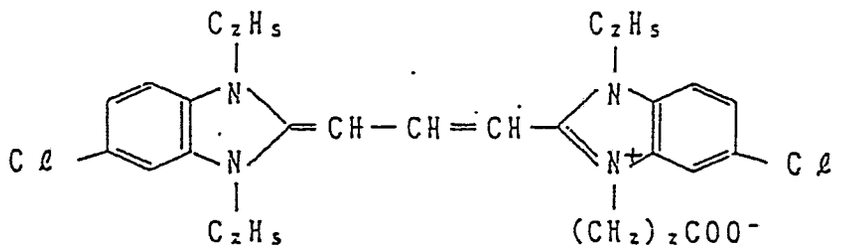

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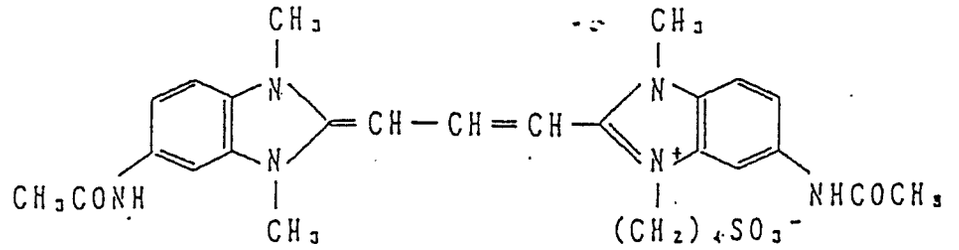

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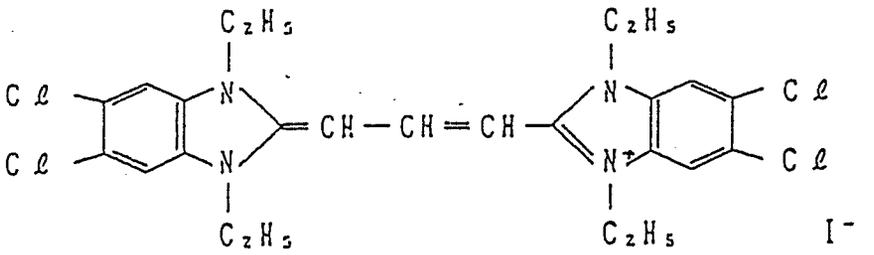

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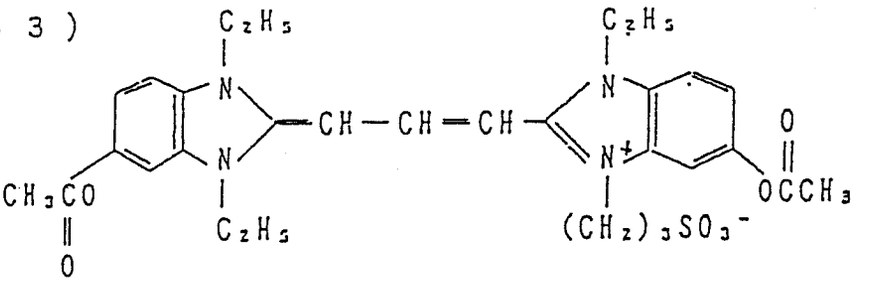

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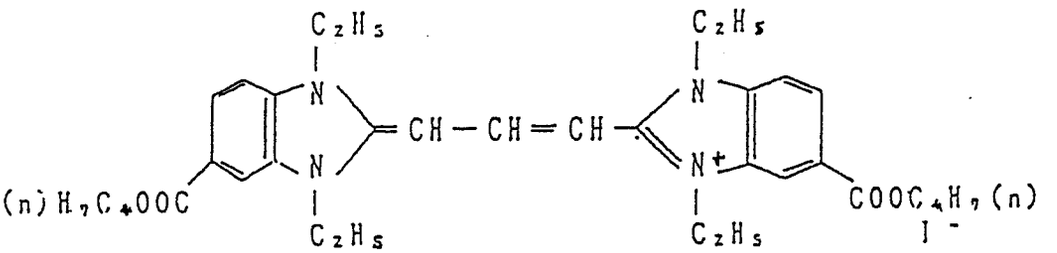

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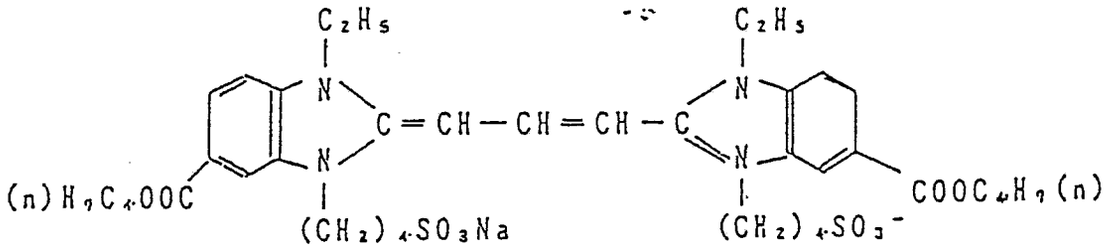

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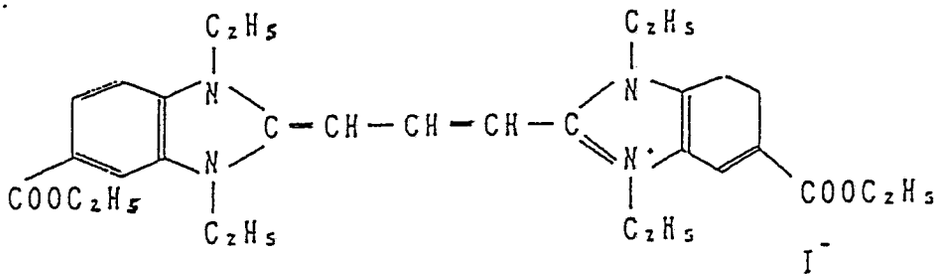

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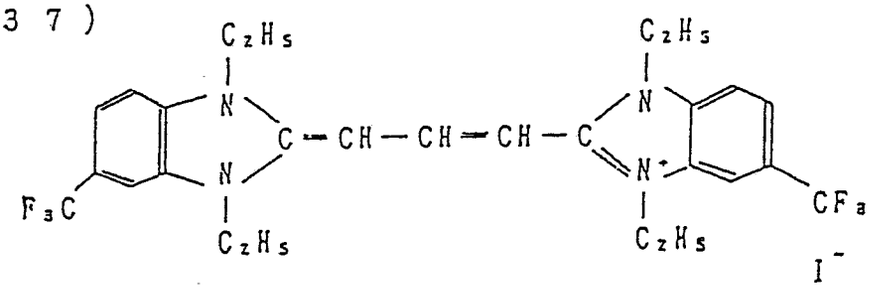

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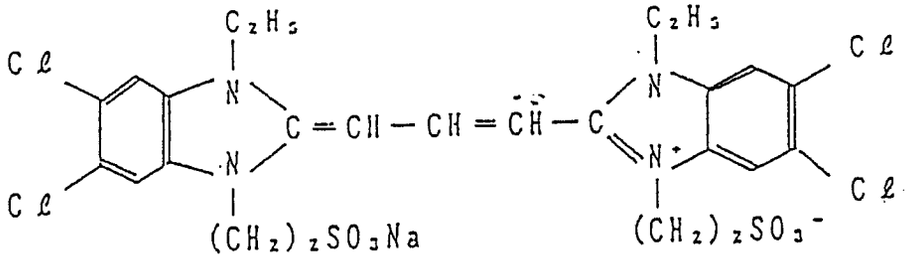
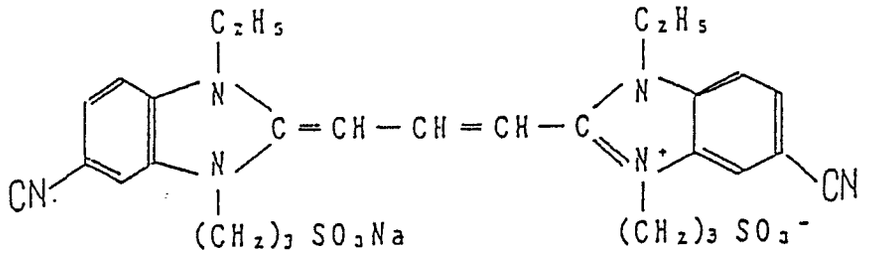


(3 9)



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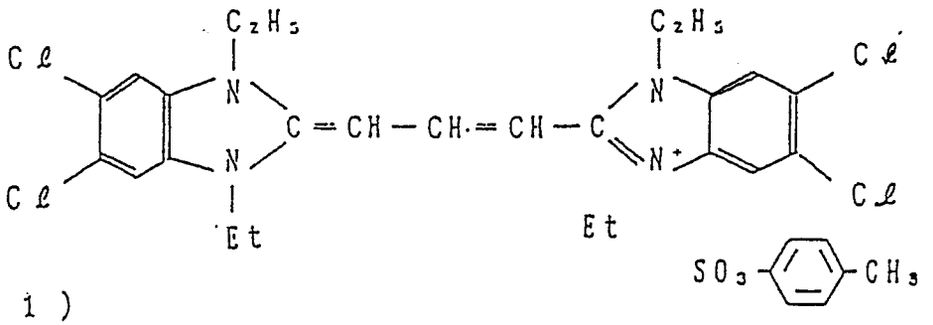
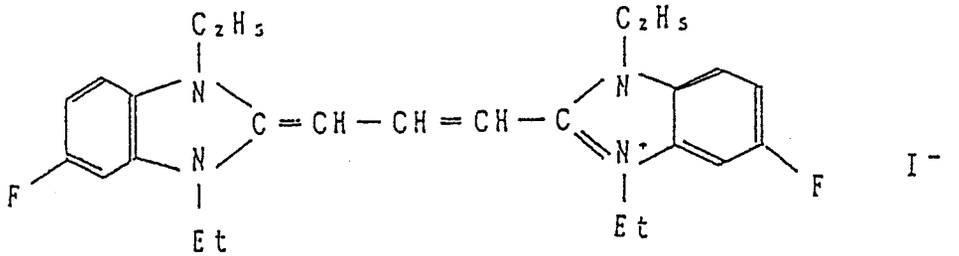
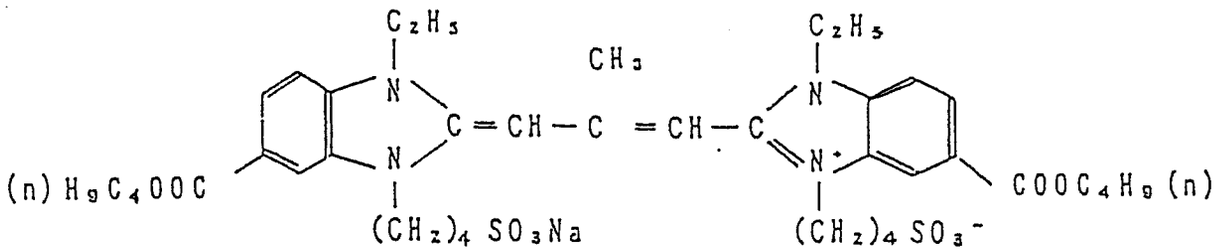


(4 1)

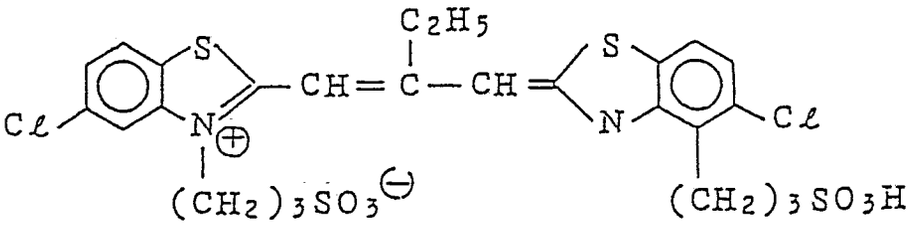


(4 2)

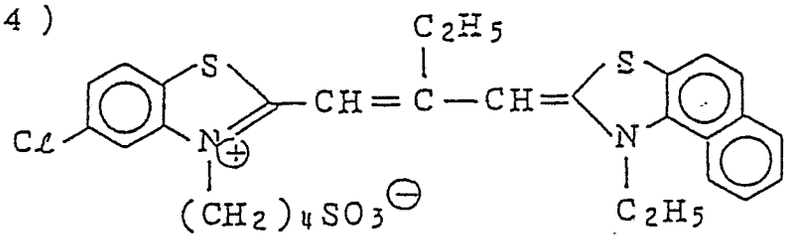


Otherwise, as the sensitizing dyes to be used in the present invention, sensitizing dyes other than the compounds [I] and the compounds [II] can be also used in combination depending on various objects. Representative specific examples of them are shown below.

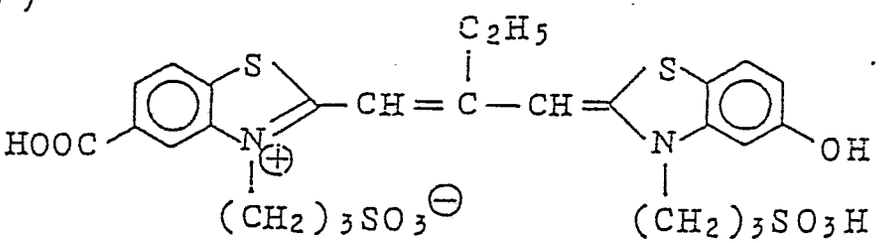
(4 3)



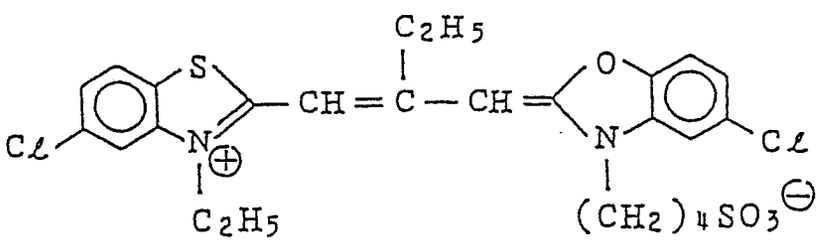
(4 4)



(4 5)



(4 6)



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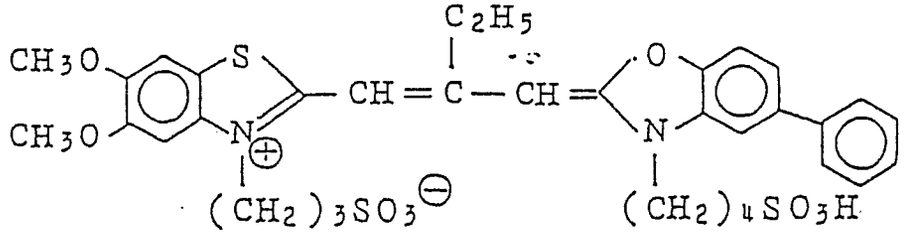

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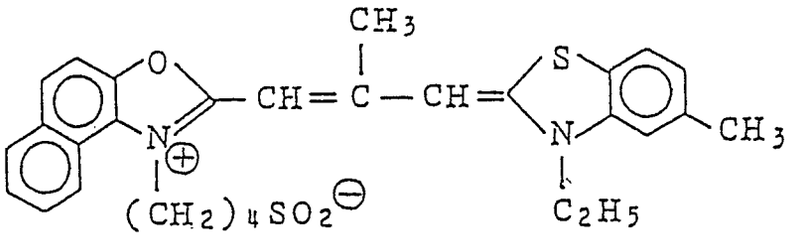

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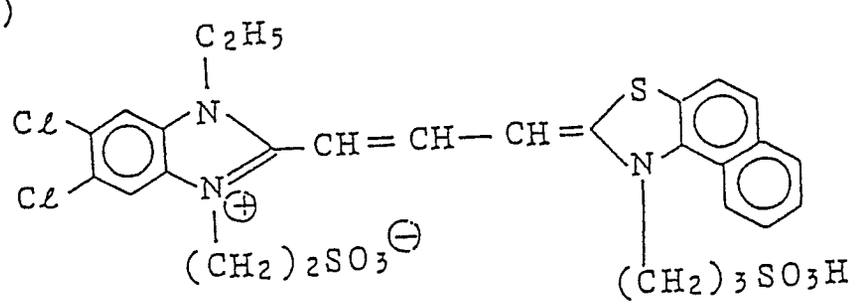
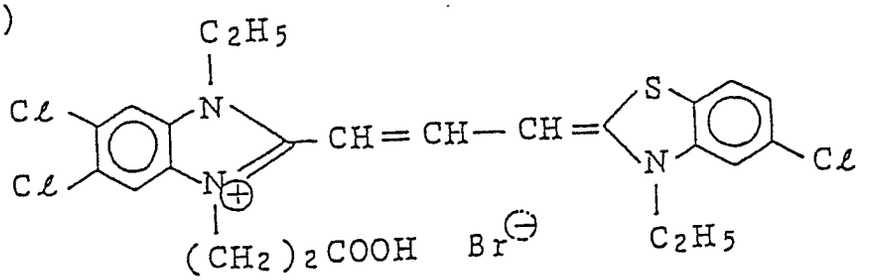
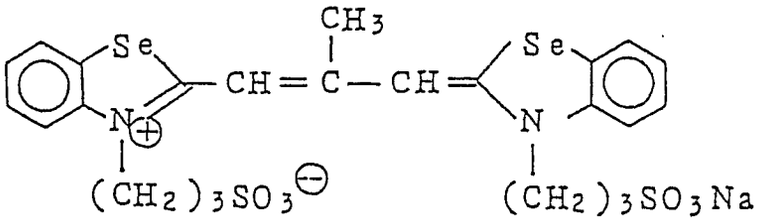


(5 0)



(5 1)



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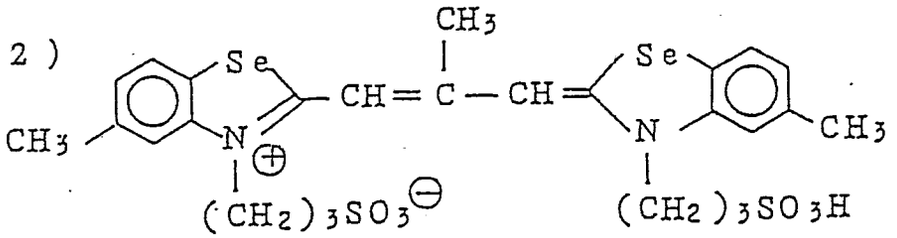

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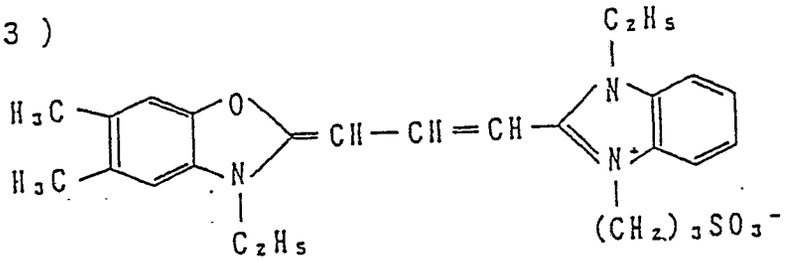
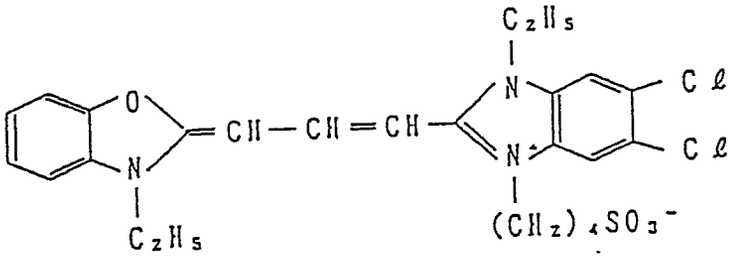


(5 4)



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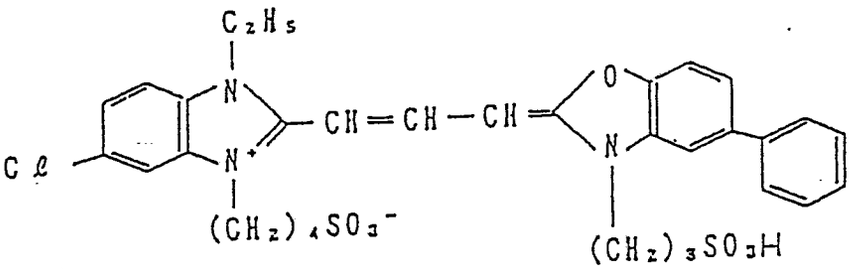

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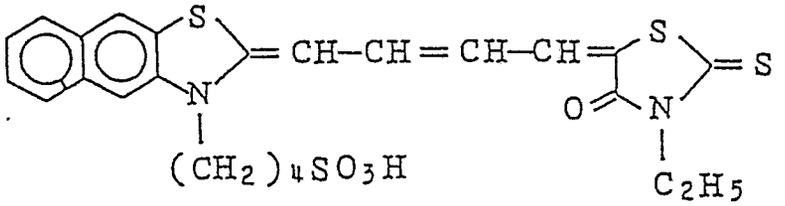

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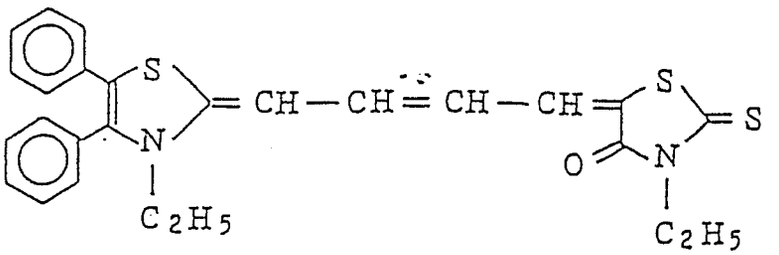

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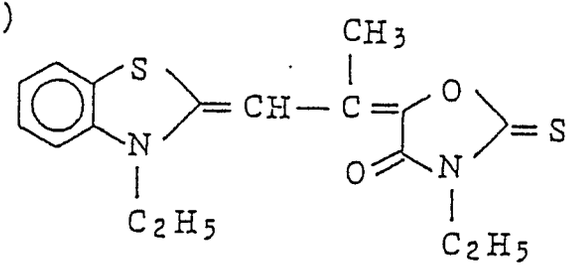

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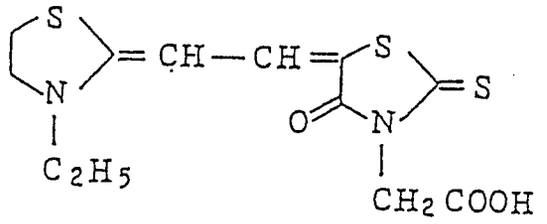
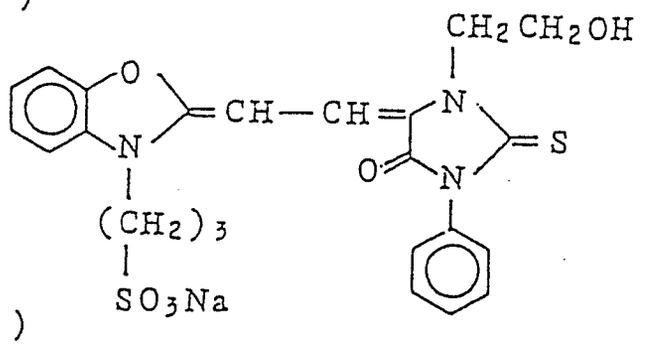
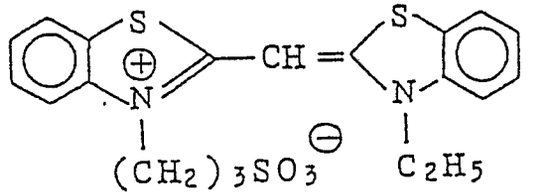


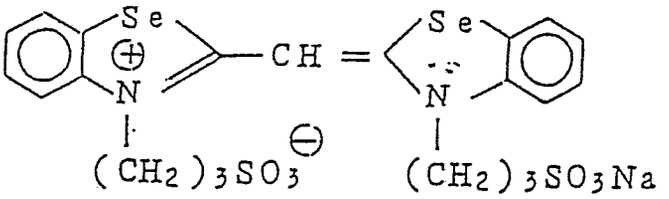
(6 0)



(6 1)



(6 2)



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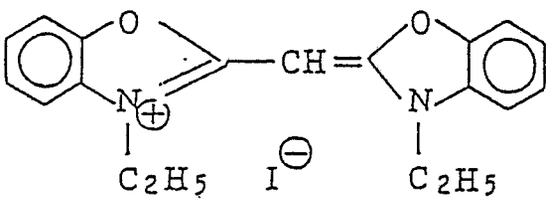

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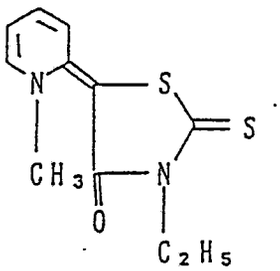

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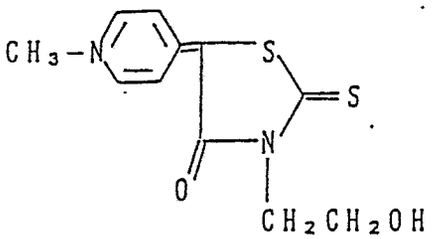
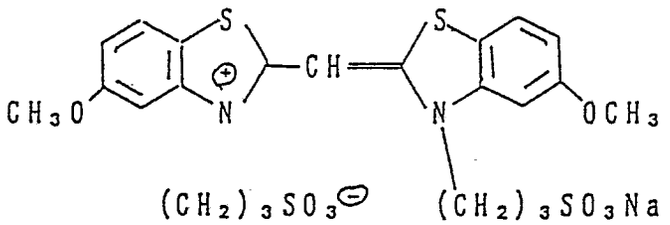


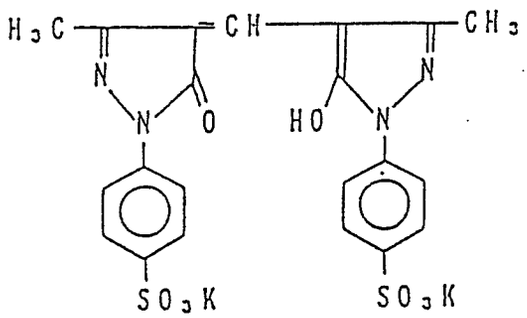
(6 6)



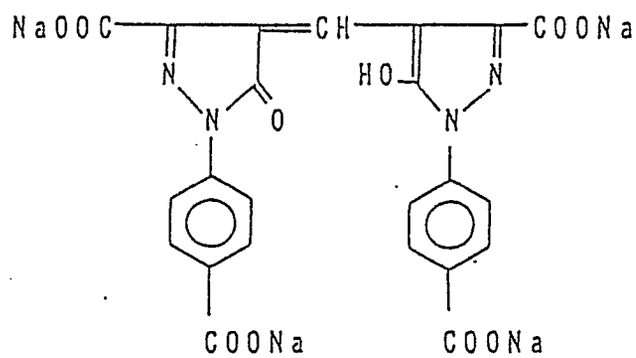
As the dyes other than a sensitizing dye, which is used in combination with the sensitizing dye for the purpose of controlling the relative blue light sensitivity, filter dyes are particularly preferred, and dyes absorbing a large amount of light having wavelengths in the range from 350 nm to 480 nm rather than light having wavelengths in the range from 481 nm to 580 nm are used. That is, the dyes to be used in the present invention may be those capable of absorbing a large amount of light with wavelengths in the range as specified above, but some of particularly preferable dyes are mentioned below.

Filter dyes:

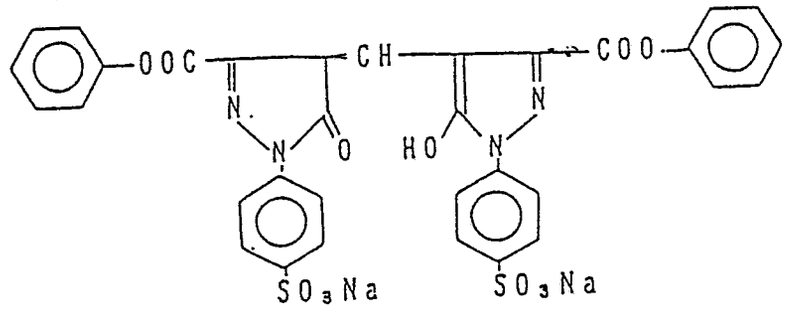
a)



b)

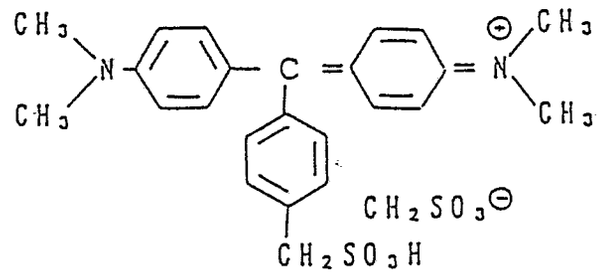


c)



and

d)



These filter dyes may be used either singly or as a combination of two or more dyes.

As the filter dye to be used in the present invention, in addition to those mentioned above, the filter dyes as disclosed on page 283 to page 284 in Japanese Unexamined Patent Publication No. 214845/1984 can be used.

In the present invention, the above filter dye may be added in an amount in the range from 50 to 1000 mg/m^2 to give preferable results.

When two kinds of sensiizing dyes are used for the purpose of controlling the relative blue light sensitivity, at least one compound represented by the formula [I] as shown above and at least one compound represented by the formula [II] above are used in combination.

Some of particularly preferable compounds represented by the formula [I] and the formula [II] are as shown above as Exemplary compounds on pages 8 to 18 of this specification.

The compound represented by the formula [I] may be used in an amount ranging from 100 mg to 1800 mg, more preferably, 200 to 1500 mg and the compound represented by the formula [II] in an amount ranging from 3 mg to 90 mg, more preferably, 5 to 60 mg per 1 mol of silver halide. The one-surface light-sensitive material thus obtained becomes to have sufficiently satiafactory sensitivity and graininess.

If the amount of the compound represented by the above formula [II] is more than 90 mg, safelight characteristic may be worsened or the dye remaining after the development processing may be increased in amount. In the present invention, the relative sensitivity of blue light can be determined as described below. That is, the relative sensitivity of blue light is the ratio of the green light sensitivity and the blue light sensitivity, and with the use of the standard light B described in "New Edition: Databook of illumination" edited by Corporation, Society of Illumination, First Edition, Second Print, page 39 as a light source, non-filter exposure was effected at 3.2 CMS for a exposure time of 0.1 sec. This was made the white light exposure. Under the same conditions, with insertion of "Latten Filter No. 57" in the optical pathway at a distance of 15 cm from the light source, exposure was effected to give the green light exposure. Similarly, exposure with insertion of "Latten Filter No. 47B" (produced by Eastman Kodak Co.) was made the blue light exposure.

The sensitivity ratio was determined after subjecting the sample exposed under the above conditions to the processings of developing, fixing, water washing to drying by use of an automatic developing machine KX-500 produced by Konishiroku Photo Industry Co. with a developing processing liquor XD-90 at 35 °C for 90 seconds.

For the developed sample obtained as described above, reciprocal number of the dose necessary for obtaining the density (1/4 of maximum density + fog) of each sample by use of PDA-65 densitometer produced by Konishiroku Photo Industry Co., and the blue light sensitivity is expressed as the relative value to the green light sensitivity of each sample which is made as 100.

In the one-surface light-sensitive material, the blue light sensitivity relative to the sensitivity of the green light sensitivity of the light-sensitive photographic material which is made as 100 is limited to 45 or less, because graininess cannot be improved if it is higher than 45. Also, if the lower limit of the blue light sensitivity is lower than the above limited value, roughening of image is conspicuous in spite of the large amount of the sensitizing dyes added and graininess cannot be improved.

The light-sensitive photographic material having at least green-sensitive layer may contain any desired combination of blue-sensitive layer, green-sensitive layer and red-sensitive layer.

As the silver halide in the one-surface light-sensitive material to be used in the present invention, silver halides used in conventional light-sensitive photographic materials may be available, including silver chloride, silver bromide, silve iodide, silver chlorobromide, silver iodobromide, silver chloroiodobromide and the like.

The compositions and the shapes of grains of the silver halide to be used in the present invention are not particularly limited. The grain size may be preferably between 0.1 to 1.8 μm.

The crystal structure of silver halide grains may be either uniform to the inner portion, or a layered structure with different inner and outer portions, the so called conversion emulsion, the Lipman emulsion, the covered grain emulsion or one previously endowed optically or chemically with fog. Also, it may be of the type which forms latent images primarily on the surface or of the internal latent image type which forms latent images internally of the grains.

The grain size distribution of silver halide grains may be either mono-dispersed or poly-dispersed, but mono-dispersed distribution is preferable for uniform grain sensitivity. Also, as the grain crystal habit, any of cubic, octahedral, dodecahedral, tetradecahedral, spherical, flat plate, or other shapes may be useful.

The silver halide grains can be prepared according to the methods as disclosed in Japanese Unexamined Patent Publications Nos. 51627/1973, 113926/1983, 113927/1983 and 113928/1983. Preferable spectral sensitization methods are disclosed in Japanese Unexamined Patent Publications Nos. 177535/1984 and 178447/1984.

For preparation of the CRT sensitive material of the present invention, the silver halide may be dispersed in an appropriate protective colloid and provided by coating on a suitable support to constitute a silver halide emulsion layer. As the protective colloid to be used for said light-sensitive layer and other auxiliary layers such as intermediate layer, protective layer, filter layer, etc., there may be employed generally alkali-treated gelatin, or otherwise acid-treated gelatin, derivative gelatin, colloidal albumin, cellulose derivative or synthetic resins such as polyvinyl alcohol, polyvinyl pyrrolidone, etc., and these can be used either individually or in combination. The above silver halide emulsion can be sensitized with a chemical sensitizer. The chemical sensitizer may be classified broadly into the four kinds of noble metal sensitizer (potassium aurithiocyanate, ammonium chloropalladate, potassium chloroplatinate, etc.), sulfur sensitizer (allyl thiocarbamide, thiourea, cystine, etc.), selenium sensitizer (active and inert selenium compounds, etc.) and reducutive sensitizer (stannous salts, polyamines, etc.). The silver halide emulsion can be chemically sensitized by use of a single kind or a suitable combination of plural kinds of these sensitizers.

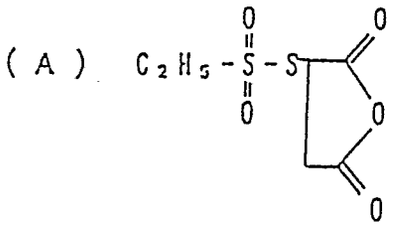
Also, as other chemical sensitizers, polyalkylene oxide type compounds, etc. can be used.

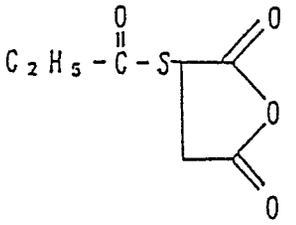
In preparation of the one-surface light-sensitive material of the present invention, the sensitizing dye should be preferably added into the silver halide emulsion, but it may be also added in other photographic constituent layers. Also, in the case of a filter dye, it may be added into the silver halide emulsion layer to exhibit the effect, but it is most preferably added in the fliter layer or a photographic layer near the light source.

In the emulsion layer, the protective layer and the backing layer of the one-surface light-sensitive material of the present invention, additives can be added, and preferable examples of additives are set forth below.

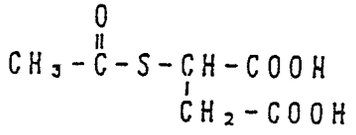
Stabilizers:

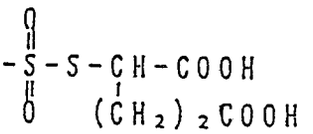
1) Japanese Unexamined Patent Publication No. 200232/1983

(A) 

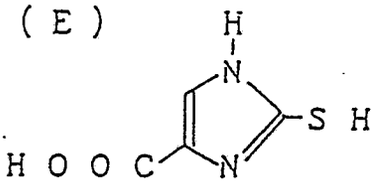
(B) 

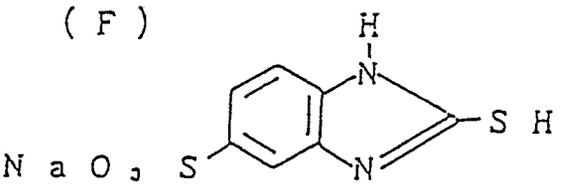
2) Japanese Unexamined Patent Publication No. 224349/1983

(C) 

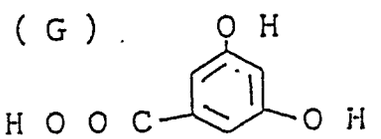
(D) 

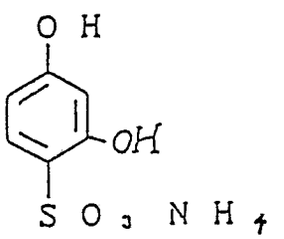
3) Japanese Unexamined Patent Publication No. 217928/1983

(E) 

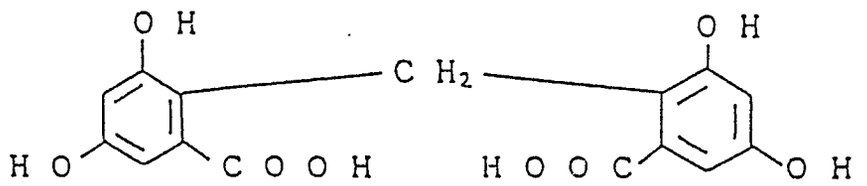
(F) 

4) · Japanese Patent Application No. 144832/1982

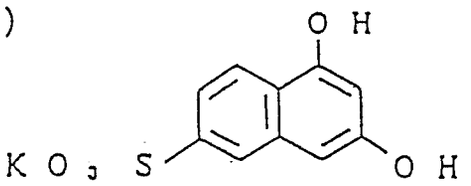
(G) 

(H) 

(I)

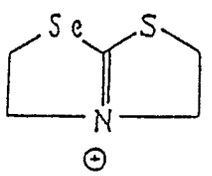


(J)



5) Japanese Unexamined Patent Publication No. 40637/1984

(K)



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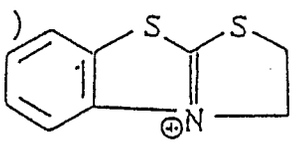
(L)



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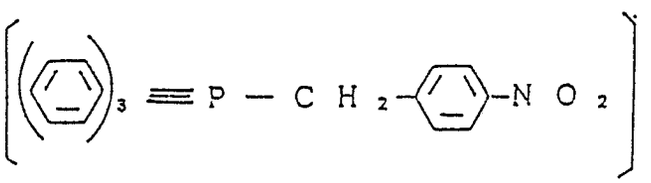
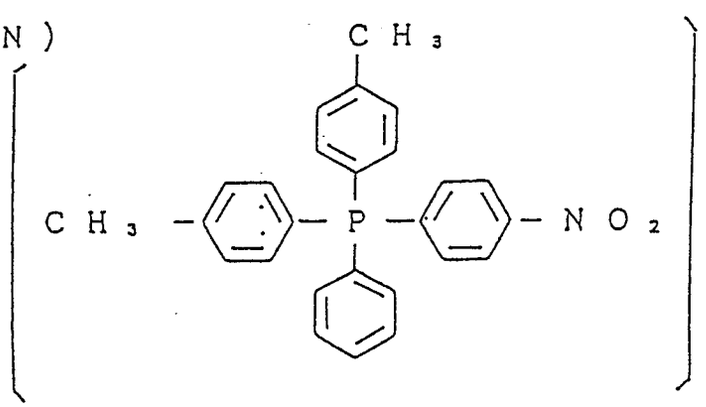
6) Japanese Patent Publication No. 40665/1975

(M)

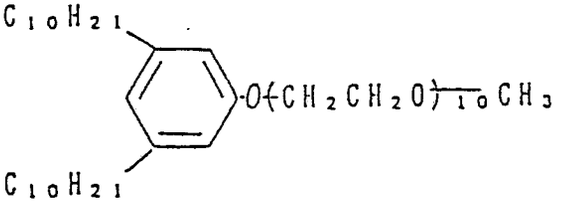


(N)

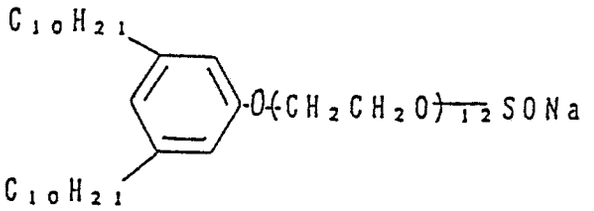


Antistatic agents:

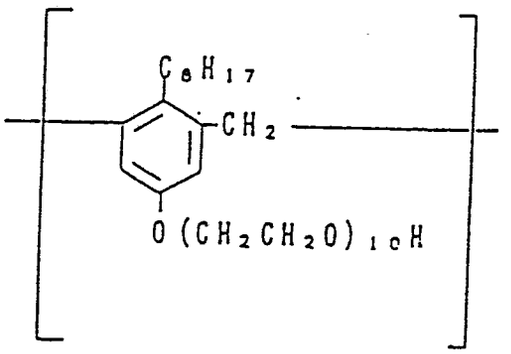
(a)



(b)



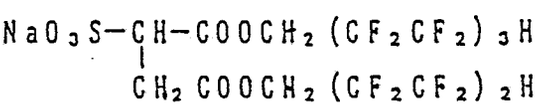
(c)



n = 2 ~ 6

(d) $C_{10}H_{21}CONH(CH_2CH_2O)_5H$

(e)



(f) $C_{10}F_{21}CH_2\overset{OH}{\overset{|}{C}}HCH_2O\text{-}(CH_2CH_2O)_{\overline{9}}CH_3$

(g) $(CH_3)_3\overset{\oplus}{N}\text{-}NHCOC_{15}H_{31}$ $C\ell^{\ominus}$

(h) KNO_3 (i) $LiBF_4$

(j) CF_3COONa (k) $C_4F_9SO_3Na$

(l) Crystalline compounded metal oxide fine particle of ZnO and $A\ell_2O_3$

The compounds as described above can be used as desired as the compounded mixture on the emulsion surface, the back surface, etc. of the CRT sensitive material.

The light-sensitive material to be used in the one-surface light-sensitive material of the present invention can give the best results in aspect of sensitivity in the case of a light-sensitive silver halide photographic material, but it is applicable not only for light-sensitive silver halide photographic materials but also for non-silver salt light-sensitive materials (e.g. electrophotographic light-sensitive materials).

Also, the present invention can produce a one-surface light-sensitive material which has controlled the blue light sensitivity within the range of 45 or less preferably from 20 to 45, more preferably from 25 to 35, relative to the relative green light sensitivity which is made as 100 by controlling the color sensitivity, depending on the material.

As an embodiment of the present invention, for a conventionally used light-sensitive material, a filter having the above filter dye can be provided between CRT and the light-sensitive material used.

The light-sensitive silver halide photographic material for which the present invention is applied may be preferably provided with a backing layer, and preferably coated with a filter dye as disclosed in Japanese Unexamined Patent Publication No. 214845/1984 in an amount of 1.05 to 2.0 g/m^2. At the same time, as in the present invention, by simultaneous coating with the compound added in the protective layer liquid (Example 1), a backing layer excellent in high speed coatability and antistatic property can be provided.

The support for the one-surface light-sensitive material of the present invention is not particularly limited, but conventional supports for light-sensitive photographic materials may be used.

For the support of the one-surface light-sensitive material, plastic films such as cellulose esters, polycarbonates and polyethylene terephthalate, paper or glass, etc. may be used.

When the support is transparent, it is preferable to provide a backing layer or an anti-halation layer with an optical density of green color or blue color of 0.1 to 3.0 by use of a dye conventionally known in the art on the back surface of said support.

Further, the dye to be used in these may be preferably the filter dye as disclosed in Japanese Unexamined Patent Publication No. 224843/1984.

The one-surface light-sensitive material of the present invention is used for photographing CRT display images and, during photographing, the CRT sensitive material of the present invention may preferably be arranged so as to have a light-sensitive layer on the surface confronting CRT.

Accordingly, the one-surface light-sensitive photographic material of the present invention may be a light-sensitive photographic material which is substantially one-surface sensitive, but it may also have a light-sensitive layer on the opposite side to said light-sensitive surface, which can be exposed at 10 or less of the light-sensitive surface by 1/10 sec. exposure by the JIS B light source.

As the phosphor for the CRT, P4 is used, and the components of P4 include the two phosphors of ZnS:Ag and ZnCdS:Ag. Fig. 1 shows the emission spectrum of the image of the CRT by use of said P4.

The one-surface light-sensitive material can be used also for the light-sensitive material for X-ray indirect photographing, or otherwise for the light-sensitive material of the trigger type having internally fogged nuclei, or diffusion transfer, the reversal sensitive material and the color senaitive material.

The one-surface light-sensitive materials of the present invention are also subjected to optimum processing, when automatic development of X-ray film is not adequate. However, green exposure sensitivity and blue exposure sensitivity of the same sensitive material are determined by performing the same processing.

The light-sensitive material for X-ray automatic development of the present invention should preferably harden gelatin by film hardening treatment, for example, with a film hardener, etc. to the extent that the emulsion layer will not be dissolved in an aqueous 2 wt.% NaOH solution at 50 °C for 5 minutes or more, in order to prevent deterioration of graininess by developing.

The one-surface light-sensitive material of the present invention is used for photographing CRT display image and one-surface fluorescent sensitiing dye, and should be preferably arranged so as to have the light-sensitive layer on the plane confronting the CRT image during photographing of CRT image, and on the plane confronting the sensitizing paper during photographing of fluorescent sensitizing dye.

Example 1

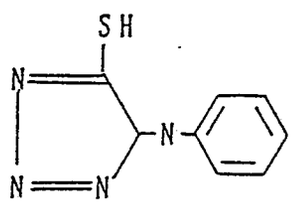
According to the same pattern as the emulsion No. I-5 in Examples of Japanese Unexamined Patent Publication No. 178447/1984, three kinds of silver iodobromide mono-dispersed grains with a mean grain size (area average mean grain size) of 0.42 μm, 0.51 μm and 0.72 μm, respecitvely were prepared and chemical aging was effected thereon with addition of 1.8×10^{-3} mol of a thiocyanate per 1 mol of silver and optimum amounts of chloroauric acid and hypo, followed subsequently by addition of 8×10^{-4} mol of potassium iodide per 1 mol of silver, and thereafter sensitizing dye, sodium salt of anhydro-5,5'-dichloro-9-ethyl-3,3'-di(3-sulfopropyl)oxacarbocyanine oxide (Exemplary compound No. (6) - 1) was added in the amount as shown in Table 1. By use of the grains thus obtained, an emulsion coating solution containing the additives shown below was prepared. The emulsion coating solution and the protective solution were applied simultaneously at a speed of 140 m/min so as to give for the coating solution a silver quantity of 3.3 g/m^2 and for the protective solution a gelatin quantity of 0.98 g./m^2, and dried.

(Emulsion liquid composition)

Per one liter of coating solution:

(a) Lime-treated ossein gelatin 51 g
(b) 5-Methyl-1,3,4,7a-tetrazaindene7-ol 0.8 g
(c) silver halide grains 0.6 mol
(d) 2,2-Dihydroxymethyl-1-butanol 0.8 g

(e)



0.015 g

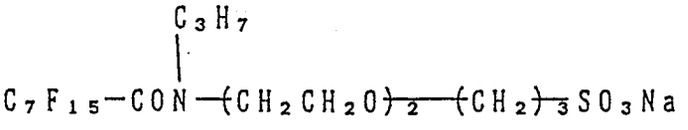
(f) Nitrone 0.05 g
(g) Fine particles of styrene-butadiene copolymer (mean particle size : 0.03 μm) 2.5 g
(h) Copolymer of styrene and maleic acid 1.5 g

(Protective layer liquid composition)

Per one liter of coating solution:

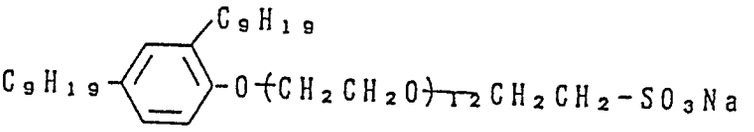
(a) Lime-treated inert gelatin 68 g
(b) Acid-treated gelatin 2 g

(c)



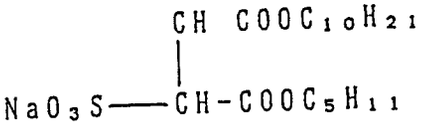
1 g

(d)



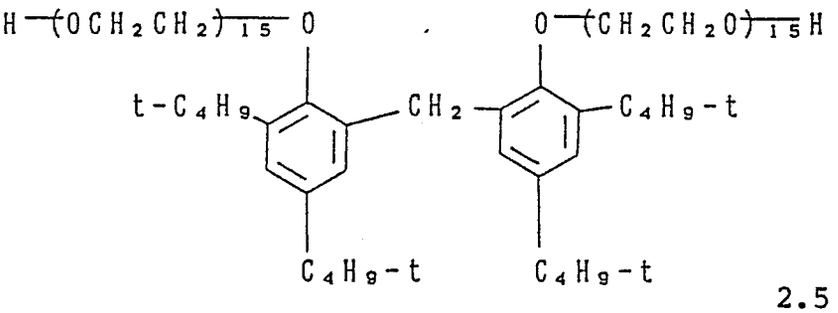
1.5 g

(e)



1 g

(f)



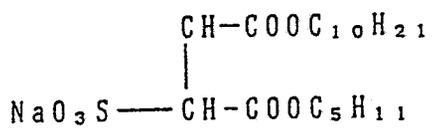
2.5 g

(g) Matte agent of colloidal silica (mean particle size : 1.9 μm) 1.1 g
(h) Ludox AM (colloidal silica, (produced by Du Pont Co.) 30 g
(i) Aqueous solution (2%) of sodium 2,4-dichloro-6-hydroxy-1,3,5-triazine 15 ml
(j) Aqueous formalin solution (35%) 1.8 ml

(Backing layer liquid composition)

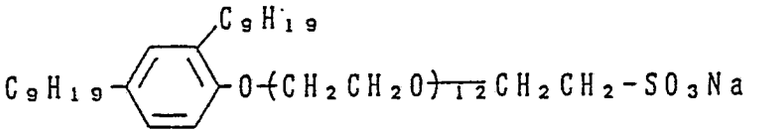
(a) Lime-treated gelatin 50 g
(b) filter dye - 1 0.5 g
(c) filter dye - 2 0.5 g
(d) filter dye - 3 0.5 g
(e) glyoxal (40 %) 3 ml
(f) aqueous solution (2%) of sodium 2,4-dichloro-6-hydroxy-1,3,5-triazine 20 ml

(g)



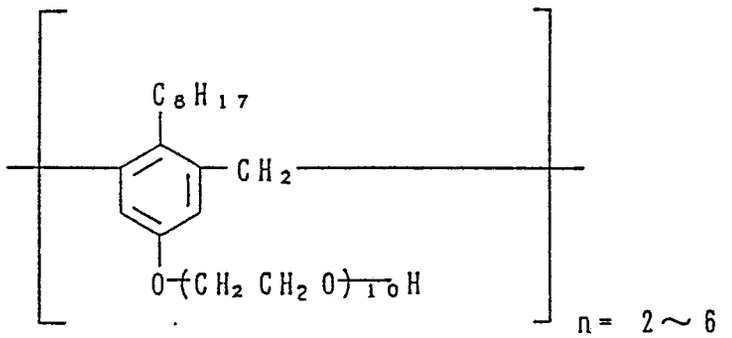
1 g

(i)



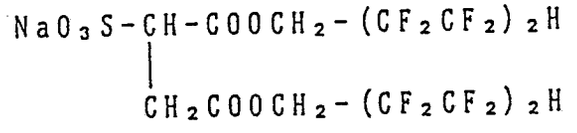
1.5g

(j)



2.8g

(k)



0.5 g

(ℓ) Matte agent of polymethyl methacrylate (mean particle size of 4.5 μm).

The backing layer liquid compositin thus obtained was applied on the side opposite to emulsion so as to give a gelatin quantity of 5 g/m^2.

On the samples Nos.1 to 20 prepared as described above, with the use of the standard light B described in "New Edition: Databook of illumination" edited by Corporation, Society of Illumination, First Edition, Second Print, page 39 as a light source, non-filter exposure was effected at 3.2 CMS for a exposure time of 0.1 sec. This sample thus exposed was used as the white light exposured sample. Under the same conditions except for insertion of "Latten Filter No. 57" in the optical pathway at a distance of 15 cm from the light source, exposure was effected to give the green light exposured sample. Similarly exposure with insertion of "Latten Filter No. 47B" (produced by Eastman Kodak Co.) was effected to give the blue light exposured sample.

These exposed samples were subjected to processing of developing, fixing, water washing and drying within a period of 90 seconds by use of an automatic developing machine KX-500 (produced by Konishiroku Photo Industry Co.) with a developer XD-90 (produced by the same Company) at 35 °C, to give developed samples.

For the developed samples thus obtained, the reciprocal numbers of doses necessary for obtaining the densities (1/4 of the maximum density + fog) of the respective samples were determined as the sensitivities by use of PDA-65 densitometer produced by Konishiroku Photo Industry Co. The sensitivity ratio of the blue light sensitivity relative to the green light sensitivity is a relative value of the blue light sensitivity, when the green light sensitivity is made as 100.

On the other hand, after photographing the CRT[P4] image by Sakura Imaging Camera M.M. (produced by Konishiroku Medical), processing was conducted by an automatic developing machine KX-500 (produced by Konishiroku Photo Industry Co.) with a developer XD-90 (produced by the same Company) at 35 °C and with a fixing solution XF (produced by the same Company) at 32 °C, followed by water washing and drying, to give a developed sample.

For the samples subjected to development processing, roughness of image quality was evaluated by observation with eyes.

The evaluation standards were the five ranks as follows:

1: Very good, 2: Good, 3: Common, 4: Bad, 5: Very bad

The results are shown in Table 1.

Concentration at which the sensitivity of the samples to be compared was found as follows:

No.	
1 - 5	about 1.5
6 - 10	about 1.2
11 - 15	about 0.8
16 - 20	about 1.3

Table 1

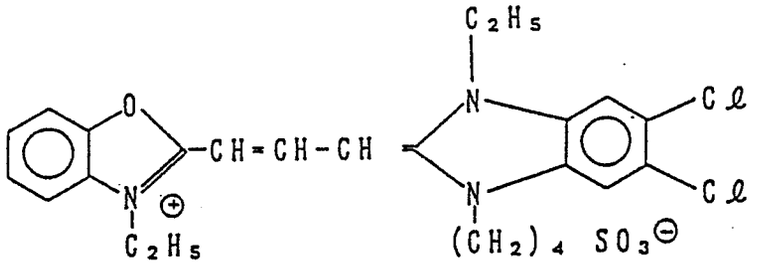
Sample No.	Grain size	Weight percentage of grain used	Amount of sensitizing dye added mg/Ag x 1 mol	Relative blue light sensitivity	Graininess	Remarks
1	0.42μ	100%	50	53	5	comparative
2	"	"	100	44	2	the invention
3	"	"	300	33	1	the invention
4	"	"	800	28	1	the invention
5	"	"	1600	22	2	the invention
6	0.51μ	100%	50	55	5	comparative
7	"	"	100	48	4	comparative
8	"	"	300	35	1	the invention
9	"	"	800	31	1	the invention
10	"	"	1600	30	1	the invention
11	0.72μ	100%	50	58	5	comparative
12	"	"	00	52	4	comparative
13	"	"	300	38	2	the invention
14	"	"	800	34	1	the invention
15	"	"	1600	34	1	the invention
16	0.42μ 0.51μ 0.72μ 45% + 40% + 15%		50	54	4	comparative
17	"		100	45	2	the invention
18	"		300	34	1	the invention
19	"		800	30	1	the invention
20	"		1600	29	1	the invention

As is apparent from Table 1, the samples of the present invention can be found to have good graininess. Particularly, samples Nos. 3, 4, 8, 9, 10, 14, 15, 18, 19 and 20 having a relative blue light sensitivity ranging between 25 and 35 can be found to have particularly excellent graininess.

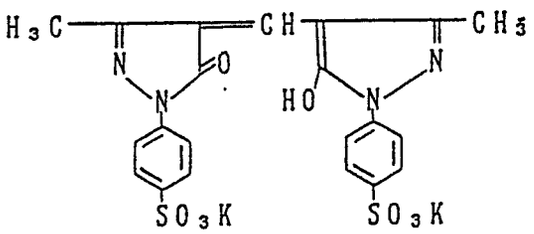
Example 2

Silver halide grains with a mean grain size of 0.51 μm prepared in Example 1 were subjected to the same chemical aging as in Example 1, and sensitivity dye A was added thereto in an amount of 100 mg per 1 mol of silver, followed by coating by use of the same emulsion additives and the same protective layer liquid (however, the nonion surface active agent C shown below was further added) as in Example 1, and drying. Into the emulsion coating liquid, the filter dye B was added in the amount as shown in Table 2. Evaluation was effected in the same manner as in Example 1.

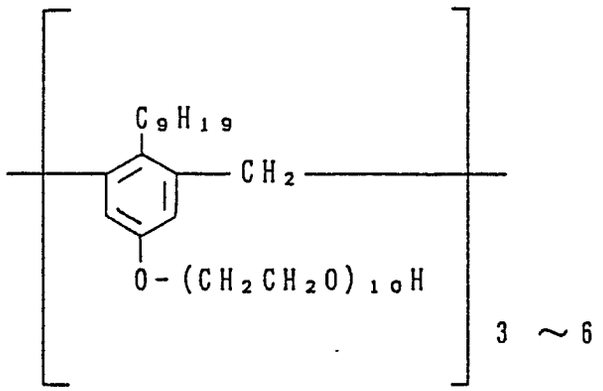
Sensitizing dye A



Filter dye B



Nonion surface active agent C



The results are shown in Table 2.

Table 2

Sample No.	Amount of dye B added (mg/m^2)	Relative blue light sensitivity	Graini-ness	Remarks
21	0	49	5	comparative
22	20	46	4	comparative
23	50	43	2	the invention
24	100	40	2	the invention
25	200	35	1	the invention
26	300	31	1	the invention
27	500	26	1	the invention
28	700	23	2	the invention

As is apparent from Table 2, the samples of the present invention have excellent graininess. Namely, comparative samples Nos. 21 and 22 have bad or extremely bad graininess of 4 to 5, while the present samples Nos. 23 to 28 show evaluation values of 1 to 2, and thus good in graininess.

Example 3

According to the method shown in Example 2 of Japanese Unexaminet Patent Publication No. 113927/1983, silver iodobromide grains shaped in flat plates with a mean grain size of 171 μm and an aspect ratio of 30:1 were prepared.

70% or more of the total projected area of silver iodobromide grains are comprised of these grains.

The grains thus obtained were optimally chemically sensitized at 58 °C in the same manner as in Example 1, and to the grains as such at 58 °C was added 2.1×10^{-3} mol of potassium iodide per 1 mol of silver. Subsequently, the sensitizing dye used in Example 1 was added in the amount shown in Table 3, permitted to be adsorbed for 15 minutes, and then similarly the emulsion additives were added to form an emulsion coating liquid, which was coated simultaneously with the protective layer liquid and dried. In this case, the emulsion additives, the protective layer liquid and the coating conditions were the same as in Example 1. The samples obtained were evaluated by use of the same evaluation standards as described in Example 1.

The results are shown in Table 3.

Table 3

Sample No.	Amount of spectral sensitizing dye added (mg/Ag x 1 mol)	Relative blue light sensitivity	Graininess	Remarks
29	3	63	5	comparative
30	10	52	5	comparative
31	30	46	4	comparative
32	100	43	2	the invention
33	300	31	1	the invention
34	600	26	1	the invention
35	1200	21	2	the invention
36	1500	19	4	comparative

As is apparent from Table 4, it can be appreciated that the present samples have good graininess. Particularly, samples having relative blue light sensitivity to the green light sensitivity of 25 to 35 show the most excellent results.

Example 4

The samples No. 1 - 20 which had been prepared in Example 1 were exposed to X-ray through a penetrometer B Model [Aluminum Step, sold by Konishiroku Medical K.K.] according to the single back method by use of a fluorescent sensitizing paper Titan-2U produced by Simens Co. only on one side under the conditions of a tube voltage of 60 KOP, 150 mA and 0.1 sec, and then subjected to the same development processing as in Example 1.

For the developed samples obtained, by use of PDA-densitometer produced by Konishiroku Photo Industry Co., reciprocal number of the dose necessary for the sample No. 1 to obtain a density of fog + density 1.0 and, with its value being 100, also for samples No. 2 - 20, reciprocal numbers of the doses necessary for obtaining fog + density 1.0 were determined, expressed in terms of relative sensitivities, and shown in Table 4.

Evaluation of graininess around the density 1.0 by observation with eyes and reciprocal number of the dose necessary for the sample No. 1 to obtain a density of fog + density 1.0 were determined, expressed in terms of relative sensitivity, and shown in Table 4.

Also, graininess of the developed samples around the density 1.0 was evaluated by observation with eyes and shown in Table 4. The evaluation standards are the same as in Example 1.

Table 4

Sample No.	Relative X-ray exposure sensitivity	Graininess	Remarks
1	100	2	comparative
2	110	1	the invention
3	125	1	the invention
4	130	2	the invention
5	110	1	the invention
6	140	4	comparative
7	150	4	comparative
8	165	3	the invention
9	160	2	the invention
10	140	2	the invention
11	260	5	comparative
12	275	5	comparative
13	280	4	the invention

Table 4 (Cont'd)

Sample No.	Relative X-ray exposure sensitivity	Graininess	Remarks
14	275	4	the invention
15	255	3	the invention
16	140	4	comparative
17	150	3	the invention
18	170	3	the invention
19	165	2	the invention
20	165	2	the invention

From Table 4, it can be appreciated that the samples of the present invention have high sensitivity also in X-ray photographing, and are excellent in graininess.

Samples No. 1, 6, 11 and 16 in Table 4, although they are the same in the amount of the dye added and comparatively approximate in the relative blue light sensitivity, are remarkably different in graininess, which may attribute to the fact that the smaller the grains are, the lower the x-ray ralative sensitivity becomes, to result in increase of amount of x-ray required for obtained the same concentration (decrease in quantum mottle having a large influence on the graininess in x-ray photographing).

Example 5

According to the same pattern as in Example 1, silver iodobromide mono-dispersed grains with a mean grain size (area average mean grain size) of 0.48 μm were prepared and chemical aging was effected thereon with addition of 1.8×10^{-3} mol of a thiocyanate per 1 mol of silver and optimum amounts of chloroauric acid and hypo, followed subsequently by addition of 8×10^{-4} mol of potassium iodide per 1 mol of silver, and thereafter the sensitizing dye as shown in Table 5 was added to be adsorbed at 55 °C for one minute. By use of the grains thus obtained, an emulsion coating solution containing the additives shown below was prepared. The emulsion coating solution and the protective solution were applied simultaneously at a speed of 140 m/min so as to give for the coating solution a silver quantity of 3.3 g/m² d for the protective solution a gelatin quantity of 0.98 g/m², and dried.

(Emulsion liquid composition)

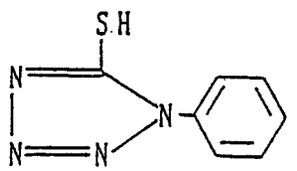
per one liter of coating solution:

(a) Lime-treated ossein gelatin 51 g

(b) 5-Methyl-1,3,4,7a-tetrazaindene-7-ol 0.8 g

(c) silver halide grains 0.6 mol

(d)



0.015 g

(e) Nitrone 0.05 g

(f) Fine particles of styrene-butadiene copolymer (mean particle size 0.03 μm) 2.5 g

(g) Copolymer of styrene and maleic acid 1.5 g

(h) 2,2-Dihydroxymethyl-l-butanol 8 g

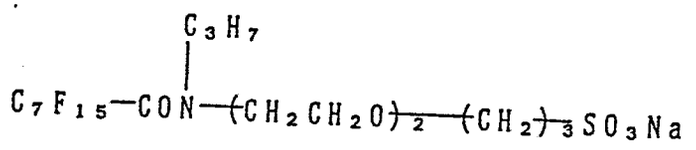
(Protective layer liquid composition)

Per one liter of coating solution:

(a) Lime treated inert gelatin 68 g

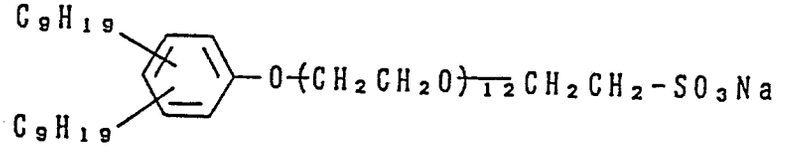
(b) Acid-treated gelatin 2 g

(c)



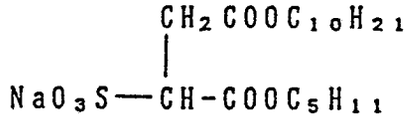
1 g

(d)



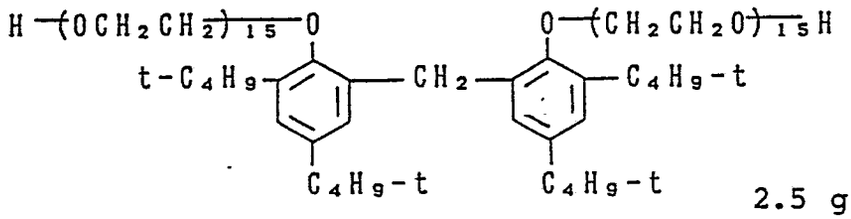
1.5 g

(e)



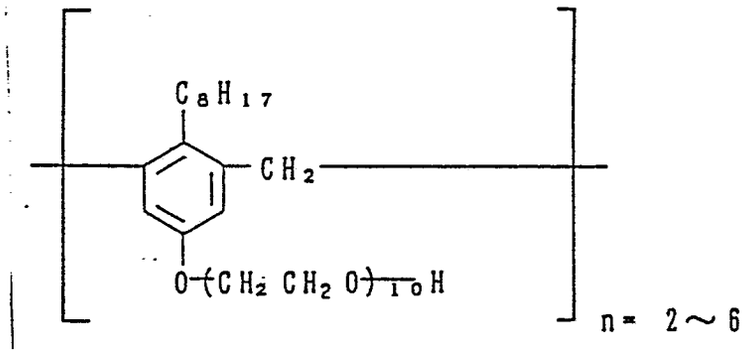
1 g

(f)



2.5 g

(g)



3 g

(h) Matte agent of polymethyl methacrylate (mean particle size 3 μm) 1.1 g

(i) Ludox AM (colloidal silica, (produced by Du Pont Co.) 30 g

(j) Aqueous solution (2%) of sodium 2,4-dichloro-6-hydroxy-1,3,5-triazine 5 ml

(k) Aqueous formalin solution (35%) 0.8 ml

(ℓ) Aqueous glyoxal solution (40%) 0.9 ml

On the sample prepared as described above, with the use of the standard light B described in "New Edition: Databook of illumination" edited by Corporation, Society of Illumination, First Edition, Second Print, page 39 as a light source, non-filter exposure was effected at 3.2 CMS for a exposure time of 0.1 sec. This sample thus exposed was used as the white light exposured sample. Under the same conditions except for insertion of "Latten Filter No. 57" in the optical pathway at a distance of 15 cm from the light source, exposure was effected to give the green light exposured sample. Similarly exposure with insertion of "Latten Filter No. 47B" (produced by Eastman Kodak Co.) was effected to give the blue light exposured sample.

These exposed samples were subjected to processing of developing, fixing, water washing and drying within a period of 90 seconds by use of an automatic developing machine KX-500 (produced by Konishiroku Photo Industry Co.) with a developer XD-90 (produced by the same Company) at 35 °C, to give developed samples.

For the developed samples thus obtained, the reciprocal numbers of doses necessary for obtaining the densities (1/4 of the maximum density + fog) of the respective samples were determined as the sensitivities by use of PDA-65 densitometer produced by Konishiroku Photo Industry Co. The sensitivity ratio of the blue light sensitivity relative to the green light sensitivity is a relative value of the blue light sensitivity, when the green light sensitivity is made as 100.

On the other hand, after photographing the CRT[P4] image by Sakura Imaging Camera M.M. (produced by Konishiroku Medical), processing was conducted by an automatic developing machine KX-500 (produced by Konishiroku Photo Industry Co.) with a developer XD-90 (produced by the same Company) at 35 °C and with a fixing solution XF (produced by the same Company) at 35 °C, followed by water washing and drying, to give a developed sample.

For the samples subjected to development processing, roughness of image quality was evaluated by observation with eyes.

The evaluation standards were the same as in Example 1.

The results are shown in Table 5. (The white light exposure relative sensitivity is represented as a relative value to the sensitivity of the sample No. 1 which is made as 100.)

Table 5

Sample No.	Dye used and amount added (mg/Ag x 1 mol)	Relative white light sensitivity	Relative blue light sensitivity	Graininess	Remarks
37	Exemplary compound (54) 50	100	56	5	comparative
38	(54) 100	112	49	4	comparative
39	(54) 200	98	48	4	comparative
40	(53) 100	95	50	5	comparative
41	(2) 100	82	54	5	comparative
42	(2) 300	87	35	1	the invention
43	(2) 600	89	32	1	the invention
44	(11) 600	81	38	2	the invention
45	(35) 2	67	67	5	comparative
46	(35) 30	92	63	5	comparative
47	(35) 100	94	56	5	comparative
48	(28) 30	91	66	5	comparative
49	(54) 100 + (35) 30	110	48	4	comparative
50	(2) 100 + (35) 30	101	37	2	the invention
51	(2) 300 + (35) 30	123	31	1	the invention
52	(2) 600 + (35) 30	131	30	1	the invention
53	(2) 1200 + (35) 30	130	29	1	the invention
54	(2) 2000 + (35) 30	118	28	1	the invention
55	(2) 600 + (28) 30	127	31	1	the invention
56	(11) 600 + (35) 30	121	34	1	the invention
57	(11) 600 + (28) 30	119	35	1	the invention

As is apparent from Table 5, the samples No. 50 - 57 of the present invention use combinations of two kinds of sensitizing dyes, whereby it can be understood that higher sensitivity and better graininess can be obtained as compared with those using respective dyes alone.

Example 6

According to the method as shown in Emulsion 3 (Example) in Japanese Unexamined Patent Publication No. 113927/1983, silver iodobromide grains shaped in flat plates with a mean grain diameter of 1.71 μ and an aspect raio of about 16:1 were prepared. 80% or more of the whole projected area of the silver iodobromide grains are comprised of these grains. The silver halide grains thus obtained were chemically sensitized in the same manner as in Example 5, subsequently added with 2.1×10^{-3} mol of potassium iodide per 1 mol of silver, subsequently added with the sensitizing dye shown in Table 6 for adsorption for 15 minutes, followed by coating and drying by use of the same emulsion additives and the same protective layer as in Example 5. The samples obtained were evaluated according to the same method as in Example 5.

The results are shown in Table 6. (The white light exposure relative sensitivity is represented as a relative value to the sensitivity of the sample No. 58 which is made as 100.)

Table 6

Sample No.	Dye used and amount added (mg/Ag x 1 mol)	Relative white light sensitivity	Relative blue light sensitivity	Graininess	Remarks
58	Exemplary compound (54) 50	100	56	5	comparative
59	(54) 100	111	53	5	comparative
60	(54) 300	96	46	3	comparative
61	(2) 600	93	35	1	the invention
62	(35) 30	88	49	4	comparative
63	(54) 100 + (35) 2	112	53	5	comparative
64	(54) 100 + (35) 30	118	52	5	comparative
65	(54) 100 + (35) 100	116	50	5	comparative
66	(54) 100 + (28) 2	113	55	5	comparative
67	(54) 100 + (28) 30	121	54	5	comparative
68	(54) 100 + (28) 100	119	52	5	comparative
69	(2) 600 + (35) 2	97	33	1	the invention
70	(2) 600 + (35) 30	128	30	1	the invention
71	(2) 600 + (35) 100	125	32	1	the invention
72	(2) 600 + (28) 2	95	35	1	the invention
73	(2) 600 + (28) 30	124	32	1	the invention
74	(2) 600 + (28) 100	122	33	1	the invention
75	(11) 600 + (35) 7	94	37	2	the invention
76	(11) 600 + (35) 30	120	35	1	the invention
77	(11) 600 + (35) 100	118	35	1	the invention
78	(11) 600 + (28) 2	92	38	2	the invention
79	(11) 600 + (28) 30	118	35	1	the invention
80	(11) 600 + (28) 100	117	36	2	the invention

As is apparent from Table 6, it can be appreciated that the samples No. 61 and 69 - 80 of the present invention have high sensitivity and good graininess. However, for the samples No. 71, 74, 77 and 80, in which 100 mg of the exemplary compound (35) or (28) was added, dyes remainings were recognized in all the samples.

Example 7

The samples No. 37 - 57 which had been prepared in Example 5 were exposed to X-ray through a penetrometer B Model [Aluminum Step, sold by Konishiroku Medical K.K.] according to the single back method by use of a fluorescent sensitizing paper Titan-2U produced by Simens Co. only on one side under the conditions of a tube voltage of 60 KOP, 150 mA and 0.1 sec, and then subjected to the same development processing as in Example 1.

For the developed samples obtained, by use of PDA-densitometer produced by Konishiroku Photo Industry Co., reciprocal number of the dose necessary for the sample No. 37 to obtain a density of fog + density 1.0 and, with its value being 100, also for samples No. 38 - 57, reciprocal numbers of the doses necessary for obtaining fog + density 1.0 were determined, expressed in terms of relative sensitivities, and shown in Table 7.

Evaluation of graininess around the density 1.0 by observation with eyes and reciprocal number of the dose necessary for the sample No. 37 to obtain a density of fog + density 1.0 were determined, expressed in terms of relative sensitivity, and shown in Table 7.

Also, graininess of the developed samples around the density 1.0 was evaluated by observation with eyes and shown in Table 7. The evaluation standards are the same as in Example 5.

Table 7

Sample No.	Relative X-ray exposure sensitivity	Graininess	Remarks
37	100	5	comparative
38	115	5	comparative
39	98	4	comparative
40	95	2	comparative
41	80	5	comparative
42	84	1	the invention
43	87	1	the invention
44	78	2	the invention
45	64	5	comparative
46	90	5	comparative
47	92	5	comparative
48	90	5	comparative
49	111	4	comparative
50	101	2	the invention
51	125	1	the invention
52	134	1	the invention
53	134	1	the invention
54	120	1	the invention
55	129	1	the invention
56	124	2	the invention
57	121	2	the invention

As is apparent from Table 7, it can be appreciated that the samples No. 42 - 44 and 50 - 57 of the present invention have also high sensitivity and yet excellent graininess in X-ray photographing.

According to the present invention, by controlling the relative blue light sensitivity to be 45 or less, preferably, from 20 to 45, more preferably from 25 to 35 to the green light sensitivity which is made as 100, a one-surface light-sensitive material with high sensitivity and yet excellent graininess, and also with little dye remained after development can be obtained.

During CRT photographing, particularly when the P4 phosphor as shown in Fig. 1 is employed, high sensitivity can be obtained with improvement of graininess, resolution of the CRT sensitive material to great extent.

Also, during X-ray photogrphing, particularly when photographing is performed by use of a sensitizing paper containing a mixture of two or more kinds of phosphor particles emitting blue and green lights as the fluorescent sensitizing dye Titan-2 produced by Simens Co., etc., high sensitivity can be obtained with improvement of graininess and sharpness to great extent.

Claims

1. A one-surface light-sensitive silver halide photographic material having, on a support, at least one of green sensitive layer, characterized in that the relative blue light sensitivity of the light-sensitive photographic material is controlled to be 45 or less to the green light sensitivity which is made as 100.

2. The photographic material according to Claim 1, wherein the relative blue light sensitivity of the material is controlled to be from 20 to 45 to the green light sensitivity which is made as 100.

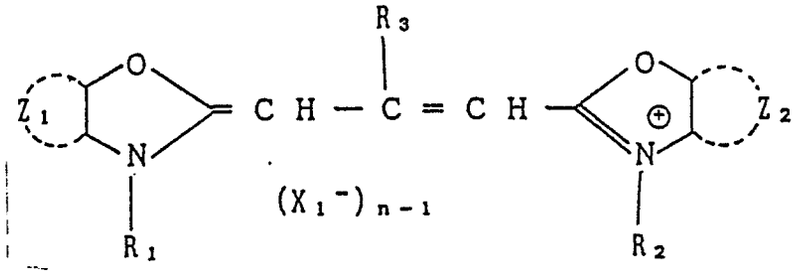
3. The photographic material according to Claim 2, wherein the relative blue light sensitivity of the material is controlled to be from 25 to 35 to the green light sensitivity which is made as 100.

4. The photographic material according to Claim 1, wherein the light-sensitive photographic material contains one or more of dyes in an amount enough to control the relative blue light sensitivity to said sensitivity range.

5. The photographic material according to Claim 4, wherein said one or more of dyes is single kind of sensitizing dye.

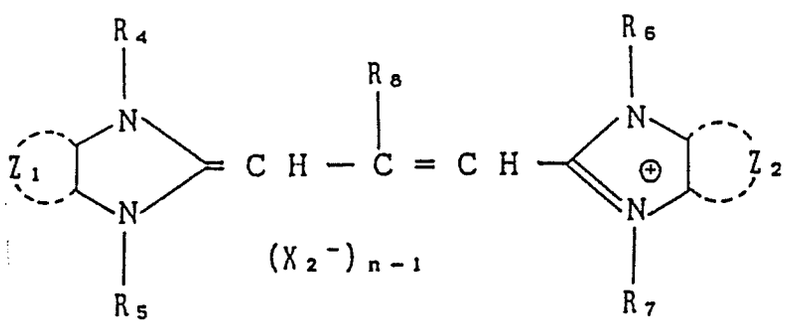
6. The photographic material according to Claim 5, wherein said sensitizing dye is one selected from the group consisting of a compound represented by the following formulas:

Formula [I]



wherein R_1 and R_2 each represent a substituted or unsubstituted alkyl group, alkenyl group or aryl group, and at least one of R_1 and R_2 represents a sulfoalkyl group or a carboxyalkyl group; R_3 represents a hydrogen atom, an alkyl group having 1 to 3 carbon atoms or an aryl group; X_1^- represents an anion; Z_1 and Z_2 each represent a group of nonmetallic atoms necessary for the completion of a substituted or unsubstituted benzene ring; and n represents 1 or 2 (with proviso that n is 1 when an intramolecular salt is formed), and

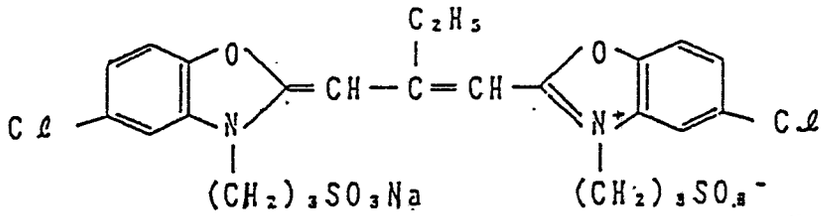
Formula [II]



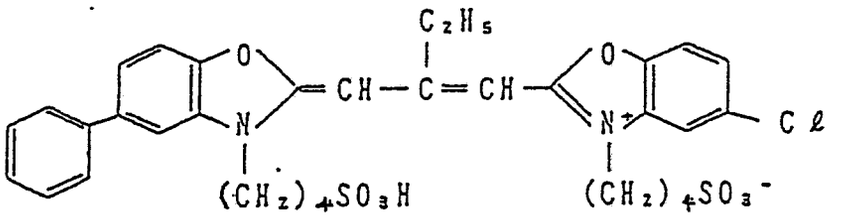
wherein R_4 and R_6 each represent a substituted or unsubstituted lower alkyl group; R_5 and R_7 each represent a lower alkyl group, a hydroxyalkyl group, a sulfoalkyl group or a carboxylalkyl group; R_8 represents a hydrogen atom or an alkyl group having 1 to 3 carbon atoms; X_2^- represents an anion; Z_1 and Z_2 each represent a group of nonmetallic atoms necessary for the completion of a substituted or unsubstituted benzene ring; and n represents 1 or 2 (with proviso that n is 1 when an intramolecular salt is formed).

7. The photographic material according to Claim 6, wherein said sensitizing dye is one selected from the group consisting of

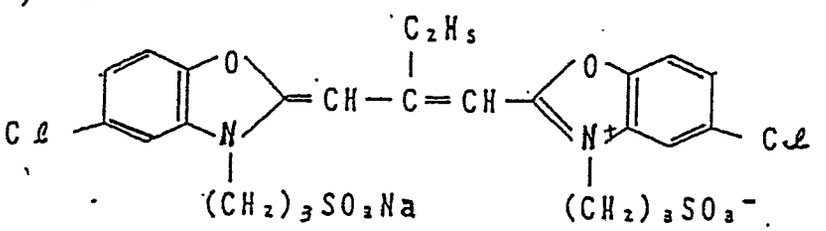
(2)



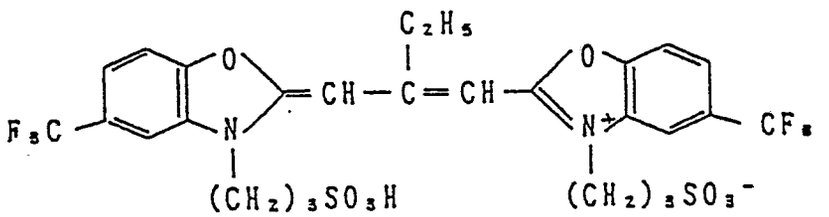
(5)



(6)- 1



(9)



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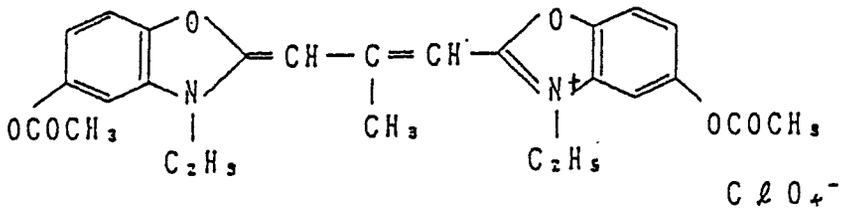

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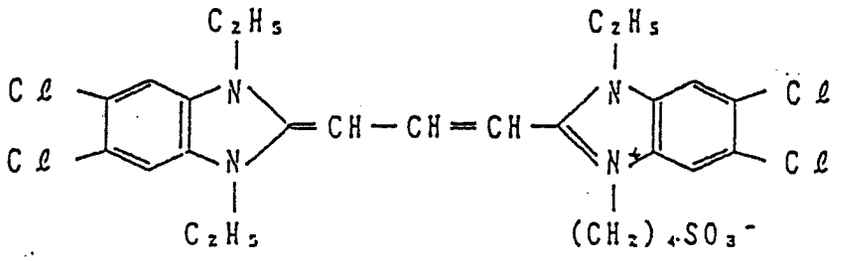
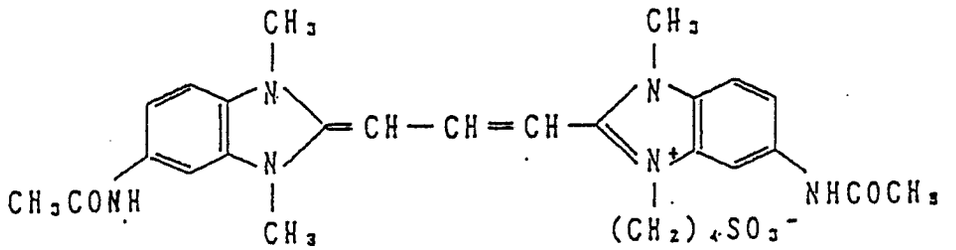
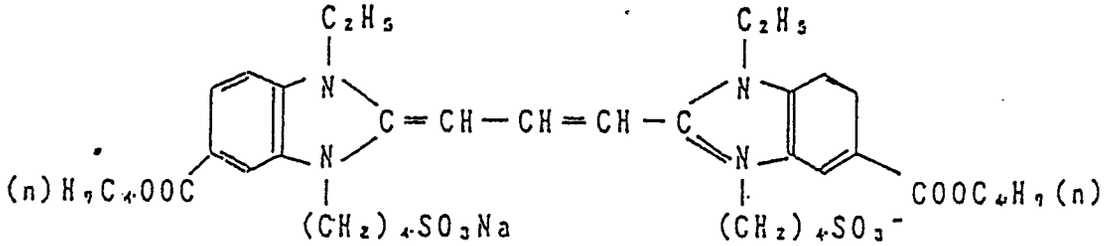


(3 1)

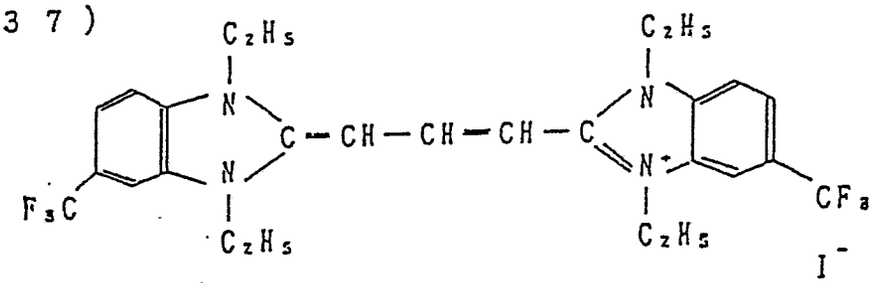


(3 5)



and

(3 7)



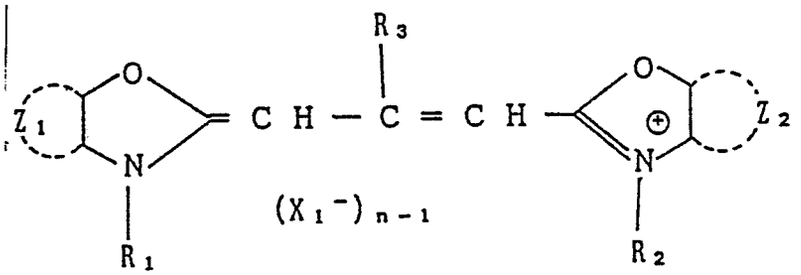
8. The photographic material according to Claim 5, wherein the light-sensitive photographic material contains said sensitizing dye in an amount ranging from 200 to 2000 mg, per 1 mol of silver halide.

9. The photographic material according to Claim 8, wherein the light-sensitive photographic material contains said sensitizing dye in an amount ranging from 250 to 1500 mg, per 1 mol of silver halide.

10. The photographic material according to Claim 4, wherein said one or more of dyes are single kind of sensitizing dye and a dye other than a sensitizing dye in combination with each other.

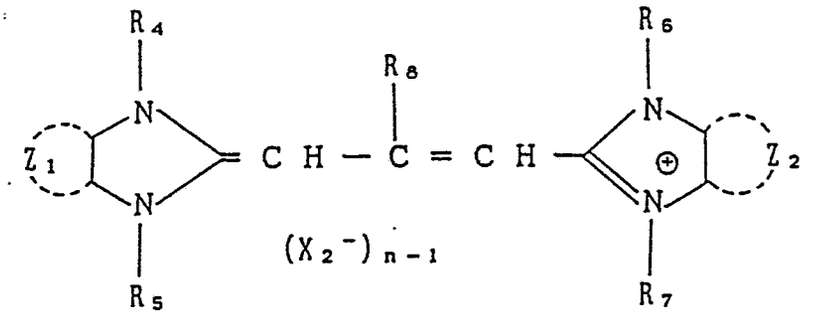
11. The photographic material according to Claim 10, wherein said single kind of sensitizing dye is one selected from the group consisting of a compound represented by the following formulas:

Formula [I]



wherein R_1 and R_2 each represent a substituted or unsubstituted alkyl group, alkenyl group or aryl group, and at least one of R_1 and R_2 represents a sulfoalkyl group or a carboxyalkyl group; R_3 represents a hydrogen atom, an alkyl group having 1 to 3 carbon atoms or an aryl group; X_1^- represents an anion; Z_1 and Z_2 each represent a group of nonmetallic atoms necessary for the completion of a substituted or unsubstituted benzene ring; and n represents 1 or 2 (with proviso that n is 1 when an intramolecular salt is formed), and

Formula [II]

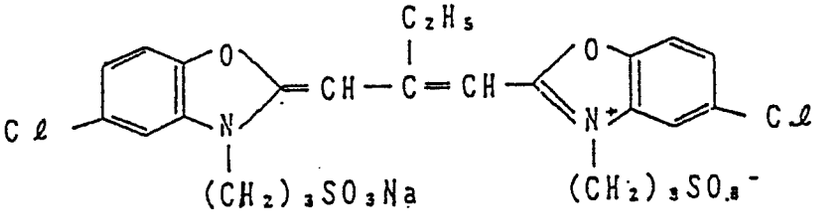


wherein R_4 and R_6 each represent a substituted or unsubstituted lower alkyl group; R_5 and R_7 each represent a lower alkyl group, a hydroxyalkyl group, a sulfoalkyl group or a carboxylalkyl group; R_8 represents a hydrogen atom or an alkyl group having 1 to 3 carbon atoms; X_2^- represents an anion; Z_1 and

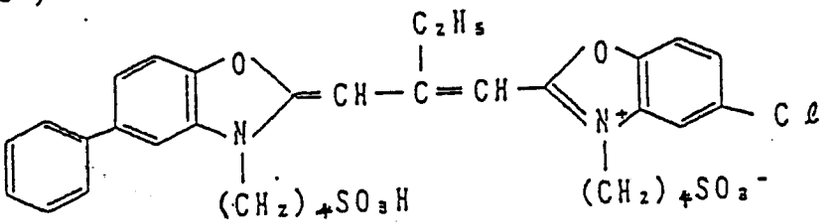
Z_2 each represent a group of nonmetallic atoms necessary for the completion of a substituted or unsubstituted benzene ring; and n represents 1 or 2 (with proviso that n is 1 when an intramolecular salt is formed).

12. The photographic material according to Claim 11, wherein said sensitizing dye is one selected from the group consisting of

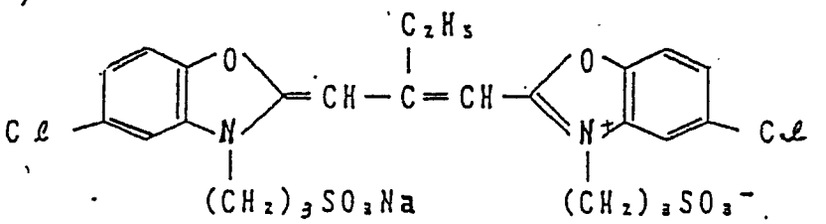
(2)



(5)



(6)- 1



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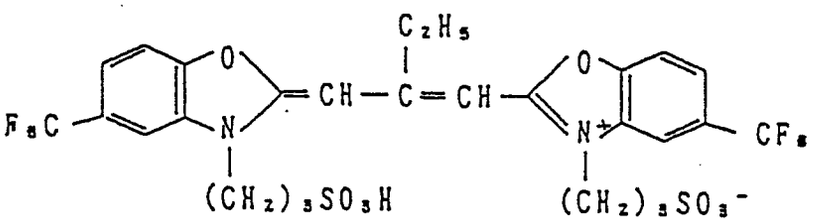

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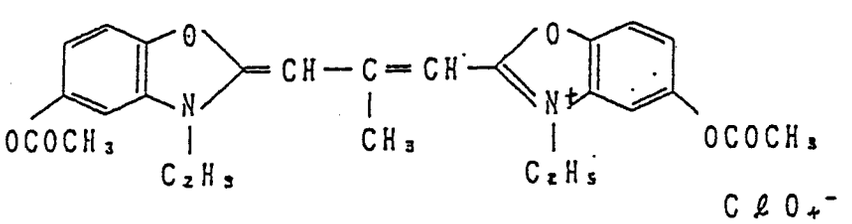
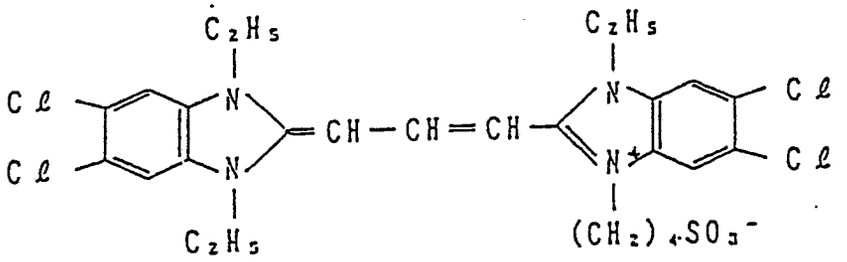
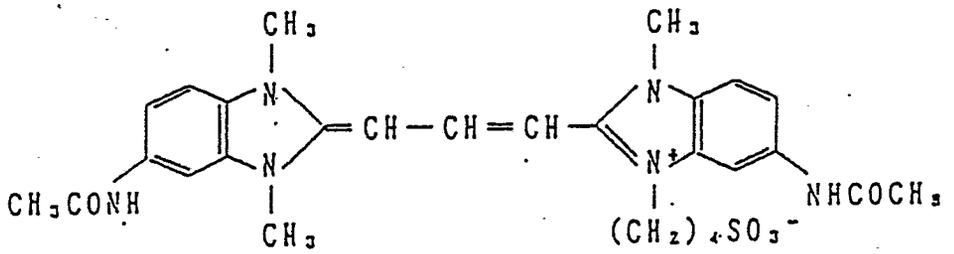


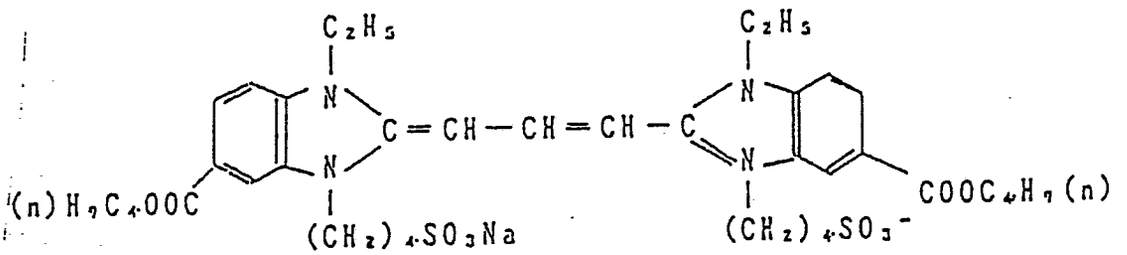
(2 7)



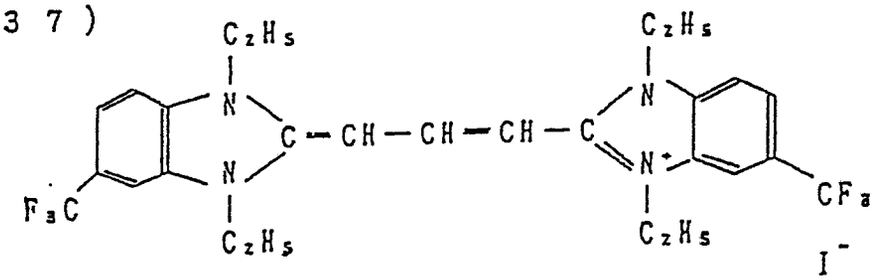
(3 1)



(3 5)



(3 7)

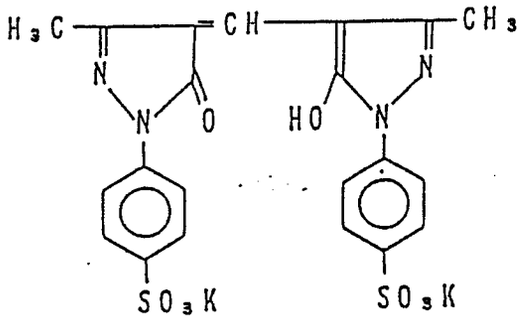


and

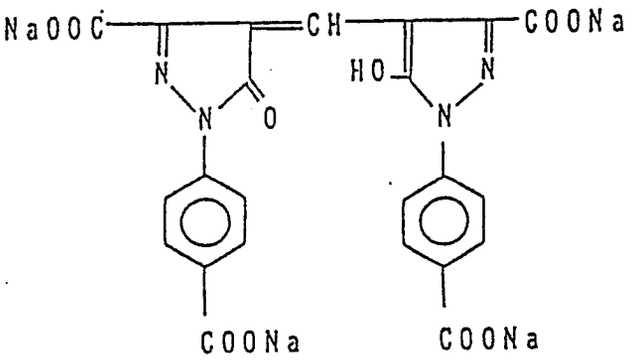
13. The photographic material according to Claim 10, wherein the light-sensitive photographic material contains said sensitizing dye in an amount ranging from 200 to 2000 mg, per 1 mol of silver halide.

14. The photographic material according to Claim 10, wherein said dye other than a sensitizing dye is one selected from the group consisting of

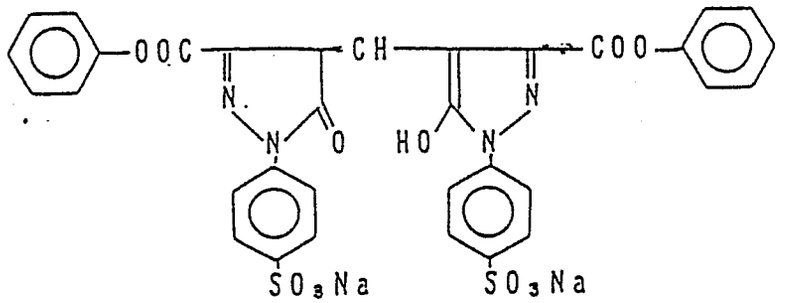
a)



b)

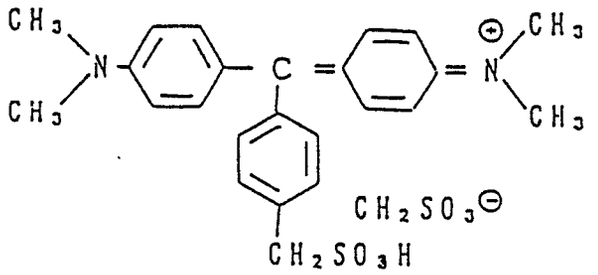


c)



and

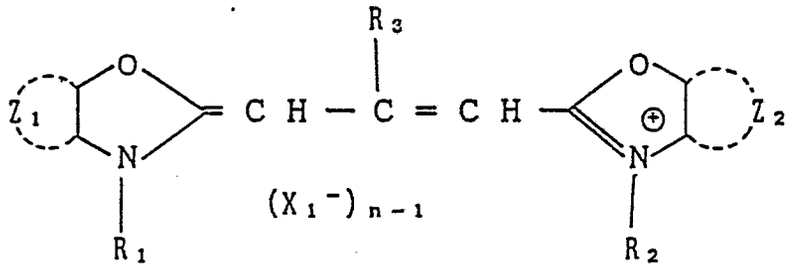
d)



15. The photographic material according to Claim 10, wherein the light-sensitive photographic material contains said dye other than a sensitizing dye in an amount ranging from 50 to 1000 mg/ m^2.

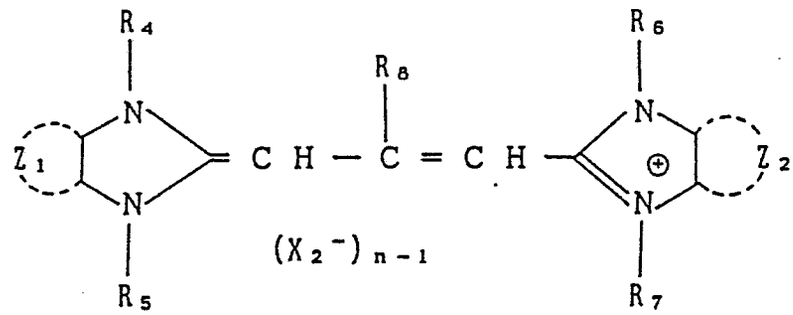
16. The photographic material according to Claim 4, wherein said one or more of dyes are two kinds of sensitizing dyes in combination with each other.

17. The photographic material according to Claim 16, wherein one of said two kinds of sensitizing dyes is a compound represented by the formula [I] :



wherein R_1 and R_2 each represent a substituted or unsubstituted alkyl group, alkenyl group or aryl group, and at least one of R_1 and R_2 represents a sulfoalkyl group or a carboxyalkyl group; R_3 represents a hydrogen atom, an alkyl group having 1 to 3 carbon atoms or an aryl group; X_1^- represents an anion; Z_1 and Z_2 each represent a group of nonmetallic atoms necessary for the completion of a substituted or unsubstituted benzene ring; and n represents 1 or 2 (with proviso that n is 1 when an intramolecular salt is formed), and

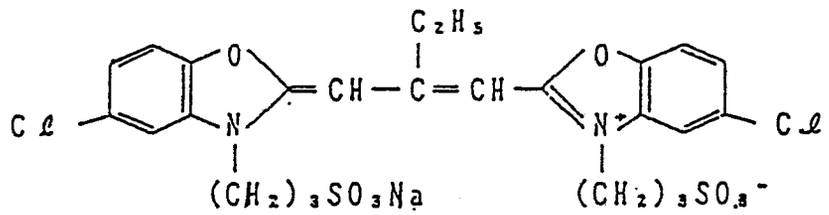
and the other of said two kinds of the sensitizing dye is a compound represented by the formula [II]:



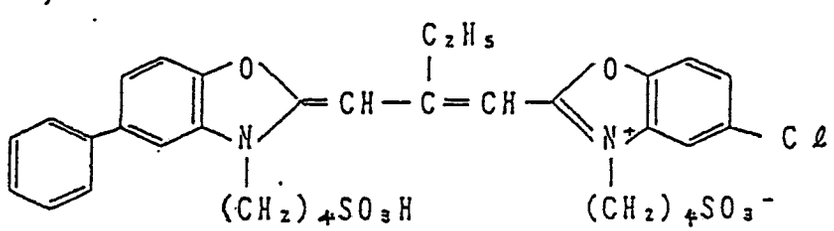
wherein R_4 and R_6 each represent a substituted or unsubstituted lower alkyl group; R_5 and R_7 each represent a lower alkyl group, a hydroxyalkyl group, a sulfoalkyl group or a carboxylalkyl group; R_8 represents a hydrogen atom or an alkyl group having 1 to 3 carbon atoms; X_2^- presents an anion; Z_1 and Z_2 each represent a group of nonmetallic atoms necessary for the completion of a substituted or unsubstituted benzene ring; and n represents 1 or 2 (with proviso that n is 1 when an intramolecular salt is formed).

18. The photograhic material according to Claim 17, wherein said sensitizing dye represented by the formula [I] is one selected from the group consisting of

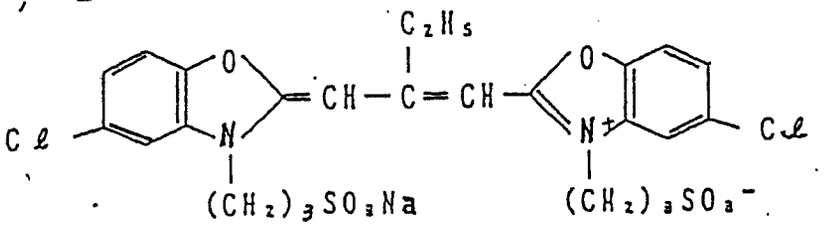
(2)



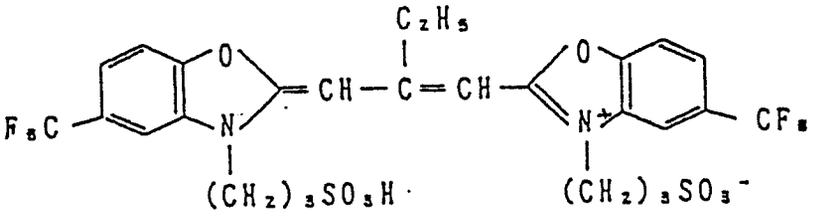
(5)



(6)- 1

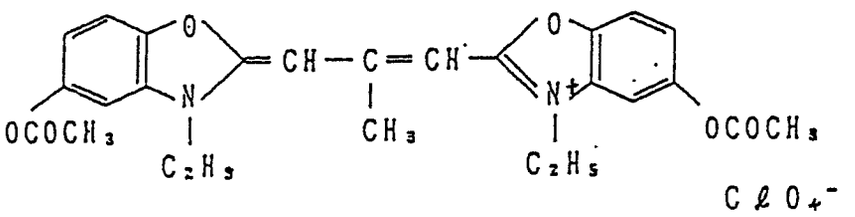


(9)



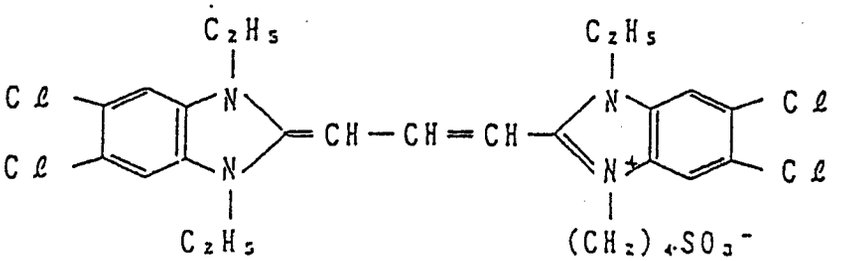
and

(1 8)

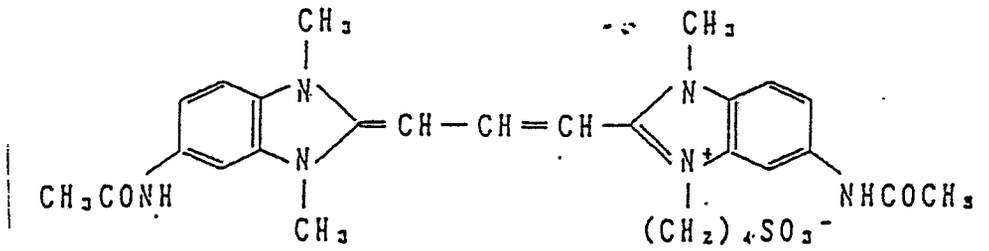


and said sensitizing dye represented by the formula [II] is one selected from the group consisting of

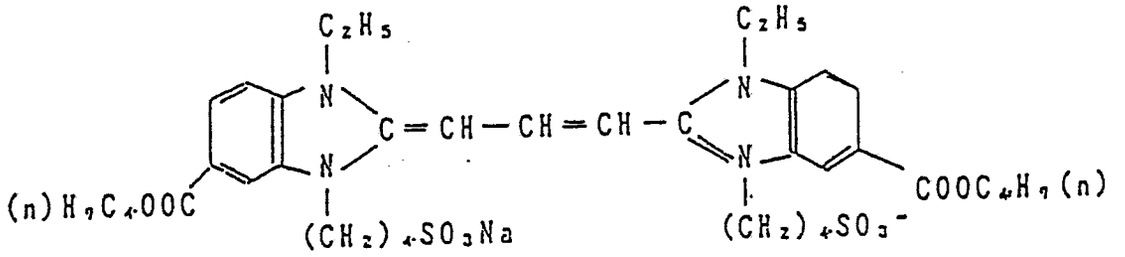
(2 7)



(3 1)

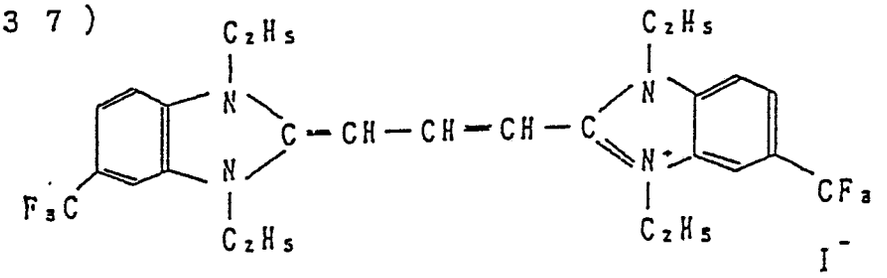


(3 5)



and

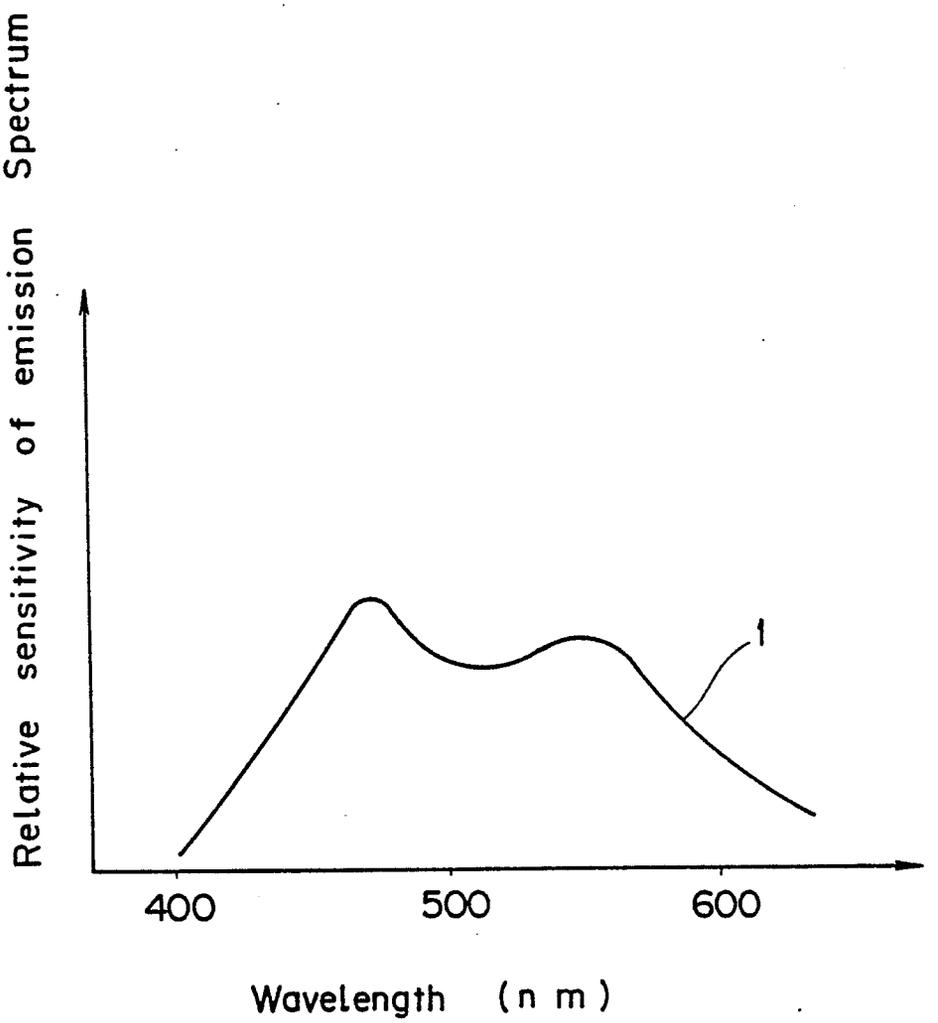
(3 7)



19. The photographic material according to Claim 17, wherein the light-sensitive photographic material contains said sensitizing dye represented by the formula [I] in an amount ranging from 100 mg to 1800 mg, and said sensitizing dye represented by the formula [II] in an amount ranging from 3 mg to 90 mg, per 1 mol of silver halide.

20. The photographic material according to Claim 19, wherein the light-sensitive photographic material contains said sensitizing dye represented by the formula [I] in an amount ranging from 200 mg to 1500 mg, and said sensitizing dye represented by the formula [II] in an amount ranging from 5 mg to 60 mg, per 1 mol of silver halide.

FIG. 1


Relative sensitivity of emission Spectrum
1
400
500
600
Wavelength (n m)