

RADIATION SENSITIVE COMPOSITION, COLOR FILTER AND LIQUID
CRYSTAL DISPLAY DEVICE

Field of the Invention

5 The present invention relates to a radiation sensitive composition, a color filter and a liquid crystal display device. More specifically, it relates to a radiation sensitive composition which is used to form a colored layer useful for color filters for use in transmission and
10 reflection type color liquid crystal display devices, color image pick-up devices, etc., a color filter having a colored layer made of the radiation sensitive composition and a liquid crystal display device having the color filter.

15 Description of the Prior Art

 As means of manufacturing a color filter by using a colored radiation sensitive composition, there is known a method in which a colored radiation sensitive composition is applied to a substrate or a substrate comprising a light
20 screening layer having a desired pattern and dried and then the dried coating film is exposed to radiation in a desired pattern (to be referred to as "exposure" hereinafter) and developed to obtain color pixels (see JP-A 2-144502 and JP-A 3-53201) (the term "JP-A" as used herein means an "unexamined
25 published Japanese patent application").

 The tact time is now generally shortened by reducing the amount of exposure or accelerating the substrate transfer speed in the development step in the technical field of color filters. However, since development conditions become
30 severe due to a reduction in the amount of exposure or an increase in the substrate transfer speed, it is difficult to obtain a satisfactory pixel pattern and black matrix pattern from the colored radiation sensitive composition of the prior art while the tact time is shortened because a

missing part of the edge or an undercut is apt to be produced at the time of development.

Summary of the Invention

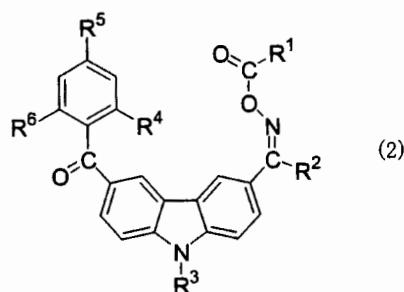
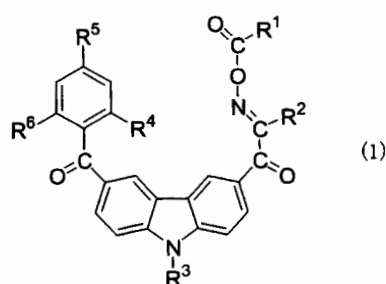
5 It is an object of the present invention to provide a radiation sensitive composition which exhibits excellent developability, more specifically a radiation sensitive composition which does not produce an undissolved product or scum on the pattern edge at the time of development and
10 provides pixels and a black matrix without a missing part of the pattern edge or an undercut even when the amount of exposure is small and development conditions are severe.

 It is another object of the present invention to provide a color filter having a colored layer made of the radiation
15 sensitive composition of the present invention.

 It is still another object of the present invention to provide a liquid crystal display device comprising the color filter of the present invention.

 Other objects and advantages of the present invention
20 will become apparent from the following description.

 According to the present invention, firstly, the above objects and advantages of the present invention are attained by a radiation sensitive composition which comprises (A) a colorant, (B) an alkali-soluble resin, (C) a polyfunctional
25 monomer and (D) an optical radical generator containing at least one component selected from the group consisting of a compound represented by the following formula (1) and a compound represented by the following formula (2) and at least one component selected from the group consisting of
30 a biimidazole compound, benzophenone compound, thioxanthone compound and ketocoumarin compound and which is used to form a colored layer:



(in the formulas (1) and (2), R^1 's are each independently a linear, branched or cyclic alkyl group having 1 to 12 carbon atoms or phenyl group, R^2 's are each independently a hydrogen atom, linear, branched or cyclic alkyl group having 1 to 12 carbon atoms or phenyl group, R^3 's are each independently a hydrogen atom or linear, branched or cyclic alkyl group having 1 to 12 carbon atoms, R^4 , R^5 and R^6 are each independently a hydrogen atom or linear, branched or cyclic alkyl group having 1 to 6 carbon atoms, with the proviso that the alkyl group represented by R^1 , R^2 , R^3 , R^4 , R^5 and R^6 may be substituted by a substituent selected from the group consisting of a linear, branched or cyclic alkoxy group having 1 to 6 carbon atoms, phenyl group and halogen atom, and the phenyl group represented by R^1 and R^2 may be substituted by a substituent selected from the group consisting of a linear, branched or cyclic alkyl group having 1 to 6 carbon atoms, linear, branched or cyclic alkoxy group having 1 to 6 carbon atoms, phenyl group and halogen atom).

The term "colored layer" as used herein means a layer composed of pixels and/or a black matrix for use in a color filter.

According to the present invention, secondly, the

above objects and advantages of the present invention are attained by a color filter having a colored layer made of the radiation sensitive composition of the present invention.

5 According to the present invention, thirdly, the above objects and advantages of the present invention are attained by a liquid crystal display device comprising the color filter of the present invention.

 The present invention will be described in detail
10 hereinunder.

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Radiation sensitive composition

- (A) Colorant -

15 The colorant in the present invention is not limited to a particular color and is suitably selected according to the application purpose of the obtained color filter. It may be a pigment, dye or natural coloring matter.

 Since the development of a high-definition color and
20 heat resistance are required for a color filter, a colorant having high color developability and high heat resistance, especially a colorant having high resistance to thermal decomposition is preferred as the colorant in the present invention. Therefore, a pigment is generally used, and an
25 organic pigment or carbon black is particularly preferably used.

 Examples of the above organic pigment are compounds classified into a group of pigments according to color index (C.I.; issued by The Society of Dyers and Colourists),
30 specifically compounds having the following color index (C.I.) numbers:

C.I. Pigment Yellow 1, C.I. Pigment Yellow 3, C.I. Pigment Yellow 12, C.I. Pigment Yellow 13, C.I. Pigment Yellow 14, C.I. Pigment Yellow 15, C.I. Pigment Yellow 16, C.I. Pigment

Yellow 17, C.I. Pigment Yellow 20, C.I. Pigment Yellow 24,
 C.I. Pigment Yellow 31, C.I. Pigment Yellow 55, C.I. Pigment
 Yellow 60, C.I. Pigment Yellow 61, C.I. Pigment Yellow 65,
 C.I. Pigment Yellow 71, C.I. Pigment Yellow 73, C.I. Pigment
 5 Yellow 74, C.I. Pigment Yellow 81, C.I. Pigment Yellow 83,
 C.I. Pigment Yellow 93, C.I. Pigment Yellow 95, C.I. Pigment
 Yellow 97, C.I. Pigment Yellow 98, C.I. Pigment Yellow 100,
 C.I. Pigment Yellow 101, C.I. Pigment Yellow 104, C.I.
 Pigment Yellow 106, C.I. Pigment Yellow 108, C.I. Pigment
 10 Yellow 109, C.I. Pigment Yellow 110, C.I. Pigment Yellow 113,
 C.I. Pigment Yellow 114, C.I. Pigment Yellow 116, C.I.
 Pigment Yellow 117, C.I. Pigment Yellow 119, C.I. Pigment
 Yellow 120, C.I. Pigment Yellow 126, C.I. Pigment Yellow 127,
 C.I. Pigment Yellow 128, C.I. Pigment Yellow 129, C.I.
 15 Pigment Yellow 138, C.I. Pigment Yellow 139, C.I. Pigment
 Yellow 150, C.I. Pigment Yellow 151, C.I. Pigment Yellow 152,
 C.I. Pigment Yellow 153, C.I. Pigment Yellow 154, C.I.
 Pigment Yellow 155, C.I. Pigment Yellow 156, C.I. Pigment
 Yellow 166, C.I. Pigment Yellow 168, C.I. Pigment Yellow 175,
 20 C.I. Pigment Yellow 180 and C.I. Pigment Yellow 185;
 C.I. Pigment Orange 1, C.I. Pigment Orange 5, C.I. Pigment
 Orange 13, C.I. Pigment Orange 14, C.I. Pigment Orange 16,
 C.I. Pigment Orange 17, C.I. Pigment Orange 24, C.I. Pigment
 Orange 34, C.I. Pigment Orange 36, C.I. Pigment Orange 38,
 25 C.I. Pigment Orange 40, C.I. Pigment Orange 43, C.I. Pigment
 Orange 46, C.I. Pigment Orange 49, C.I. Pigment Orange 51,
 C.I. Pigment Orange 61, C.I. Pigment Orange 63, C.I. Pigment
 Orange 64, C.I. Pigment Orange 71 and C.I. Pigment Orange
 73;
 30 C.I. Pigment Violet 1, C.I. Pigment Violet 19, C.I. Pigment
 Violet 23, C.I. Pigment Violet 29, C.I. Pigment Violet 32,
 C.I. Pigment Violet 36 and C.I. Pigment Violet 38;
 C.I. Pigment Red 1, C.I. Pigment Red 2, C.I. Pigment Red 3,
 C.I. Pigment Red 4, C.I. Pigment Red 5, C.I. Pigment Red 6,

C.I. Pigment Red 7, C.I. Pigment Red 8, C.I. Pigment Red 9,
C.I. Pigment Red 10, C.I. Pigment Red 11, C.I. Pigment Red
12, C.I. Pigment Red 14, C.I. Pigment Red 15, C.I. Pigment
Red 16, C.I. Pigment Red 17, C.I. Pigment Red 18, C.I. Pigment
5 Red 19, C.I. Pigment Red 21, C.I. Pigment Red 22, C.I. Pigment
Red 23, C.I. Pigment Red 30, C.I. Pigment Red 31, C.I. Pigment
Red 32, C.I. Pigment Red 37, C.I. Pigment Red 38, C.I. Pigment
Red 40, C.I. Pigment Red 41, C.I. Pigment Red 42, C.I. Pigment
Red 48:1, C.I. Pigment Red 48:2, C.I. Pigment Red 48:3, C.I.
10 Pigment Red 48:4, C.I. Pigment Red 49:1, C.I. Pigment Red
49:2, C.I. Pigment Red 50:1, C.I. Pigment Red 52:1, C.I.
Pigment Red 53:1, C.I. Pigment Red 57, C.I. Pigment Red 57:1,
C.I. Pigment Red 57:2, C.I. Pigment Red 58:2, C.I. Pigment
Red 58:4, C.I. Pigment Red 60:1, C.I. Pigment Red 63:1, C.I.
15 Pigment Red 63:2, C.I. Pigment Red 64:1, C.I. Pigment Red
81:1, C.I. Pigment Red 83, C.I. Pigment Red 88, C.I. Pigment
Red 90:1, C.I. Pigment Red 97, C.I. Pigment Red 101, C.I.
Pigment Red 102, C.I. Pigment Red 104, C.I. Pigment Red 105,
C.I. Pigment Red 106, C.I. Pigment Red 108, C.I. Pigment Red
20 112, C.I. Pigment Red 113, C.I. Pigment Red 114, C.I. Pigment
Red 122, C.I. Pigment Red 123, C.I. Pigment Red 144, C.I.
Pigment Red 146, C.I. Pigment Red 149, C.I. Pigment Red 150,
C.I. Pigment Red 151, C.I. Pigment Red 166, C.I. Pigment Red
168, C.I. Pigment Red 170, C.I. Pigment Red 171, C.I. Pigment
25 Red 172, C.I. Pigment Red 174, C.I. Pigment Red 175, C.I.
Pigment Red 176, C.I. Pigment Red 177, C.I. Pigment Red 178,
C.I. Pigment Red 179, C.I. Pigment Red 180, C.I. Pigment Red
185, C.I. Pigment Red 187, C.I. Pigment Red 188, C.I. Pigment
Red 190, C.I. Pigment Red 193, C.I. Pigment Red 194, C.I.
30 Pigment Red 202, C.I. Pigment Red 206, C.I. Pigment Red 207,
C.I. Pigment Red 208, C.I. Pigment Red 209, C.I. Pigment Red
215, C.I. Pigment Red 216, C.I. Pigment Red 220, C.I. Pigment
Red 224, C.I. Pigment Red 226, C.I. Pigment Red 242, C.I.
Pigment Red 243, C.I. Pigment Red 245, C.I. Pigment Red 254,

C.I. Pigment Red 255, C.I. Pigment Red 264 and C.I. Pigment Red 265;

C.I. Pigment Blue 15, C.I. Pigment Blue 15:3, C.I. Pigment Blue 15:4, C.I. Pigment Blue 15:6 and C.I. Pigment Blue 60;

5 C.I. Pigment Green 7 and C.I. Pigment Green 36;

C.I. Pigment Brown 23 and C.I. Pigment Brown 25; and

C.I. Pigment Black 1 and C.I. Pigment Black 7.

These organic pigments may be purified by sulfuric acid re-crystallization, solvent cleaning or a combination
10 thereof before use.

Examples of inorganic pigment include titanium oxide, barium sulfate, calcium carbonate, zinc white, lead sulfate, yellow lead, zinc yellow, red iron oxide (red iron oxide (III)), cadmium red, ultramarine, Prussian blue, chromium
15 oxide green, cobalt green, amber, titanium black, synthetic iron black and carbon black.

In the present invention, the above organic pigments and inorganic pigments may be used alone or in combination of two or more, respectively, or both may be used in
20 combination. For example, one or more organic pigments are preferably used to form pixels, and two or more organic pigments and/or carbon black are preferably used to form a black matrix.

In the present invention, the surface of the particle
25 of the pigment may be optionally modified by a polymer before use. Examples of the polymer used to modify the surface of the particle of the pigment include polymers disclosed by JP-A 8-259876 and commercially available polymers and oligomers for dispersing a pigment.

30 In the present invention, optionally, the colorant may be used in conjunction with a dispersant.

The above dispersant is, for example, a cationic, anionic, nonionic, ampholytic, silicone-based or fluorine-based surfactant.

Examples of the above surfactant include polyoxyethylene alkyl ethers such as polyoxyethylene lauryl ether, polyoxyethylene stearyl ether and polyoxyethylene oleyl ether; polyoxyethylene alkylphenyl ethers such as
5 polyoxyethylene n-octylphenyl ether and polyoxyethylene n-nonylphenyl ether; polyethylene glycol diesters such as polyethylene glycol dilaurate and polyethylene glycol distearate; sorbitan fatty acid esters; fatty acid modified polyesters; tertiary amine modified polyurethanes; and
10 polyethylene imines. These surfactants are available on the market under the trade names of KP (of Shin-Etsu Chemical, Co., Ltd.), Polyflow (of Kyoeisha Chemical Co., Ltd.), F Top (of Tokem Products Co., Ltd.), Megafac (of Dainippon Ink and Chemicals, Inc.), Florade (of Sumitomo 3M Limited), Asahi
15 Guard and Surflon (of Asahi Glass Co., Ltd.), Disperbyk (of BYK Chemie Japan KK), and Solsperse (of Seneka Co., Ltd.).

These surfactants may be used alone or in combination of two or more.

The amount of the surfactant is preferably 50 parts
20 or less by weight, more preferably 0 to 30 parts by weight based on 100 parts by weight of the colorant.

- (B) alkali-soluble resin -

Any alkali-soluble resin may be used as the
25 alkali-soluble resin in the present invention if it serves as a binder for the colorant (A) and has solubility in a developer, particularly preferably an alkali developer, which is used in the development step of a color filter production process. It is preferably an alkali-soluble
30 resin having a carboxyl group, particularly preferably a copolymer (to be referred to as "carboxyl group-containing copolymer" hereinafter) of an ethylenically unsaturated monomer having at least one carboxyl group (to be referred to as "carboxyl group-containing unsaturated monomer"

hereinafter) and other copolymerizable ethylenically unsaturated monomer (to be referred to as "copolymerizable unsaturated monomer" hereinafter).

Examples of the carboxyl group-containing unsaturated monomer include unsaturated monocarboxylic acids such as (meth)acrylic acid, crotonic acid, α -chloroacrylic acid and cinnamic acid; unsaturated dicarboxylic acids and anhydrides thereof such as maleic acid, maleic anhydride, fumaric acid, itaconic acid, itaconic anhydride, citraconic acid, citraconic anhydride and mesaconic acid; unsaturated polycarboxylic acids having three or more carboxyl groups and anhydrides thereof; mono[(meth)acryloyloxyalkyl]esters of a polycarboxylic acid having two or more carboxyl groups such as mono[2-(meth)acryloyloxyethyl]succinate and mono[2-(meth)acryloyloxyethyl]phthalate; and mono(meth)acrylates of a polymer having a carboxyl group and a hydroxyl group at both terminals such as ω -carboxypolycaprolactone mono(meth)acrylate.

Out of these carboxyl group-containing unsaturated monomers, mono(2-acryloyloxyethyl)succinate and mono(2-acryloyloxyethyl)phthalate are available on the market under the trade names of M-5300 and M-5400 (of Toagosei Co., Ltd.), respectively.

The above carboxyl group-containing unsaturated monomers may be used alone or in combination of two or more.

Examples of the copolymerizable unsaturated monomer include aromatic vinyl compounds such as styrene, α -methylstyrene, o-vinyltoluene, m-vinyltoluene, p-vinyltoluene, p-chlorostyrene, o-methoxystyrene, m-methoxystyrene, p-methoxystyrene, o-vinylbenzylmethyl ether, m-vinylbenzylmethyl ether, p-vinylbenzylmethyl ether, o-vinylbenzylglycidyl ether, m-vinylbenzylglycidyl ether and p-vinylbenzylglycidyl ether; indenenes such as indene and 1-methylindene; unsaturated imides such as

maleimide, N-phenylmaleimide and N-cyclohexylmaleimide; unsaturated carboxylates such as methyl (meth)acrylate, ethyl (meth)acrylate, n-propyl (meth)acrylate, i-propyl (meth)acrylate, n-butyl (meth)acrylate, i-butyl (meth)acrylate, sec-butyl (meth)acrylate, t-butyl (meth)acrylate, 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, 3-hydroxybutyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, allyl (meth)acrylate, benzyl (meth)acrylate, cyclohexyl (meth)acrylate, phenyl (meth)acrylate, 2-methoxyethyl (meth)acrylate, 2-phenoxyethyl (meth)acrylate, methoxydiethylene glycol (meth)acrylate, methoxytriethylene glycol (meth)acrylate, methoxypropylene glycol (meth)acrylate, methoxydipropylene glycol (meth)acrylate, isobornyl (meth)acrylate, dicyclopentadienyl (meth)acrylate, 2-hydroxy-3-phenoxypropyl (meth)acrylate and glycerol mono(meth)acrylate; unsaturated aminoalkyl carboxylates such as 2-aminoethyl (meth)acrylate, 2-dimethylaminoethyl (meth)acrylate, 2-aminopropyl (meth)acrylate, 2-dimethylaminopropyl (meth)acrylate, 3-aminopropyl (meth)acrylate and 3-dimethylaminopropyl (meth)acrylate; unsaturated glycidyl carboxylates such as glycidyl (meth)acrylate; vinyl cyanide compounds such as (meth)acrylonitrile, α -chloroacrylonitrile and vinylidene cyanide; unsaturated amides such as (meth)acrylamide, α -chloroacrylamide and N-2-hydroxyethyl (meth)acrylamide; vinyl carboxylates such as vinyl acetate, vinyl propionate, vinyl butyrate and vinyl benzoate; unsaturated ethers such as vinyl methyl ether, vinyl ethyl ether and allyl glycidyl ether; aliphatic conjugated dienes such as 1,3-butadiene, isoprene and chloroprene; and macromonomers having a mono(meth)acryloyl group at a terminal of a polymer molecular

chain such as polystyrene, polymethyl (meth)acrylate, poly-n-butyl (meth)acrylate and polysiloxane.

These copolymerizable unsaturated monomers may be used alone or in combination of two or more.

5 The carboxyl group-containing copolymer in the present invention is preferably a copolymer (to be referred to as "carboxyl group-containing copolymer (B1)" hereinafter) of (b1) a carboxyl group-containing unsaturated monomer component comprising (meth)acrylic acid as an essential
10 ingredient and optionally at least one compound selected from the group consisting of mono[2-(meth)acryloyloxyethyl]succinate and ω-carboxypolycaprolactone mono(meth)acrylate and (b2) at least one copolymerizable unsaturated monomer selected from
15 the group consisting of styrene, N-phenylmaleimide, methyl (meth)acrylate, 2-hydroxyethyl (meth)acrylate, allyl (meth)acrylate, benzyl (meth)acrylate, glycerol mono(meth)acrylate, polystyrene macromonomer and polymethyl methacrylate macromonomer.

20 Illustrative examples of the carboxyl group-containing copolymer (B1) include a copolymer of (meth)acrylic acid and methyl (meth)acrylate, copolymer of (meth)acrylic acid and benzyl (meth)acrylate, copolymer of (meth)acrylic acid and 2-hydroxyethyl (meth)acrylate,
25 copolymer of (meth)acrylic acid, 2-hydroxyethyl (meth)acrylate and benzyl (meth)acrylate, copolymer of (meth)acrylic acid, methyl (meth)acrylate and polystyrene macromonomer, copolymer of (meth)acrylic acid, methyl (meth)acrylate and polymethyl methacrylate macromonomer,
30 copolymer of (meth)acrylic acid, benzyl (meth)acrylate and polystyrene macromonomer, copolymer of (meth)acrylic acid, benzyl (meth)acrylate and polymethyl methacrylate macromonomer, copolymer of (meth)acrylic acid, benzyl (meth)acrylate and glycerol mono(meth)acrylate, copolymer

of (meth)acrylic acid, styrene and 2-hydroxyethyl
 (meth)acrylate, copolymer of (meth)acrylic acid,
 2-hydroxyethyl (meth)acrylate and benzyl (meth)acrylate,
 copolymer of (meth)acrylic acid, 2-hydroxyethyl
 5 (meth)acrylate and phenyl (meth)acrylate, copolymer of
 (meth)acrylic acid, styrene, N-phenylmaleimide and benzyl
 (meth)acrylate, copolymer of (meth)acrylic acid,
 2-hydroxyethyl (meth)acrylate, benzyl (meth)acrylate and
 polystyrene macromonomer, copolymer of (meth)acrylic acid,
 10 2-hydroxyethyl (meth)acrylate, benzyl (meth)acrylate
 polymethyl (meth)acrylate macromonomer, copolymer of
 (meth)acrylic acid, styrene, N-phenylmaleimide, benzyl
 (meth)acrylate and glycerol mono(meth)acrylate, copolymer
 of (meth)acrylic acid, 2-hydroxyethyl (meth)acrylate,
 15 styrene, N-phenylmaleimide, phenyl (meth)acrylate and
 polystyrene macromonomer, copolymer of (meth)acrylic acid,
 2-hydroxyethyl (meth)acrylate, styrene, N-phenylmaleimide,
 phenyl (meth)acrylate and polymethyl methacrylate
 macromonomer, copolymer of (meth)acrylic acid,
 20 mono[2-(meth)acryloyloxyethyl]succinate, benzyl
 (meth)acrylate and glycerol mono(meth)acrylate, copolymer
 of (meth)acrylic acid,
 mono[2-(meth)acryloyloxyethyl]succinate, styrene,
 N-phenylmaleimide and allyl (meth)acrylate, copolymer of
 25 (meth)acrylic acid,
 mono[2-(meth)acryloyloxyethyl]succinate, styrene,
 N-phenylmaleimide and benzyl (meth)acrylate, copolymer of
 (meth)acrylic acid,
 mono[2-(meth)acryloyloxyethyl]succinate, styrene,
 30 N-cyclohexylmaleimide and allyl (meth)acrylate, copolymer
 of (meth)acrylic acid,
 mono[2-(meth)acryloyloxyethyl]succinate, styrene,
 N-cyclohexylmaleimide and benzyl (meth)acrylate, and
 copolymer of (meth)acrylic acid, ω -carboxypolycaprolactone

mono(meth)acrylate, styrene, N-phenylmaleimide, benzyl (meth)acrylate and glycerol mono(meth)acrylate.

The copolymerization amount of the carboxyl group-containing unsaturated monomer in the carboxyl group-containing copolymer is preferably 5 to 50 wt%, more preferably 10 to 40 wt%. When the above copolymerization amount is smaller than 5 wt%, the solubility in an alkali developer of the obtained radiation sensitive composition may lower and when the copolymerization amount is larger than 50 wt%, the solubility in an alkali developer of the radiation sensitive composition may become too high. As a result, when the composition is developed with an alkali developer, the colored layer may fall off from the substrate and the film surface of the colored layer may be roughened.

The weight average molecular weight in terms of polystyrene (to be referred to as "Mw" hereinafter) measured by gel permeation chromatography (GPC, eluting solvent: tetrahydrofuran) of the alkali-soluble resin in the present invention is preferably 3,000 to 300,000, more preferably 5,000 to 100,000.

The number average molecular weight in terms of polystyrene (to be referred to as "Mn" hereinafter) measured by gel permeation chromatography (GPC, eluting solvent: tetrahydrofuran) of the alkali-soluble resin in the present invention is preferably 3,000 to 60,000, more preferably 5,000 to 25,000.

In the present invention, by using this alkali-soluble resin having specific Mw and Mn, a radiation sensitive composition having excellent developability is obtained, thereby making it possible to form pixels and a black matrix having a sharp pattern edge and difficult to produce the residue, stain or film residue on the substrate and light screening layer of an unexposed portion at the time of development.

The Mw/Mn ratio of the alkali-soluble resin in the present invention is preferably 1 to 5, more preferably 1 to 4.

In the present invention, the above alkali-soluble
5 resins may be used alone or in combination of two or more.

The amount of the alkali-soluble resin in the present invention is preferably 10 to 1,000 parts by weight, more preferably 20 to 500 parts by weight based on 100 parts by weight of the colorant (A). When the amount of the
10 alkali-soluble resin is smaller than 10 parts by weight, alkali developability may lower, or a stain or the film residue may be produced on the substrate and light screening layer of an unexposed portion. When the amount is larger than 1,000 parts by weight, the concentration of the colorant
15 becomes relatively low, whereby it may be difficult to achieve the target color density of a thin film.

- (C) polyfunctional monomer -

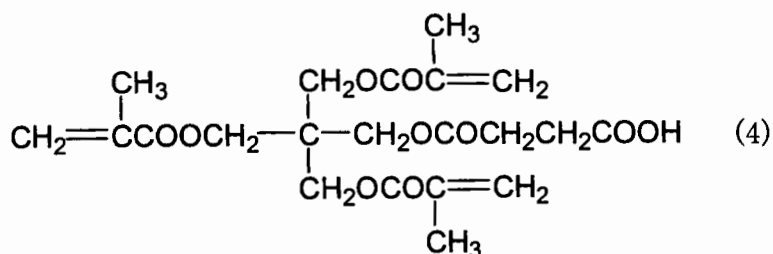
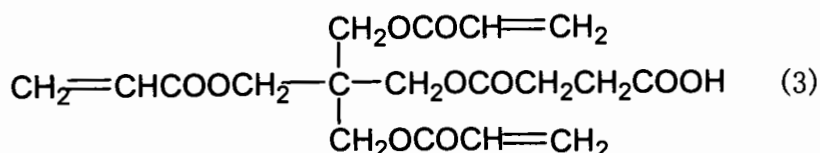
The polyfunctional monomer in the present invention
20 is a monomer having two or more polymerizable unsaturated bonds in the molecule.

Examples of the polyfunctional monomer include di(meth)acrylates of an alkylene glycol such as ethylene glycol and propylene glycol; di(meth)acrylates of a
25 polyalkylene glycol such as polyethylene glycol and polypropylene glycol; poly(meth)acrylates of a polyhydric alcohol having 3 or more hydroxyl groups and dicarboxylic acid modified products thereof such as glycerin, trimethylolpropane, pentaerythritol and dipentaerythritol;
30 oligo(meth)acrylates such as polyester, epoxy resin, urethane resin, alkyd resin, silicone resin and spiran resin; di(meth)acrylates of a polymer having a hydroxyl group at both terminals such as poly-1,3-butadiene having a hydroxyl group at both terminals, polyisoprene having a hydroxyl group

at both terminals and polycaprolactone having a hydroxyl group at both terminals; and tris[2-(meth)acryloyloxyethyl]phosphate.

Out of these polyfunctional monomers,

- 5 poly(meth)acrylates of a polyhydric alcohol having 3 or more hydroxyl groups and dicarboxylic acid modified products thereof are preferred, as exemplified by trimethylolpropane triacrylate, trimethylolpropane trimethacrylate, pentaerythritol triacrylate, pentaerythritol
10 trimethacrylate, pentaerythritol tetraacrylate, pentaerythritol tetramethacrylate, dipentaerythritol pentaacrylate, dipentaerythritol pentamethacrylate, dipentaerythritol hexaacrylate, dipentaerythritol hexamethacrylate and compounds represented by the following
15 formulas (3) and (4).



- Out of these, trimethylolpropane triacrylate,
20 pentaerythritol triacrylate and dipentaerythritol hexaacrylate are particularly preferred because they provide a colored layer having excellent strength and surface smoothness and rarely produce a stain or the film residue on the substrate and light screening layer of an unexposed
25 portion.

The above polyfunctional monomers may be used alone

or in combination of two or more.

The amount of the polyfunctional monomer in the present invention is preferably 5 to 500 parts by weight, more preferably 20 to 300 parts by weight based on 100 parts by weight of the alkali-soluble resin (B). When the amount of the polyfunctional monomer is smaller than 5 parts by weight, the strength and surface smoothness of the colored layer may deteriorate and when the amount is larger than 500 parts by weight, alkali developability may lower, or a stain or the film residue may be produced on the substrate and light screening layer of an unexposed portion.

In the present invention, the polyfunctional monomer may be used in combination with a monofunctional monomer having one polymerizable unsaturated bond.

Examples of the above monofunctional monomer include the above carboxyl group-containing unsaturated monomers and copolymerizable unsaturated monomers enumerated for the above alkali-soluble resin (B), N-(meth)acryloylmorpholine, N-vinylpyrrolidone, N-vinyl- ϵ -caprolactam and commercially available M-5600 (trade name of Toagosei Chemical Industry Co., Ltd.).

These monofunctional monomers may be used alone or in combination of two or more. The amount of the monofunctional monomer is preferably 90 wt% or less, more preferably 50 wt% or less based on the total of the polyfunctional monomer and the monofunctional monomer. When the amount of the monofunctional monomer is larger than 90 wt%, the strength and surface smoothness of the obtained colored layer may become unsatisfactory.

The total amount of the polyfunctional monomer and the monofunctional monomer in the present invention is preferably 5 to 500 parts by weight, more preferably 20 to 300 parts by weight based on 100 parts by weight of the alkali-soluble resin (B). When the total amount is smaller

than 5 parts by weight, the strength and surface smoothness of the colored layer may deteriorate and when the total amount is larger than 500 parts by weight, alkali developability may lower, or a stain or the film residue may be produced on the substrate and light screening layer of an unexposed portion.

- (D) optical radical generator -

The optical radical generator in the present invention contains at least one component (to be referred to as "optical radical generator (D1)" hereinafter) selected from the group consisting of a compound represented by the above formula (1) and a compound represented by the above formula (2) and at least one component (to be referred to as "optical radical generator D2" hereinafter) selected from the group consisting of a biimidazole compound, benzophenone compound, thioxanthone compound and ketocoumarin compound. This optical radical generator forms a radical capable of initiating the polymerization of (C) the polyfunctional monomer and the optional monofunctional monomer upon exposure to radiation such as visible radiation, ultraviolet radiation, far ultraviolet radiation, charged corpuscular rays or X-rays.

In the above formulas (1) and (2), examples of the linear, branched or cyclic alkyl group having 1 to 12 carbon atoms represented by R^1 , R^2 and R^3 include methyl group, ethyl group, n-propyl group, i-propyl group, n-butyl group, i-butyl group, sec-butyl group, t-butyl group, n-pentyl group, n-hexyl group, n-heptyl group, n-octyl group, n-nonyl group, n-decyl group, n-undecyl group, n-dodecyl group, cyclopentyl group and cyclohexyl group.

Examples of the linear, branched or cyclic alkyl group having 1 to 6 carbon atoms represented by R^4 , R^5 and R^6 include methyl group, ethyl group, n-propyl group, i-propyl group,

n-butyl group, i-butyl group, sec-butyl group, t-butyl group, n-pentyl group, n-hexyl group, cyclopentyl group and cyclohexyl group.

Out of the substituents for the alkyl group represented by R^1 , R^2 , R^3 , R^4 , R^5 and R^6 and the substituents for the phenyl group represented by R^1 and R^2 , examples of the linear, branched or cyclic alkoxy group having 1 to 6 carbon atoms include methoxy group, ethoxy group, n-propoxy group, i-propoxy group, n-butoxy group and t-butoxy group. Examples of the halogen atom include fluorine atom and chlorine atom.

Out of the substituents for the phenyl group represented by R^1 and R^2 , examples of the linear, branched or cyclic alkyl group having 1 to 6 carbon atoms include methyl group, ethyl group, n-propyl group, i-propyl group, n-butyl group and t-butyl group.

At least one of these substituents or at least one type of the substituents may be existent in each alkyl group and each phenyl group.

In the formulas (1) and (2), R^1 is preferably a methyl group, ethyl group, n-propyl group, i-propyl group, n-butyl group or phenyl group, R^2 is preferably a hydrogen atom, methyl group, ethyl group, n-propyl group, i-propyl group, n-butyl group, n-pentyl group, n-hexyl group, n-heptyl group or n-octyl group, R^3 is preferably a hydrogen atom, methyl group, ethyl group, n-propyl group, i-propyl group or n-butyl group, and R^4 , R^5 and R^6 are each preferably a hydrogen atom, methyl group, ethyl group, n-propyl group, i-propyl group or n-butyl group.

Preferred examples of the optical radical generator (D1) in the present invention include

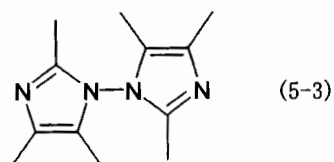
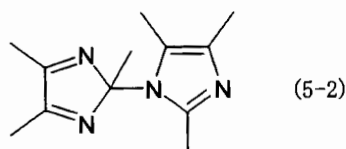
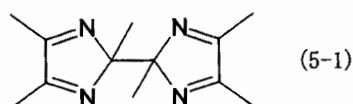
1-[9-ethyl-6-benzoyl-9.H.-carbazol-3-yl]-nonane-1,2-nonane-2-oxime-O-benzoate,
1-[9-ethyl-6-benzoyl-9.H.-carbazol-3-yl]-nonane-1,2-

nonane-2-oxime-O-acetate,
 1-[9-ethyl-6-benzoyl-9.H.-carbazol-3-yl]-pentane-1,2-
 pentane-2-oxime-O-acetate,
 1-[9-ethyl-6-benzoyl-9.H.-carbazol-3-yl]-octan-1-
 5 oneoxime-O-acetate,
 1-[9-ethyl-6-(2-methylbenzoyl)-9.H.-carbazol-3-yl]-
 ethan-1-oneoxime-O-benzoate,
 1-[9-ethyl-6-(2-methylbenzoyl)-9.H.-carbazol-3-yl]-
 ethan-1-oneoxime-O-acetate,
 10 1-[9-ethyl-6-(1,3,5-trimethylbenzoyl)-9.H.-carbazol-3-
 yl]-ethan-1-oneoxime-O-benzoate and
 1-[9-n-butyl-6-(2-ethylbenzoyl)-9.H.-carbazol-3-yl]-
 ethan-1-oneoxime-O-benzoate.

Out of these optical radical generators (D1),
 15 1-[9-ethyl-6-(2-methylbenzoyl)-9.H.-carbazol-3-yl]-
 ethan-1-oneoxime-O-acetate is particularly preferred.

The above optical radical generators (D1) may be used
 alone or in combination of two or more.

Out of the optical radical generators (D2), the
 20 biimidazole compound is, for example, a compound having at
 least one main skeleton represented by the following formula
 (5-1), (5-2) or (5-3).



Examples of the biimidazole compound include
 25 2,2'-bis(2-chlorophenyl)-4,4',5,5'-tetrakis(4-

ethoxycarbonylphenyl)-1,2'-biimidazole,
2,2'-bis(2-bromophenyl)-4,4',5,5'-tetrakis(4-
ethoxycarbonylphenyl)-1,2'-biimidazole,
2,2'-bis(2-chlorophenyl)-4,4',5,5'-tetraphenyl-1,2'-
5 biimidazole,
2,2'-bis(2,4-dichlorophenyl)-4,4',5,5'-tetraphenyl-1,2'-
biimidazole,
2,2'-bis(2,4,6-trichlorophenyl)-4,4',5,5'-tetraphenyl-
1,2'-biimidazole,
10 2,2'-bis(2-bromophenyl)-4,4',5,5'-tetraphenyl-1,2'-
biimidazole,
2,2'-bis(2,4-dibromophenyl)-4,4',5,5'-tetraphenyl-1,2'-
biimidazole and
2,2'-bis(2,4,6-tribromophenyl)-4,4',5,5'-tetraphenyl-
15 1,2'-biimidazole.

Out of these biimidazole compounds,
2,2'-bis(2-chlorophenyl)-4,4',5,5'-tetrakis(4-
ethoxycarbonylphenyl)-1,2'-biimidazole,
2,2'-bis(2,4-dichlorophenyl)-4,4',5,5'-tetraphenyl-1,2'-
20 biimidazole and
2,2'-bis(2,4,6-trichlorophenyl)-4,4',5,5'-tetraphenyl-
1,2'-biimidazole are preferred, and
2,2'-bis(2-chlorophenyl)-4,4',5,5'-tetrakis(4-
ethoxycarbonylphenyl)-1,2'-biimidazole is particularly
25 preferred.

The above biimidazole compounds have excellent
solubility in a solvent, do not produce foreign matter such
as an undissolved product and a precipitate, fully promote
a curing reaction by exposure with a small amount of energy,
30 have high sensitivity and high contrast, and do not cause
a curing reaction in an unexposed portion. Therefore, the
coating film after exposure is clearly divided into a cured
portion insoluble in a developer and an uncured portion
having high solubility in a developer, thereby making it

possible to form a high-definition pattern array having a predetermined pixel pattern or black matrix pattern without an undercut.

5 -hydrogen donor-

When the biimidazole compound is used in the present invention, it is preferably used in combination with the following hydrogen donor to further improve sensitivity.

10 The term "hydrogen donor" as used herein means a compound which can provide a hydrogen atom to a radical formed from the biimidazole compound by exposure.

The hydrogen donor is preferably a mercaptan compound defined hereinbelow or an amine compound defined hereinbelow.

15 The above mercaptan compound is a compound having a benzene ring or a hetero ring as a mother nucleus and 1 or more, preferably 1 to 3, more preferably 1 or 2 mercapto groups directly bonded to the mother nucleus (to be referred to as "mercaptan hydrogen donor" hereinafter).

20 The above amine compound is a compound having a benzene ring or a hetero ring as a mother nucleus and 1 or more, preferably 1 to 3, more preferably 1 or 2 amino groups directly bonded to the mother nucleus (to be referred to as "amine hydrogen donor" hereinafter).

25 These hydrogen donors may have a mercapto group and an amino group at the same time.

A detailed description is subsequently given of the hydrogen donor.

30 The mercaptan hydrogen donor may have at least one benzene ring or hetero ring, or both of them. When it has two or more of the rings, a fused ring may or may not be formed.

When the mercaptan hydrogen donor has two or more mercapto groups, as far as at least one free mercapto group remains, at least one of the other mercapto groups may be

substituted by an alkyl, aralkyl or aryl group. Further, as far as at least one free mercapto group remains, the mercaptan hydrogen donor may have a structural unit in which two sulfur atoms are bonded together by a divalent organic group such as an alkylene group or a structural unit in which two sulfur atoms are bonded together in the form of a disulfide.

Further, the mercaptan hydrogen donor may be substituted by a carboxyl group, substituted or nonsubstituted alkoxycarbonyl group, substituted or nonsubstituted phenoxycarbonyl group or nitrile group at a position other than the mercapto group(s).

Examples of this mercaptan hydrogen donor include 2-mercaptobenzothiazole, 2-mercaptobenzoxazole, 2-mercaptobenzoimidazole, 2,5-dimercapto-1,3,4-thiadiazole and 2-mercapto-2,5-dimethylaminopyridine.

Out of these mercaptan hydrogen donors, 2-mercaptobenzothiazole and 2-mercaptobenzoxazole are preferred, and 2-mercaptobenzothiazole is particularly preferred.

The amine hydrogen donor may have at least one benzene ring or hetero ring, or both of them. When it has two or more of the rings, a fused ring may or may not be formed.

At least one amino group of the amine hydrogen donor may be substituted by an alkyl group or substituted alkyl group. The amine hydrogen donor may be substituted by a carboxyl group, substituted or nonsubstituted alkoxycarbonyl group, substituted or nonsubstituted phenoxycarbonyl group or nitrile group at a position other than the amino group(s).

Examples of this amine hydrogen donor include 4,4'-bis(dimethylamino)benzophenone, 4,4'-bis(diethylamino)benzophenone,

4-diethylaminoacetophenone, 4-dimethylaminopropiophenone, ethyl 4-dimethylaminobenzoate, i-amyl 4-dimethylaminobenzoate, 4-dimethylaminobenzoic acid and 4-dimethylaminobenzonitrile.

5 Out of these amine hydrogen donors, 4,4'-bis(dimethylamino)benzophenone and 4,4'-bis(diethylamino)benzophenone are preferred, and 4,4'-bis(diethylamino)benzophenone is particularly preferred.

10 In the present invention, the above hydrogen donors may be used alone or in combination of two or more. A combination of at least one mercaptan hydrogen donor and at least one amine hydrogen donor is preferably used because the formed colored layer hardly falls off from the substrate
15 during development and has high strength and sensitivity.

 Preferred examples of the combination of the mercaptan hydrogen donor and the amine hydrogen donor include a combination of 2-mercaptobenzothiazole and 4,4'-bis(dimethylamino)benzophenone, combination of
20 2-mercaptobenzothiazole and 4,4'-bis(diethylamino)benzophenone, combination of 2-mercaptobenzoxazole and 4,4'-bis(dimethylamino)benzophenone, and combination of 2-mercaptobenzoxazole and
25 4,4'-bis(diethylamino)benzophenone. A combination of 2-mercaptobenzothiazole and 4,4'-bis(diethylamino)benzophenone and a combination of 2-mercaptobenzoxazole and 4,4'-bis(diethylamino)benzophenone are more preferred, and
30 a combination of 2-mercaptobenzothiazole and 4,4'-bis(diethylamino)benzophenone is particularly preferred.

 The weight ratio of the mercaptan hydrogen donor to the amine hydrogen donor in the combination of the mercaptan

hydrogen donor and the amine hydrogen donor is preferably 1:1 to 1:4, more preferably 1:1 to 1:3.

Examples of the above benzophenone compound include 4,4'-bis(dimethylamino)benzophenone and

5 4,4'-bis(diethylamino)benzophenone.

Examples of the above thioxanthone compound include thioxanthone, 2-chlorothioxanthone, 2,4-diethylthioxanthone, 2-methylthioxanthone and 2-i-propylthioxanthone.

10 Examples of the above ketocoumarin compound include 3-ketocoumarin.

In the present invention, the optical radical generator (D2) is preferably 2,4-diethylthioxanthone, 2,2'-bis(2-chlorophenyl)-4,5,4',5'-tetrakis(4-ethoxycarbonylphenyl)-1,2'-biimidazole, 15 4,4'-bis(diethylamino)benzophenone or 2-mercaptobenzothiazole.

The above optical radical generators (D2) may be used alone or in combination of two or more.

20 The optical radical generator in the present invention may contain a component (to be referred to as "other optical radical generator" hereinafter) other than the optical radical generator (D1) and the optical radical generator (D2).

25 The other optical radical generator is, for example, other O-acyloxime compound, benzoin compound, acetophenone compound, α -diketone compound, polynuclear quinone compound, phosphine compound or triazine compound.

Examples of the other O-acyloxime compound include 30 1,2-octadione-1-[4-(phenylthio)phenyl]-2-(O-benzoyloxime), 1,2-butanedione-1-[4-(phenylthio)phenyl]-2-(O-benzoyloxime), 1,2-butanedione-1-[4-(phenylthio)phenyl]-2-(O-

acetyloxime),

1,2-octadione-1-[4-(methylthio)phenyl]-2-(O-benzoyloxime) and

1,2-octadione-1-[4-(phenylthio)phenyl]-2-[O-(4-methylbenzoyloxime)].

Examples of the above benzoin compound include benzoin, benzoin methyl ether, benzoin ethyl ether, benzoin isopropyl ether, benzoin isobutyl ether and methyl 2-benzoylbenzoate.

Examples of the above acetophenone compound include
 10 2,2-dimethoxyacetophenone, 2,2-diethoxyacetophenone,
 2,2-dimethoxy-2-phenylacetophenone,
 2-hydroxy-2-methyl-1-phenylpropan-1-one,
 1-(4-isopropylphenyl)-2-hydroxy-2-methylpropan-1-one,
 2-methyl-(4-methylthiophenyl)-2-morpholino-1-propan-1-
 15 one, 4-(2-hydroxyethoxy)phenyl-(2-hydroxy-2-propyl)ketone,
 2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)butan-1-
 one, 1-hydroxycyclohexylphenyl ketone and
 2,2-dimethoxy-1,2-diphenylethan-1-one.

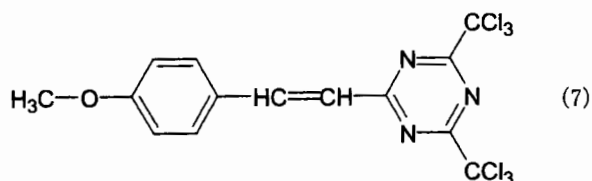
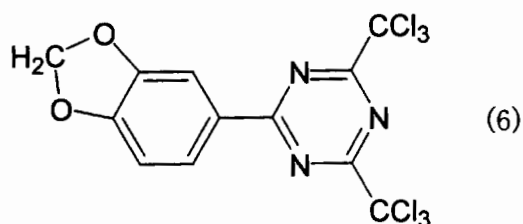
Examples of the above α -diketone compound include
 20 diacetyl, dibenzoyl and methyl benzoyl formate.

Examples of the above polynuclear quinone compound include anthraquinone, 2-ethylantraquinone, 2-*t*-butylantraquinone and 1,4-naphthoquinone.

Examples of the above phosphine compound include
 25 bis(2,4,6-trimethylbenzoyl)phenylphosphine oxide and
 2,4,6-trimethylbenzoyldiphenylphosphine oxide.

Examples of the above triazine compound include compounds having a halomethyl group such as
 2,4,6-tris(trichloromethyl)-*s*-triazine,
 30 2-methyl-4,6-bis(trichloromethyl)-*s*-triazine,
 2-[2-(furan-2-yl)ethenyl]-4,6-bis(trichloromethyl)-*s*-triazine,
 2-[2-(5-methylfuran-2-yl)ethenyl]-4,6-bis(trichloromethyl)-*s*-triazine,
 2-[2-(4-diethylamino-2-methylphenyl)ethenyl]-4,6-

bis(trichloromethyl)-s-triazine,
 2-[2-(3,4-dimethoxyphenyl)ethenyl]-4,6-bis
 (trichloromethyl)-s-triazine,
 2-(4-methoxyphenyl)-4,6-bis(trichloromethyl)-s-triazine,
 5 2-(4-ethoxystyryl)-4,6-bis(trichloromethyl)-s-triazine,
 2-(4-n-butoxyphenyl)-4,6-bis(trichloromethyl)-s-triazine,
 and compounds represented by the following formulas (6) and
 (7).



10

In the present invention, the above other optical radical generators may be used alone or in combination of two or more.

The total amount of the optical radical generators in
 15 the present invention is preferably 0.01 to 200 parts by weight, more preferably 1 to 120 parts by weight, particularly preferably 1 to 100 parts by weight based on 100 parts by weight of the total of (C) the polyfunctional monomer and the optional monofunctional monomer. When the
 20 total amount of the optical radical generators is smaller than 0.01 part by weight, it may be difficult to obtain a pattern array having a predetermined pixel pattern or black matrix pattern due to incomplete curing by exposure. When the total amount is larger than 200 parts by weight, the formed
 25 colored layer may fall off from the substrate during development and a stain or the film residue may be produced on the substrate and light screening layer of an unexposed

portion.

The amount of the optical radical generator (D2) is preferably 10 to 50 wt%, more preferably 10 to 30 wt% based on the total of the optical radical generator (D1) and the optical radical generator (D2). When the amount of the optical radical generator (D2) is smaller than 10 wt%, it may be difficult to obtain a pixel pattern and when the amount is larger than 50 wt%, the anticipated effect of the present invention may be impaired.

The amount of the other optical radical generator is preferably 50 wt% or less, more preferably 30 wt% or less based on the total of the optical radical generators. When the amount of the other optical radical generator is larger than 50 wt%, the anticipated effect of the present invention may be impaired. In the present invention, the above optical radical generators may be used in conjunction with at least one of a sensitizer, curing accelerator and polymer optical crosslinking/sensitizing agent as required.

20 - additives -

The radiation sensitive composition of the present invention may contain various additives as required.

The above additives include an organic acid or an organic amino compound (excluding the above hydrogen donor) which serves to further improve the solubility in an alkali developer of the radiation sensitive composition and further suppress the production of the residual undissolved product after development.

The above organic acid is preferably an aliphatic carboxylic acid or phenyl group-containing carboxylic acid having at least one carboxyl group in the molecule.

Examples of the above aliphatic carboxylic acid include monocarboxylic acids such as formic acid, acetic acid, propionic acid, butyric acid, valeric acid, pivalic acid,

caproic acid, diethylacetic acid, enanthic acid and caprylic acid; dicarboxylic acids such as oxalic acid, malonic acid, succinic acid, glutaric acid, adipic acid, pimelic acid, suberic acid, azelaic acid, sebacic acid, brassylic acid, methylmalonic acid, ethylmalonic acid, dimethylmalonic acid, methylsuccinic acid, tetramethylsuccinic acid, cyclohexanedicarboxylic acid, itaconic acid, citraconic acid, maleic acid, fumaric acid and mesaconic acid; and tricarboxylic acids such as tricarballylic acid, aconitic acid and camphoronic acid.

The above phenyl group-containing carboxylic acid is, for example, a compound having a carboxyl group directly bonded to a phenyl group, or a carboxylic acid having a carboxyl group bonded to a phenyl group through a carbon chain.

Examples of the phenyl group-containing carboxylic acid include aromatic monocarboxylic acids such as benzoic acid, toluic acid, cuminic acid, hemellitic acid and mesitylenic acid; aromatic dicarboxylic acids such as phthalic acid, isophthalic acid and terephthalic acid; aromatic polycarboxylic acids having 3 or more carboxyl groups such as trimellitic acid, trimesic acid, mellophanic acid and pyromellitic acid; and phenylacetic acid, hydroatropic acid, hydrocinnamic acid, mandelic acid, phenylsuccinic acid, atropic acid, cinnamic acid, cinnamylidenic acid, coumaric acid and umbellic acid.

Out of these organic acids, aliphatic dicarboxylic acids are preferred, and malonic acid, adipic acid, itaconic acid, citraconic acid, fumaric acid and mesaconic acid are particularly preferred as the aliphatic carboxylic acid from the viewpoints of alkali solubility, solubility in a solvent which will be described hereinafter and the prevention of a stain or the film residue on the substrate and light screening layer of an unexposed portion. Aromatic

dicarboxylic acids are preferred, and phthalic acid is particularly preferred as the phenyl group-containing carboxylic acid.

The above organic acids may be used alone or in
5 combination of two or more.

The amount of the organic acid is preferably 15 wt% or less, more preferably 10 wt% or less based on the whole radiation sensitive composition. When the amount of the organic acid is larger than 15 wt%, the adhesion of the formed
10 colored layer to the substrate may lower.

The above organic amino compound is preferably an aliphatic amine or phenyl group-containing amine having at least one amino group in the molecule.

Examples of the above aliphatic amine include
15 mono(cyclo)alkylamines such as n-propylamine, i-propylamine, n-butylamine, i-butylamine, sec-butylamine, t-butylamine, n-pentylamine, n-hexylamine, n-heptylamine, n-octylamine, n-nonylamine, n-decylamine, n-undecylamine, n-dodecylamine, cyclohexylamine, 2-methylcyclohexylamine,
20 3-methylcyclohexylamine, 4-methylcyclohexylamine, 2-ethylcyclohexylamine, 3-ethylcyclohexylamine and 4-ethylcyclohexylamine; di(cyclo)alkylamines such as methyl·ethylamine, diethylamine, methyl·n-propylamine, ethyl·n-propylamine, di-n-propylamine, di-i-propylamine,
25 di-n-butylamine, di-i-butylamine, di-sec-butylamine, di-t-butylamine, di-n-pentylamine, di-n-hexylamine, methylcyclohexylamine, ethylcyclohexylamine and dicyclohexylamine; tri(cyclo)alkylamines such as dimethyl·ethylamine, methyl·diethylamine, triethylamine,
30 dimethyl·n-propylamine, diethyl·n-propylamine, methyl·di-n-propylamine, ethyl·di-n-propylamine, tri-n-propylamine, tri-i-propylamine, tri-n-butylamine, tri-i-butylamine, tri-sec-butylamine, tri-t-butylamine, tri-n-pentylamine, tri-n-hexylamine,

dimethylcyclohexylamine, diethylcyclohexylamine, methylcyclohexylamine, ethylcyclohexylamine and tricyclohexylamine; mono(cyclo)alkanolamines such as 2-aminoethanol, 3-amino-1-propanol, 1-amino-2-propanol, 4-amino-1-butanol, 5-amino-1-pentanol, 6-amino-1-hexanol and 4-amino-1-cyclohexanol; di(cyclo)alkanolamines such as diethanolamine, di-n-propanolamine, di-i-propanolamine, di-n-butanolamine, di-i-butanolamine, di-n-pentanolamine, di-n-hexanolamine and di(4-cyclohexanol)amine; tri(cyclo)alkanolamines such as triethanolamine, tri-n-propanolamine, tri-i-propanolamine, tri-n-butanolamine, tri-i-butanolamine, tri-n-pentanolamine, tri-n-hexanolamine and tri(4-cyclohexanol)amine; amino(cyclo)alkanediols such as 3-amino-1,2-propanediol, 2-amino-1,3-propanediol, 4-amino-1,2-butanediol, 4-amino-1,3-butanediol, 4-amino-1,2-cyclohexanediol, 4-amino-1,3-cyclohexanediol, 3-dimethylamino-1,2-propanediol, 3-diethylamino-1,2-propanediol, 2-dimethylamino-1,3-propanediol and 2-diethylamino-1,3-propanediol; amino group-containing cycloalkane methanols such as 1-aminocyclopentane methanol, 4-aminocyclopentane methanol, 1-aminocyclohexane methanol, 4-aminocyclohexane methanol, 4-dimethylaminocyclopentane methanol, 4-diethylaminocyclopentane methanol, 4-dimethylaminocyclohexane methanol and 4-diethylaminocyclohexane methanol; and aminocarboxylic acids such as β -alanine, 2-aminobutyric acid, 3-aminobutyric acid, 4-aminobutyric acid, 2-aminoisobutyric acid, 3-aminoisobutyric acid, 2-aminovaleric acid, 5-aminovaleric acid, 6-aminocaproic acid, 1-aminocyclopropanecarboxylic acid, 1-aminocyclohexanecarboxylic acid and 4-aminocyclohexanecarboxylic acid.

The above phenyl group-containing amine is, for example, a compound having an amino group directly bonded to a phenyl group, or a compound having an amino group bonded to a phenyl group through a carbon chain.

5 Examples of the phenyl group-containing amine include aromatic amines such as aniline, 2-methylaniline, 3-methylaniline, 4-methylaniline, 4-ethylaniline, 4-n-propylaniline, 4-i-propylaniline, 4-n-butyylaniline, 4-t-butylianiline, 1-naphthylamine, 2-naphthylamine,
10 N,N-dimethylaniline, N,N-diethylaniline and 4-methyl-N,N-dimethylaniline; aminobenzyl alcohols such as 2-aminobenzyl alcohol, 3-aminobenzyl alcohol, 4-aminobenzyl alcohol, 4-dimethylaminobenzyl alcohol and 4-diethylaminobenzyl alcohol; and aminophenols such as
15 2-aminophenol, 3-aminophenol, 4-aminophenol, 4-dimethylaminophenol and 4-diethylaminophenol.

Out of these organic amino compounds, mono(cyclo)alkanolamines and amino(cyclo)alkanediols are preferred, and 2-aminoethanol, 3-amino-1-propanol,
20 5-amino-1-pentanol, 3-amino-1,2-propanediol, 2-amino-1,3-propanediol and 4-amino-1,2-butanediol are particularly preferred as the aliphatic amine from the viewpoints of solubility in a solvent which will be described hereinafter and the prevention of a stain or the film residue
25 on the substrate and light screening layer of an unexposed portion. Aminophenols are preferred, and 2-aminophenol, 3-aminophenol and 4-aminophenol are particularly preferred as the phenyl group-containing amine.

The above organic amino compounds may be used alone
30 or in combination of two or more.

The amount of the organic amino compound is preferably 15 wt% or less, more preferably 10 wt% or less based on the whole radiation sensitive composition. When the amount of the organic amino compound is larger than 15 wt%, the adhesion

of the formed colored layer to the substrate may lower.

Additives other than the above organic acid and organic amino compound include a dispersion aid such as a blue pigment derivative or yellow pigment derivative, e.g., a copper
 5 phthalocyanine derivative; filler such as glass or alumina; polymer compound such as polyvinyl alcohol, polyethylene glycol monoalkyl ether or poly(fluoroalkylacrylate); nonionic, cationic or anionic surfactant; adhesion accelerator such as vinyl trimethoxysilane, vinyl
 10 triethoxysilane, vinyl tris(2-methoxyethoxy)silane, N-(2-aminoethyl)-3-aminopropyl·methyl·dimethoxysilane, N-(2-aminoethyl)-3-aminopropyltrimethoxysilane, 3-aminopropyltriethoxysilane, 3-glycidoxypropyltrimethoxysilane,
 15 3-glycidoxypropyl·methyl·dimethoxysilane, 2-(3,4-epoxycyclohexyl)ethyltrimethoxysilane, 3-chloropropyl·methyl·dimethoxysilane, 3-chloropropyltrimethoxysilane, 3-methacryloyloxypropyltrimethoxysilane or
 20 3-mercaptopropyltrimethoxysilane; antioxidant such as 2,2'-thiobis(4-methyl-6-t-butylphenol) or 2,6-di-t-butylphenol; ultraviolet light absorber such as 2-(3-t-butyl-5-methyl-2-hydroxyphenyl)-5-chlorobenzotriazole or alkoxybenzophenone; cohesion
 25 inhibitor such as sodium polyacrylate; and heat radical generator such as 1,1'-azobis(cyclohexane-1-carbonitrile) or 2-phenylazo-4-methoxy-2,4-dimethylvaleronitrile.

Solvent

30 The radiation sensitive composition of the present invention comprises the above components (A) to (D) as essential ingredients and optionally the above additives and is preferably mixed with a solvent to be prepared as a liquid composition.

A suitable solvent may be selected and used as far as it disperses or dissolves the components (A) to (D) and additives constituting the radiation sensitive composition, does not react with these components and has suitable
5 volatility.

Examples of the solvent include (poly)alkylene glycol monoalkyl ethers such as ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol mono-n-propyl ether, ethylene glycol mono-n-butyl ether,
10 diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol mono-n-propyl ether, diethylene glycol mono-n-butyl ether, triethylene glycol monomethyl ether, triethylene glycol monoethyl ether, propylene glycol monomethyl ether, propylene glycol
15 monoethyl ether, propylene glycol mono-n-propyl ether, propylene glycol mono-n-butyl ether, dipropylene glycol monomethyl ether, dipropylene glycol monoethyl ether, dipropylene glycol mono-n-propyl ether, dipropylene glycol mono-n-butyl ether, tripropylene glycol monomethyl ether and
20 tripropylene glycol monoethyl ether; (poly)alkylene glycol monoalkyl ether acetates such as ethylene glycol monomethyl ether acetate, ethylene glycol monoethyl ether acetate, diethylene glycol monomethyl ether acetate, diethylene glycol monoethyl ether acetate, propylene glycol monomethyl
25 ether acetate and propylene glycol monoethyl ether acetate; other ethers such as diethylene glycol dimethyl ether, diethylene glycol methyl ethyl ether, diethylene glycol diethyl ether and tetrahydrofuran; ketones such as methyl ethyl ketone, cyclohexanone, 2-heptanone and 3-heptanone;
30 alkyl lactates such as methyl lactate and ethyl lactate; other esters such as ethyl 2-hydroxy-2-methylpropionate, methyl 3-methoxypropionate, ethyl 3-methoxypropionate, methyl 3-ethoxypropionate, ethyl 3-ethoxypropionate, ethyl ethoxyacetate, ethyl hydroxyacetate, methyl

2-hydroxy-3-methylbutanoate,
 3-methyl-3-methoxybutylacetate,
 3-methyl-3-methoxybutylpropionate, ethyl acetate, n-propyl
 acetate, i-propyl acetate, n-butyl acetate, i-butyl acetate,
 5 n-amyl formate, i-amyl acetate, n-butyl propionate, ethyl
 butyrate, n-propyl butyrate, i-propyl butyrate, n-butyl
 butyrate, methyl pyruvate, ethyl pyruvate, n-propyl pyruvate,
 methyl acetoacetate, ethyl acetoacetate and ethyl
 2-oxobutanoate; aromatic hydrocarbons such as toluene and
 10 xylene; and amides and lactams such as N,N-dimethylformamide,
 N,N-dimethylacetamide and N-methylpyrrolidone.

Out of these solvents, propylene glycol monomethyl
 ether, ethylene glycol monomethyl ether acetate, propylene
 glycol monomethyl ether acetate, propylene glycol monoethyl
 15 ether acetate, diethylene glycol dimethyl ether, diethylene
 glycol methyl ethyl ether, cyclohexanone, 2-heptanone,
 3-heptanone, ethyl lactate, ethyl 3-methoxypropionate,
 methyl 3-ethoxypropionate, ethyl 3-ethoxypropionate,
 3-methyl-3-methoxybutylpropionate, n-butyl acetate,
 20 i-butyl acetate, n-amyl formate, i-amyl acetate, n-butyl
 propionate, ethyl butyrate, i-propyl butyrate, n-butyl
 butyrate and ethyl pyruvate are particularly preferred from
 the viewpoints of solubility, pigment dispersibility and
 coatability.

25 The above solvents may be used alone or in combination
 of two or more.

Further, a high-boiling solvent such as benzyl ethyl
 ether, di-n-hexyl ether, acetonylacetone, isophorone,
 caproic acid, caprylic acid, 1-octanol, 1-nonanol, benzyl
 30 alcohol, benzyl acetate, ethyl benzoate, diethyl oxalate,
 diethyl maleate, γ -butyrolactone, ethylene carbonate,
 propylene carbonate or ethylene glycol monophenyl ether
 acetate may be used in conjunction with the above solvent.

These high-boiling solvents may be used alone or in

combination of two or more.

The amount of the solvent is not particularly limited but desirably a value which ensures that the total amount of all the components excluding the solvent of the
5 composition is preferably 5 to 50 wt%, particularly preferably 10 to 40 wt% from the viewpoints of the coatability and stability of the obtained radiation sensitive composition.

10 Color filter

The color filter of the present invention comprises a colored layer made of the radiation sensitive composition of the present invention.

A description is subsequently given of the method of
15 forming the color filter of the present invention.

A light screening layer is optionally formed on the surface of a substrate to define a portion for forming pixels, and a liquid radiation sensitive composition comprising, for example, a red pigment dispersed therein is applied to the
20 substrate and prebaked to vaporize the solvent so as to form a coating film.

This coating film is then exposed to radiation through a photomask, developed with an alkali developer to dissolve and remove an unexposed portion of the coating film and
25 post-baked to form a pixel array having a red predetermined pixel pattern.

Thereafter, the application, prebaking, exposure, development and post-baking of liquid radiation sensitive compositions comprising green and blue pigments dispersed
30 therein are carried out likewise to form a green pixel array and a blue pixel array on the same substrate sequentially so as to obtain a color filter having red, green and blue pixel arrays on the substrate. The order of forming the color pixels is not limited to the above in the present invention.

The black matrix can be formed likewise by using the radiation sensitive composition of the present invention.

The substrate used to form pixels and/or a black matrix is made of glass, silicon, polycarbonate, polyester,
5 aromatic polyamide, polyamide-imide or polyimide.

The substrate may be optionally subjected to a suitable pre-treatment such as chemical treatment with a silane coupling agent, plasma treatment, ion plating, sputtering, gas-phase reaction or vacuum deposition.

10 To apply the liquid radiation sensitive composition to the substrate, a suitable coating technique such as spray coating, roll coating, rotational coating (spin coating), slit die coating, bar coating or ink jet coating may be employed. Out of these, spin coating and split die coating
15 are preferred.

The thickness of the coating film after drying is preferably 0.1 to 10 μm , more preferably 0.2 to 8.0 μm , particularly preferably 0.2 to 6.0 μm .

The radiation used to form pixels and/or a black matrix
20 is selected from visible radiation, ultraviolet radiation, far ultraviolet radiation, electron beam and X-rays. Out of these, radiation having a wavelength of 190 to 450 nm is preferred.

The dose of the radiation is preferably 10 to 10,000
25 J/m^2 .

The above alkali developer is preferably an aqueous solution of sodium carbonate, sodium hydroxide, potassium hydroxide, tetramethylammonium hydroxide, choline,
1,8-diazabicyclo-[5.4.0]-7-undecene or
30 1,5-diazabicyclo-[4.3.0]-5-nonene.

A suitable amount of a water-soluble organic solvent such as methanol or ethanol, or a surfactant may be added to the above alkali developer. The coating film is preferably rinsed after alkali development.

Shower development, spray development, dip (immersion) development or puddle development may be employed. As for development conditions, the coating film is preferably developed at normal temperature for 5 to 300
5 sec.

The thus obtained color filter of the present invention is extremely useful for transmission and reflection color liquid crystal display devices, color image pick-up devices, color sensors, etc.

10

Liquid crystal display device

The liquid crystal display device of the present invention comprises the color filter of the present invention.

15

As an example of the liquid crystal display device of the present invention, a liquid crystal display device having excellent characteristic properties can be manufactured by using the radiation sensitive composition of the present invention to form pixels and/or a black matrix on a thin film transistor substrate array as described above.
20

The radiation sensitive composition of the present invention comprises the above components (A) to (D) as essential ingredients. Particularly preferred examples of the composition are given below.

25

- (1) a radiation sensitive composition comprising a carboxyl group-containing copolymer (B1) as the alkali-soluble resin (B)
- (2) the radiation sensitive composition (1) comprising at least one selected from the group consisting of
30 trimethylolpropane triacrylate, pentaerythritol triacrylate and dipentaerythritol hexaacrylate as the polyfunctional monomer (C)
- (3) the radiation sensitive composition (1) or (2) comprising

1-[9-ethyl-6-(2-methylbenzoyl)-9.H.-carbazol-3-yl]
-ethan-1-oneoxime-O-acetate as the optical radical
generator (D1)

The preferred color filter (4) of the present invention
5 has pixels and/or a black matrix made of the radiation
sensitive composition (1), (2) or (3).

The preferred liquid crystal display device (5) of the
present invention comprises the above color filter (4), and
the more preferred liquid crystal display device (6) of the
10 present invention comprises the above color filter (4) on
a thin film transistor substrate array.

As described above, when the radiation sensitive
composition of the present invention comprises an optical
radical generator which contains an optical radical
15 generator (D1) having high sensitivity to radiation and at
least one optical radical generator (D2) selected from the
group consisting of a biimidazole compound, benzophenone
compound, thioxanthone compound and ketocoumarin compound,
if the amount of exposure is small, for example, 400 J/m^2 ,
20 and the development conditions are severe, for example, a
development temperature of 30°C , a shower pressure of 110
KPa and a developer flow rate of 1.2 liters/min, an excellent
pixel pattern and black matrix pattern without a missing part
of the pattern edge or an undercut can be formed without
25 leaving an undissolved product during development and
producing scum on the pattern edge.

Further, the pixels and black matrix made of the
radiation sensitive composition of the present invention
have high surface smoothness and excellent adhesion to the
30 substrate.

Therefore, the radiation sensitive composition of the
present invention can be extremely advantageously used in
the manufacture of a color filter such as a color filter for
liquid crystal display devices in the field of the electronic

industry.

Examples

The following examples are provided for the purpose
5 of further illustrating the present invention but are in no
way to be taken as limiting.

"Parts" and "%" in the following examples are based
on weight.

10 <(B) preparation of alkali-soluble resin>

Synthetic Example 1

3 parts of 2,2'-azobis(2,4-dimethylvaleronitrile) and
200 parts of propylene glycol monomethyl ether acetate were
fed to a flask equipped with a cooling tube and a stirrer,
15 15 parts of methacrylic acid, 15 parts of styrene, 25 parts
of N-phenylmaleimide, 35 parts of benzyl methacrylate, 10
parts of glycerol monomethacrylate and 5 parts of
 α -methylstyrene dimer as a chain transfer agent were then
fed to the flask, the inside of the flask was substituted
20 by nitrogen, the resulting mixture was stirred gently, and
the reaction solution was heated at 80°C to be polymerized
by maintaining that temperature for 3 hours. Thereafter,
the reaction solution was further heated at 100°C, 0.5 part
of 2,2'-azobis(2,4-dimethylvaleronitrile) was added, and
25 polymerization was further carried out for another 1 hour
to obtain a resin solution (solid content of 33.0 %).

The obtained resin had an Mw of 17,000 and an Mn of
5,900. This resin was designated as resin (B-1).

30 Example 1

<preparation of liquid composition>

78 parts of a mixture of C.I. Pigment Blue 15:6 and
C.I. Pigment Violet 23 in a weight ratio of 95/5 as a colorant
(A), 60 parts of the resin (B-1) as an alkali-soluble resin

(B), 90 parts of dipentaerythritol hexaacrylate as a polyfunctional monomer (C), 10 parts of 1-[9-ethyl-6-(2-methylbenzoyl)-9.H.-carbazol-3-yl]-ethan-1-oneoxime-O-acetate (CGI-242 (trade name) of Ciba Specialty Chemicals Holding Inc., the same shall apply hereinafter) as an optical radical generator (D1), 15 parts of 2,4-diethylthioxanthone (KAYACUREDET-X-S (trade name) of Nippon Kayaku Co., Ltd.) as an optical radical generator (D2) and 1,000 parts of a mixture of cyclohexanone and propylene glycol monomethyl ether acetate in a weight ratio of 80/20 as a solvent were mixed together to prepare a liquid radiation sensitive composition (B1).

<formation of colored layer>

15 This liquid composition (B1) was applied to a soda-lime glass substrate having an SiO₂ film for preventing the elution of sodium ions on the surface with a spin coater and prebaked on a hot plate heated at 80°C for 100 sec to form a 2.5 μm-thick coating film.

20 Thereafter, this substrate was cooled to room temperature and exposed to ultraviolet radiation having wavelengths of 365 nm, 405 nm and 436 nm through a photomask (slit width of 90 μm) with a high-pressure mercury lamp to the coating film. The amount of exposure was set to 400 J/m².
25 Thereafter, the substrate was shower developed with a 0.04 wt% aqueous solution of potassium hydroxide at a development temperature of 30°C, a shower pressure of 110 KPa and a developer flow rate of 1.2 liters/min. It was then rinsed with super pure water, dried with air and post-baked in a
30 clean oven heated at 220°C for 30 minutes to form a blue pixel array having a striped pixel pattern on the substrate.

<evaluation>

When the pixel array on the substrate was observed

through an optical microscope, no development residue was seen on the substrate of an unexposed portion, and no scum and no missing part were seen on the edge of the pixel pattern.

When the section of the pixel pattern was observed
5 through a scanning electron microscope (SEM), no undercut was seen.

Comparative Example 1

<preparation of liquid composition and formation of colored
10 layer>

A radiation sensitive composition (b1) was prepared in the same manner as in Example 1 except that only 10 parts of
1- [9-ethyl-6- (2-methylbenzoyl) -9.H.-carbazol-3-yl] -ethan
15 -1-oneoxime-O-acetate which is the optical radical generator (D1) was used as an optical radical generator.

Thereafter, a pixel array having a blue striped pixel pattern was formed on the substrate in the same manner as in Example 1 except that the liquid composition (b1) was used
20 in place of the liquid composition (B1).

<evaluation>

When the pixel array on the substrate was observed through an optical microscope, no development residue was
25 seen on the substrate of an unexposed portion but a missing part of the edge of the pixel pattern and the peeling of the pattern itself were seen.

When the section of the pixel pattern was observed through a scanning electron microscope (SEM), an undercut was
30 seen.

Example 2

<preparation of liquid composition and formation of colored layer>

80 parts of a mixture of C.I. Pigment Blue 15:6 and C.I. Pigment Violet 23 in a weight ratio of 95/5 as a colorant (A), 60 parts of the resin (B-1) as an alkali-soluble resin (B), 90 parts of dipentaerythritol hexaacrylate as a polyfunctional monomer (C), 5 parts of 1-[9-ethyl-6-(2-methylbenzoyl)-9.H.-carbazol-3-yl]-ethan-1-oneoxime-O-acetate as an optical radical generator (D1), 2 parts of 2,2'-bis(2-chlorophenyl)-4,5,4',5'-tetrakis(4-ethoxycarbonylphenyl)-1,2'-biimidazole, 6 parts of 4,4'-bis(diethylamino)benzophenone and 2 parts of 2-mercaptobenzothiazole as optical radical generators (D2) and 1,000 parts of a mixture of cyclohexanone and propylene glycol monomethyl ether acetate in a weight ratio of 80/20 as a solvent were mixed together to prepare a liquid radiation sensitive composition (B2).

A blue pixel array having a striped pixel pattern was formed on the substrate in the same manner as in Example 1 except that the liquid composition (B2) was used in place of the liquid composition (B1).

<evaluation>

When the pixel array on the substrate was observed through an optical microscope, no development residue was seen on the substrate of an unexposed portion, and no scum and no missing part were seen on the edge of the pixel pattern.

When the section of the pixel pattern was observed through a scanning electron microscope (SEM), no undercut was seen.

Comparative Example 2

<preparation of liquid composition and formation of colored layer>

A radiation sensitive composition (b2) was prepared in the same manner as in Example 2 except that only 5 parts

of

1- [9-ethyl-6- (2-methylbenzoyl) -9.H. -carbazol-3-yl] -ethan
-1-oneoxime-O-acetate which is the optical radical generator
(D1) was used as an optical radical generator.

5 Thereafter, a pixel array having a blue striped pixel
pattern was formed on the substrate in the same manner as
in Example 2 except that the liquid composition (b2) was used
in place of the liquid composition (B2).

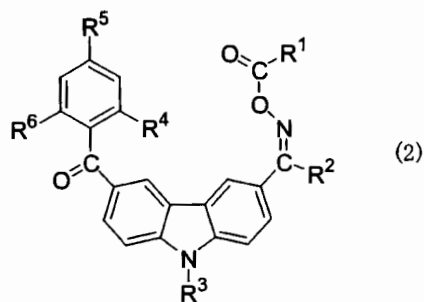
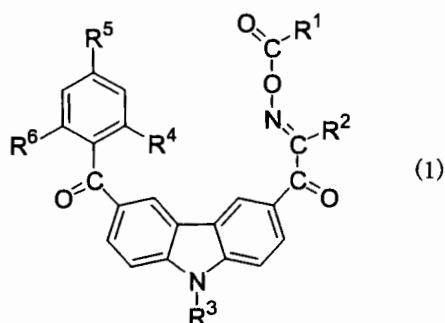
10 <evaluation>

 When the pixel array on the substrate was observed
through an optical microscope, no development residue was
seen on the substrate of an unexposed portion but a missing
part of the edge of the pixel pattern and the peeling of the
15 pattern itself were seen.

 When the section of the pixel pattern was observed
through a scanning electron microscope (SEM) , an undercut was
seen.

What is claimed is:

1. A radiation sensitive composition which comprises (A) a colorant, (B) an alkali-soluble resin, (C) a polyfunctional monomer and (D) an optical radical generator containing at least one component selected from the group consisting of a compound represented by the following formula (1) and a compound represented by the following formula (2) and at least one component selected from the group consisting of a biimidazole compound, benzophenone compound, thioxanthone compound and ketocoumarin compound and which is used to form a colored layer:



- (in the formulas (1) and (2), R¹'s are each independently a linear, branched or cyclic alkyl group having 1 to 12 carbon atoms or phenyl group, R²'s are each independently a hydrogen atom, linear, branched or cyclic alkyl group having 1 to 12 carbon atoms or phenyl group, R³'s are each independently a hydrogen atom or linear, branched or cyclic alkyl group having 1 to 12 carbon atoms, R⁴, R⁵ and R⁶ are each independently a hydrogen atom or linear, branched or cyclic alkyl group having 1 to 6 carbon atoms, with the proviso that the alkyl group represented by R¹, R², R³, R⁴, R⁵ and R⁶ may

be substituted by a substituent selected from the group consisting of a linear, branched or cyclic alkoxy group having 1 to 6 carbon atoms, phenyl group and halogen atom, and the phenyl group represented by R^1 and R^2 may be

5 substituted by a substituent selected from the group consisting of a linear, branched or cyclic alkyl group having 1 to 6 carbon atoms, linear, branched or cyclic alkoxy group having 1 to 6 carbon atoms, phenyl group and halogen atom).

10 2. A color filter having a colored layer made of the radiation sensitive composition of claim 1.

3. A liquid crystal display device comprising the color filter of claim 2.

15

4. Use of the radiation sensitive composition of claim 1 for forming a colored layer for a color filter.