

RADIATION SENSITIVE COMPOSITION FOR COLOR FILTERS, METHOD
FOR THE PREPARATION OF THE SAME, COLOR FILTER AND COLOR LIQUID
CRYSTAL DISPLAY DEVICE

5 Field of the Invention

The present invention relates to a radiation sensitive composition for color filters, a method for the preparation of the same, a color filter and a color liquid crystal display device. More specifically, it relates to a radiation
10 sensitive composition for color filters which is useful for the manufacture of a color filter for use in transmission and reflection color liquid crystal display devices and color image pick-up devices, a method for the preparation of the same, a color filter having red pixels formed from the
15 radiation sensitive composition for color filters, and a color liquid crystal display device having the color filter.

Description of the Prior Art

As means of manufacturing a color filter from a colored
20 radiation sensitive composition, there is known a method in which a coating film of the colored radiation sensitive composition is formed on a substrate or a substrate comprising a light screening layer having a desired pattern, exposed to radiation through a mask having a desired pattern
25 (to be referred to as "exposure" hereinafter), developed with an alkali developer to dissolve and remove an unexposed portion, and post-baked in a clean oven or on a hot plate to obtain color pixels (refer to JP-A 2-144502 and JP-A 3-53201) (the term "JP-A" as used herein means an "unexamined
30 published Japanese patent application").

Since it is desired that a liquid crystal display device comprising a color filter should have high brightness, demand for a color filter having high transmittance is now growing. To meet this demand, as disclosed by JP-A 2002-372618, it

is known that use of a combination of C.I. Pigment Red 254 and C.I. Pigment Red 242 is particularly effective as a pigment for forming red pixels.

Along with the recent spread of digital video cameras
5 and high-vision TV's, demand for color liquid crystal display devices capable of displaying a deep color such as a deep blue winter sea or bright red setting sun is rising. If the "blackness" of a black display portion is not displayed clearly, an unclear blurred image will be obtained.
10 Therefore, pixels or colored layers having high color strength and high contrast ratio are in demand.

As liquid crystal display devices are becoming larger in size, glass substrates for the manufacture of a color filter are also becoming larger in size. It is known that
15 when the substrate becomes large in size, it is difficult to form a uniform coating film on the entire surface of the substrate. Typical coating techniques for radiation sensitive compositions for color filters include central drop coating, slit & spin coating, and slit coating. It is
20 found that when these coating techniques are employed, the rheology of the coating solution itself has a great influence upon coating efficiency. Although the desired rheology of the solution is a Newtonian solution in terms of coating efficiency, when the dispersion efficiency of a pigment
25 dispersion is low, the resulting dispersion tends to become a non-Newtonian solution. In this case, with a coating technique for controlling the thickness of a film by rotation, such as central drop coating and slit & spin coating techniques, there is a difference in film thickness between
30 the center portion and the end portion of the substrate. Even with a slit coating technique with no rotation, delivery and leveling properties become worse, thereby causing a coating failure such as nonuniformity in film thickness or the formation of a streak. Therefore, a radiation sensitive

composition for color filters having rheological characteristics close to those of a Newtonian solution is desired.

5 Summary of the Invention

It is an object of the present invention to provide a radiation sensitive composition for color filters which provides red pixels having high transmittance and high contrast ratio and has rheological characteristics suitable
10 for the application of a large-sized substrate.

It is another object of the present invention to provide a method for the preparation of the radiation sensitive composition for color filters of the present invention.

It is still another object of the present invention
15 to provide a color filter and a color liquid crystal display device having the color filter in connection with the method for the preparation of the radiation sensitive composition for color filters of the present invention.

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

Firstly, the above objects and advantages of the present invention are attained by a radiation sensitive composition for color filters, comprising (A) a pigment, (B) a dispersant, (C) an alkali-soluble resin comprising a
25 copolymer of (c1) a carboxyl group-containing unsaturated monomer comprising (meth)acrylic acid, (c2) an N-substituted maleimide and (c3) at least one selected from the group consisting of styrene, α -methylstyrene, p-hydroxy- α -methylstyrene, methyl (meth)acrylate,
30 2-hydroxyethyl (meth)acrylate, allyl (meth)acrylate, benzyl (meth)acrylate, glycerol mono(meth)acrylate, polystyrene macromonomer and polymethyl methacrylate macromonomer, (D) a polyfunctional monomer, (E) a radiation sensitive radical generator and (F) a solvent, wherein

the pigment (A) contains 20 wt% or more of C.I. Pigment Red 242 and has an average particle diameter "r" (nm) of 50 to 200.

5 The term "radiation" as used herein includes visible radiation, ultraviolet radiation, far ultraviolet radiation, electron radiation and X-radiation.

Secondly, the above objects and advantages of the present invention are attained by a method for the preparation of the above radiation sensitive composition for
10 color filters, comprising the steps of:

dispersing (A) a pigment which contains 20 wt% or more of C.I. Pigment Red 242 and has an average particle diameter larger than 200 nm in a medium containing (B) a dispersant, at least part of (C) an alkali-soluble resin and at least
15 part of (F) a solvent; and

mixing the obtained dispersion with (D) a polyfunctional monomer, (E) a radiation sensitive radical generator and optionally (C) the alkali-soluble resin and (F) the solvent.

20 Thirdly, the above objects and advantages of the present invention are attained by a color filter having red pixels formed from the above radiation sensitive composition for color filters.

In the fourth place, the above objects and advantages
25 of the present invention are attained by a color liquid crystal display device having the above color filter.

Detailed Description of the Preferred Embodiments

The present invention will be described in detail
30 hereinafter.

(A) pigment

The pigment in the present invention contains C.I. Pigment Red 242 according to color index (C.I.; issued by The Society of Dyers and Colourists, the same shall apply

hereinafter).

The pigment in the present invention may further contain other pigment as the case may be.

Although the above other pigment is not particularly
5 limited, it is preferably an organic pigment because high purity, the development of a highly transparent color and heat resistance are required for a color filter.

Examples of the above other organic pigment are compounds classified into a group of pigments according to
10 color index, specifically compounds having the following color index (C.I.) numbers:

C.I. Pigment Yellow 12, C.I. Pigment Yellow 13, C.I. Pigment Yellow 14, C.I. Pigment Yellow 17, C.I. Pigment Yellow 20, C.I. Pigment Yellow 24, C.I. Pigment Yellow 31, C.I. Pigment
15 Yellow 55, C.I. Pigment Yellow 83, C.I. Pigment Yellow 93, C.I. Pigment Yellow 109, C.I. Pigment Yellow 110, C.I. Pigment Yellow 138, C.I. Pigment Yellow 139, C.I. Pigment Yellow 150, C.I. Pigment Yellow 153, C.I. Pigment Yellow 154, C.I. Pigment Yellow 155, C.I. Pigment Yellow 166, C.I.

20 Pigment Yellow 168 and C.I. Pigment Yellow 211;

C.I. Pigment Orange 5, C.I. Pigment Orange 13, C.I. Pigment Orange 14, C.I. Pigment Orange 24, C.I. Pigment Orange 34, C.I. Pigment Orange 36, C.I. Pigment Orange 38, C.I. Pigment Orange 40, C.I. Pigment Orange 43, C.I. Pigment Orange 46,
25 C.I. Pigment Orange 49, C.I. Pigment Orange 51, C.I. Pigment Orange 61, C.I. Pigment Orange 64, C.I. Pigment Orange 68, C.I. Pigment Orange 70, C.I. Pigment Orange 71, C.I. Pigment Orange 72, C.I. Pigment Orange 73 and C.I. Pigment Orange 74; and

30 C.I. Pigment Red 1, C.I. Pigment Red 2, C.I. Pigment Red 5, C.I. Pigment Red 9, C.I. Pigment Red 17, C.I. Pigment Red 31, C.I. Pigment Red 32, C.I. Pigment Red 41, C.I. Pigment Red 97, C.I. Pigment Red 122, C.I. Pigment Red 123, C.I. Pigment Red 144, C.I. Pigment Red 149, C.I. Pigment Red 166,

C.I. Pigment Red 168, C.I. Pigment Red 170, C.I. Pigment Red 171, 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 202, 5 C.I. Pigment Red 206, C.I. Pigment Red 207, C.I. Pigment Red 208, C.I. Pigment Red 209, C.I. Pigment Red 214, C.I. Pigment Red 215, C.I. Pigment Red 220, C.I. Pigment Red 221, C.I. Pigment Red 224, C.I. Pigment Red 243, C.I. Pigment Red 254, C.I. Pigment Red 255, C.I. Pigment Red 262, C.I. Pigment Red 10 264 and C.I. Pigment Red 272.

Out of these other organic pigments, at least one selected from the group consisting of C.I. Pigment Yellow 139, C.I. Pigment Orange 38, C.I. Pigment Red 177 and C.I. Pigment Red 254 is preferred, and C.I. Pigment Red 254 is 15 particularly preferred.

The above other organic pigments may be used alone or in combination of two or more.

The content of C.I. Pigment Red 242 in the pigment of the present invention is 20 wt% or more, that is, 20 to 100 20 wt%, preferably 30 to 100 wt%, particularly preferably 50 to 100 wt%. By using this pigment, red pixels having a high contrast ratio and high transmittance can be obtained, and a radiation sensitive composition for color filters having rheological characteristics suitable for the application of 25 a large-sized substrate can be obtained.

In the present invention, C.I. Pigment Red 242 and other pigment may be purified by re-crystallization, re-precipitation, solvent cleaning, sublimation, vacuum heating or a combination thereof before use as required.

30 The average particle diameter "r" of the pigment used in the present invention is 50 to 200 nm, preferably 50 to 150 nm. By using a pigment having the above average particle diameter "r", red pixels having a high contrast ratio and high transmittance can be obtained. The term "average

particle diameter" as used herein means the average particle diameter of secondary particles which are agglomerates of the primary particles (fine monocrystals) of the pigment.

As for the particle size distribution (to be simply referred to as "particle size distribution" hereinafter) of the secondary particles of the pigment used in the present invention, secondary particles having a particle diameter of (average particle diameter $\pm$ 100) nm account for 70 wt% or more, preferably 80 wt% or more of the total.

The pigment having the above average particle diameter and particle size distribution can be prepared by mixing and dispersing commercially available C.I. Pigment Red 242 (its average particle diameter is generally larger than 300 nm) and optionally other pigment (its average particle diameter is generally larger than 300 nm) into (B) a dispersant, (C) an alkali-soluble resin and a solvent while the obtained pigment mixed solution is milled with a mill such as a bead mill or roll mill. The thus obtained pigment is generally prepared as a pigment dispersion.

20

(B) dispersant

Examples of the dispersant in the present invention include polyoxyethylene alkyl ethers such as polyoxyethylene lauryl ether, polyoxyethylene stearyl ether and polyoxyethylene oleyl ether; polyoxyethylene alkylphenyl ethers such as 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 polyethylene imines. These dispersants are available on the market under the trade names of KP (of Shin-Etsu Chemical, Co., Ltd.), Polyflow (of Kyoeisha Kagaku Co., Ltd.), F Top (of Tokem Products Co., Ltd.),

Megafac (of Dainippon Ink and Chemicals, Inc.), Florade (of Sumitomo 3M Limited), Asahi Guard and Surflon (of Asahi Glass Co., Ltd.), Disperbyk-101, -103, -107, -110, -111, -115, -130, -160, -161, -162, -163, -164, -165, -166, -170, -180, -182, 5 -2000 and -2001 (of BYK Chemie Japan Co., Ltd.), Solsperse S5000, 12000, 13240, 13940, 17000, 20000, 22000, 24000, 24000GR, 26000, 27000 and 28000 (of Avicia Co., Ltd.), EFKA 46, 47, 48, 745, 4540, 4550, 6750, EFKA LP4008, 4009, 4010, 4015, 4050, 4055, 4560, 4800, EFKA Polymer400, 401, 402, 403, 10 450, 451 and 453 (of EFKA Chemicals Co., Ltd.), and Adispar PB-821 and 822 (of Ajinomoto Fine Techno Co., Ltd.).

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

The amount of the dispersant in the present invention 15 (in terms of solid content) is preferably 1 to 50 parts by weight, more preferably 3 to 30 parts by weight based on 100 parts by weight of the pigment (A). When the amount of the dispersant is smaller than 1 part by weight, the storage stability of the obtained composition may lower and when the 20 amount is larger than 50 parts by weight, the residue may be produced on the substrate.

The solvent used for the preparation of the pigment dispersion is identical to a solvent which will be described hereinafter for the radiation sensitive composition for 25 color filters in the present invention.

The amount of the solvent for the preparation of the pigment dispersion is preferably 500 to 1,000 parts by weight, more preferably 700 to 900 parts by weight based on 100 parts by weight of the pigment.

30 To prepare the pigment dispersion by using a bead mill, glass beads or titania beads having a diameter of about 0.5 to 10 mm are used to mix and disperse the pigment mixed solution preferably while it is cooled with cooling water or the like.

The filling rate of the beads is preferably 50 to 80 % of the capacity of the mill, and the amount of the pigment mixed solution injected is about 20 to 50 % of the capacity of the mill. The treating time is preferably 2 to 50 hours, more preferably 2 to 25 hours.

To prepare the pigment dispersion by using a roll mill, a three-roll mill or two-roll mill is used to mix the pigment mixed solution preferably while it is cooled with cooling water or the like.

The interval between rolls is preferably 10 μm or less, and the shearing force is preferably about 10^8 dyn/sec. The treating time is preferably 2 to 50 hours, more preferably 2 to 25 hours.

The average particle diameter and particle size distribution of the pigment contained in the thus prepared pigment dispersion can be measured by a dynamic light scattering method.

(C) alkali-soluble resin

The alkali-soluble resin in the present invention serves as a binder for the pigment (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 not particularly limited but preferably an alkali-soluble 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 Chemical Industry 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 maleimide; N-substituted maleimides such as N-phenylmaleimide, N-o-hydroxyphenylmaleimide, N-m-hydroxyphenylmaleimide, N-p-hydroxyphenylmaleimide, N-benzylmaleimide, N-cyclohexylmaleimide, N-succinimidyl-3-maleimide benzoate, N-succinimidyl-4-maleimide butyrate, N-succinimidyl-6-maleimide caproate, N-succinimidyl-3-maleimide propionate and N-(acridinyl)maleimide; aromatic vinyl compounds such as styrene, α -methylstyrene, o-vinyltoluene, m-vinyltoluene, p-vinyltoluene, p-chlorostyrene, o-methoxystyrene, m-methoxystyrene, p-methoxystyrene,

p-hydroxy- α -methylstyrene, o-vinylbenzylmethyl ether, m-vinylbenzylmethyl ether, p-vinylbenzylmethyl ether, o-vinylbenzylglycidyl ether, m-vinylbenzylglycidyl ether and p-vinylbenzylglycidyl ether; indenenes such as indene and

5 1-methylindene; 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

10 (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

15 (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,

20 tricyclo[5.2.1.0^{2,6}]decan-8-yl (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,

25 2-dimethylaminopropyl (meth)acrylate, 3-aminopropyl (meth)acrylate and 3-dimethylaminopropyl (meth)acrylate; unsaturated glycidyl carboxylates such as glycidyl (meth)acrylate; vinyl carboxylates such as vinyl acetate, vinyl propionate, vinyl butyrate and vinyl benzoate; other

30 unsaturated ethers such as vinyl methyl ether, vinyl ethyl ether and allyl glycidyl ether; 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; 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
 5 (meth)acrylate, poly-n-butyl (meth)acrylate and polysiloxane.

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

The carboxyl group-containing copolymer in the present
 10 invention is preferably a copolymer (to be referred to as "carboxyl group-containing copolymer (C1)" hereinafter) of (c1) a carboxyl group-containing unsaturated monomer comprising (meth)acrylic acid as an essential ingredient and optionally mono[2-(meth)acryloyloxyethyl]succinate and/or
 15 ω -carboxypolycaprolactone mono(meth)acrylate, (c2) an N-substituted maleimide and (c3) at least one other copolymerizable unsaturated monomer selected from the group consisting of styrene, α -methylstyrene, p-hydroxy- α -methylstyrene, methyl (meth)acrylate,
 20 2-hydroxyethyl (meth)acrylate, allyl (meth)acrylate, benzyl (meth)acrylate, glycerol mono(meth)acrylate, polystyrene macromonomer and polymethyl methacrylate macromonomer.

Preferred examples of the carboxyl group-containing
 25 copolymer (C1) include a copolymer of (meth)acrylic acid, N-phenylmaleimide, styrene and benzyl (meth)acrylate, copolymer of (meth)acrylic acid, N-m-hydroxyphenylmaleimide, styrene and benzyl (meth)acrylate, copolymer of (meth)acrylic acid,
 30 N-p-hydroxyphenylmaleimide, styrene and benzyl (meth)acrylate, copolymer of (meth)acrylic acid, N-cyclohexylmaleimide, styrene and benzyl (meth)acrylate, copolymer of (meth)acrylic acid, N-phenylmaleimide, α -methylstyrene and benzyl (meth)acrylate, copolymer of

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

(meth)acrylate, copolymer of (meth)acrylic acid,
 ω -carboxypolycaprolactone mono(meth)acrylate,
 N-phenylmaleimide, styrene, benzyl (meth)acrylate and
 glycerol mono(meth)acrylate, and copolymer of (meth)acrylic
 5 acid, ω -carboxypolycaprolactone mono(meth)acrylate,
 N-p-hydroxyphenylmaleimide, styrene, benzyl (meth)acrylate
 and glycerol mono(meth)acrylate.

Examples of the carboxyl group-containing copolymer
 other than the carboxyl group-containing copolymer (C1)
 10 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,
 2-hydroxyethyl (meth)acrylate and benzyl (meth)acrylate,
 copolymer of (meth)acrylic acid, methyl (meth)acrylate and
 15 polystyrene macromonomer, copolymer of (meth)acrylic acid,
 methyl (meth)acrylate and polymethyl methacrylate
 macromonomer, copolymer of (meth)acrylic acid, benzyl
 (meth)acrylate and polystyrene macromonomer, copolymer of
 (meth)acrylic acid, benzyl (meth)acrylate and polymethyl
 20 methacrylate macromonomer, copolymer of (meth)acrylic acid,
 2-hydroxyethyl (meth)acrylate, benzyl (meth)acrylate and
 polystyrene macromonomer, and copolymer of (meth)acrylic
 acid, 2-hydroxyethyl (meth)acrylate, benzyl (meth)acrylate
 and polymethyl methacrylate macromonomer.

25 The content 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 content of the carboxyl group-containing
 unsaturated monomer is lower than 5 wt%, the solubility in
 30 an alkali developer of the obtained radiation sensitive
 composition may lower and when the content is higher 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

pixels may fall off from the substrate and the film surface of the pixels may be roughened.

The content of the carboxyl group-containing unsaturated monomer in the carboxyl group-containing copolymer (C1) is preferably 5 to 50 wt%, more preferably 10 to 40 wt%. When the content of the carboxyl group-containing unsaturated monomer is lower than 5 wt%, the solubility in an alkali developer of the obtained radiation sensitive composition may lower and when the content is higher 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 pixels may fall off from the substrate.

The content of the N-substituted maleimide is preferably 5 to 40 wt%, more preferably 10 to 30 wt%. When the content of the N-substituted maleimide is lower than 5 wt%, the residue may be produced during development and when the content is higher than 40 wt%, the adhesion of the pixels to the substrate may deteriorate.

Further, the content of the other copolymerizable unsaturated monomer is preferably 30 to 90 wt%, more preferably 40 to 80 wt%. When the content of the other copolymerizable unsaturated monomer is lower than 30 wt%, the adhesion of the pixels to the substrate may deteriorate and when the content is higher than 90 wt%, the solubility in an alkali developer may lower.

The weight average molecular weight (M_w) measured by gel permeation chromatography (GPC, eluting solvent: tetrahydrofuran) of the alkali-soluble resin is preferably 3,000 to 300,000, more preferably 5,000 to 100,000.

The number average molecular weight (M_n) measured by gel permeation chromatography (GPC, eluting solvent: tetrahydrofuran) of the alkali-soluble resin is preferably

3,000 to 60,000, more preferably 5,000 to 25,000.

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

5 In the present invention, by using this alkali-soluble resin having specific Mw and Mn, a radiation sensitive composition having excellent developability is obtained, a pixel pattern having a sharp pattern edge can be thereby formed, and the residue, stain or film residue is hardly
10 produced on the substrate and light screening layer of an unexposed portion during development.

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

15 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 pigment (A). When the amount of the alkali-soluble resin is smaller than 10 parts by weight, alkali developability may lower, or a stain or the film
20 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 pigment becomes relatively low, whereby it may be difficult to achieve the target color strength of a thin film.

25

(D) polyfunctional monomer

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

30

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 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; 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, 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 tri(meth)acrylate, pentaerythritol tri(meth)acrylate, pentaerythritol tetra(meth)acrylate, dipentaerythritol penta(meth)acrylate and dipentaerythritol hexa(meth)acrylate, out of which trimethylolpropane triacrylate, pentaerythritol triacrylate and dipentaerythritol hexaacrylate are particularly preferred because they provide pixels having excellent strength and surface smoothness and hardly produce a stain or the film residue on the substrate and light screening layer of an unexposed 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 (C). When the amount of the polyfunctional monomer is smaller than 5 parts by weight, the strength and surface smoothness of the pixels 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, a monofunctional monomer
5 having one polymerizable unsaturated bond may be used in combination with the polyfunctional monomer.

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

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

15 The amount of the monofunctional monomer in the present invention is preferably 90 wt% or less, more preferably 50 wt% or less based on the total weight of the polyfunctional monomer and the monofunctional monomer. When the amount of the monofunctional monomer is larger than 90 wt%, the
20 strength and surface smoothness of the pixels 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
25 300 parts by weight based on 100 parts by weight of the alkali-soluble resin (C). When the above total amount is smaller than 5 parts by weight, the strength and surface smoothness of the pixels may deteriorate and when the total amount is larger than 500 parts by weight, alkali
30 developability may lower, or a stain or the film residue may be produced on the substrate and light screening layer of an unexposed portion.

(E) radiation sensitive radical generator

The radiation sensitive radical generator in the present invention is a compound which can form active species capable of initiating the polymerization of the above polyfunctional monomer (D) and the optionally used

5 monofunctional monomer upon exposure to radiation such as visible radiation, ultraviolet radiation, far ultraviolet radiation, electron radiation or X-radiation.

Examples of the radiation sensitive radical generator include an acetophenone-based compound, biimidazole-based
10 compound, triazine-based compound, benzoin-based compound, benzophenone-based compound, α -diketone-based compound, polynuclear quinone-based compound, xanthone-based compound and diazo-based compound.

In the present invention, the above radiation
15 sensitive radical generators may be used alone or in combination of two or more. The radiation sensitive radical generator in the present invention is preferably at least one selected from the group consisting of an acetophenone-based compound, biimidazole-based compound
20 and triazine-based compound.

Examples of the acetophenone-based compound out of the preferred radiation sensitive radical generators in the present invention include

2-hydroxy-2-methyl-1-phenylpropanone-1,
25 2-methyl-1-(4-methylthiophenyl)-2-morpholinopropanone-1,
2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)butanone-1, 1-hydroxycyclohexyl phenyl ketone and
2,2-dimethoxy-1,2-diphenylethanone-1.

Out of these acetophenone-based compounds,
30 2-methyl-1-(4-methylthiophenyl)-2-morpholinopropanone-1 and
2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)butanone-1 are particularly preferred.

The above acetophenone-based compounds may be used

alone or in combination of two or more.

When the acetophenone-based compound is used as the radiation sensitive radical generator in the present invention, the amount of the acetophenone-based compound is preferably 0.01 to 100 parts by weight, more preferably 1 to 80 parts by weight, particularly preferably 5 to 60 parts by weight based on 100 parts by weight of the total of the polyfunctional monomer (D) and the monofunctional monomer. When the amount of the acetophenone-based compound is smaller than 0.01 part by weight, it may be difficult to obtain a colored layer having a predetermined pixel pattern due to incomplete curing by exposure. When the amount is larger than 100 parts by weight, the formed pixels may fall off from the substrate during development.

Examples of the above biimidazole-based compound include 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'-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, 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-1,2'-biimidazole.

Out of these biimidazole-based compounds, 2,2'-bis(2-chlorophenyl)-4,4',5,5'-tetraphenyl-1,2'-biimidazole,

2,2'-bis(2,4-dichlorophenyl)-4,4',5,5'-tetraphenyl-1,2'-biimidazole and

2,2'-bis(2,4,6-trichlorophenyl)-4,4',5,5'-tetraphenyl-1,2'-biimidazole are preferred, and

5 2,2'-bis(2,4-dichlorophenyl)-4,4',5,5'-tetraphenyl-1,2'-biimidazole is particularly preferred.

The above biimidazole-based compounds have excellent solubility in a solvent, do not produce foreign matter such as an undissolved product and a precipitate, have high
10 sensitivity, can fully promote a curing reaction by exposure with a small amount of energy and do not cause a curing reaction in an unexposed portion. Therefore, the coating film obtained after exposure is clearly divided into a cured portion insoluble in a developer and an uncured portion
15 having high solubility in a developer, thereby making it possible to form a high-definition colored layer having a predetermined pixel pattern which is not undercut.

The above biimidazole-based compounds may be used alone or in combination of two or more.

20 When the biimidazole-based compound is used as the radiation sensitive radical generator in the present invention, the amount of the biimidazole-based compound is preferably 0.01 to 40 parts by weight, more preferably 1 to 30 parts by weight, particularly preferably 1 to 20 parts
25 by weight based on 100 parts by weight of the total of the polyfunctional monomer (D) and the monofunctional monomer. When the amount of the biimidazole-based compound is smaller than 0.01 part by weight, it may be difficult to obtain a colored layer having a predetermined pixel pattern due to
30 incomplete curing by exposure. When the amount is larger than 40 parts by weight, the formed pixels may fall off from the substrate during development.

When the biimidazole-based compound is used as the radiation sensitive radical generator in the present invention, it is preferably used in combination with the following hydrogen donor to further improve sensitivity.

5 The term "hydrogen donor" as used herein means a compound which can provide a hydrogen atom to a radical formed from the biimidazole-based compound upon exposure.

 The hydrogen donor in the present invention is preferably a mercaptan-based compound or an amine-based
10 compound defined hereinbelow.

 The above mercaptan-based 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
15 be referred to as "mercaptan-based hydrogen donor" hereinafter).

 The above amine-based 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
20 directly bonded to the mother nucleus (to be referred to as "amine-based hydrogen donor" hereinafter).

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

 A detailed description is subsequently given of these
25 hydrogen donors.

 The mercaptan-based 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.

30 When the mercaptan-based 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-based 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-based hydrogen donor may be substituted by a carboxyl group, alkoxy carbonyl group, substituted alkoxy carbonyl group, phenoxy carbonyl group, substituted phenoxy carbonyl group or nitrile group at a position other than the mercapto group(s).

Examples of this mercaptan-based 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-based hydrogen donors, 2-mercaptobenzothiazole and 2-mercaptobenzoxazole are preferred, and 2-mercaptobenzothiazole is particularly preferred.

The amine-based 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-based hydrogen donor may be substituted by an alkyl group or substituted alkyl group. The amine-based hydrogen donor may be substituted by a carboxyl group, alkoxy carbonyl group, substituted alkoxy carbonyl group, phenoxy carbonyl group, substituted phenoxy carbonyl group or nitrile group at a position other than the amino group(s).

Examples of the above amine-based hydrogen donor include 4,4'-bis(dimethylamino)benzophenone, 4,4'-bis(diethylamino)benzophenone, 4-diethylaminoacetophenone, 4-dimethylaminopropiophenone, ethyl-4-dimethylaminobenzoate, 4-dimethylaminobenzoic

acid and 4-dimethylaminobenzonitrile.

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

The amine-based hydrogen donor serves as a sensitizer even when a radiation sensitive radical generator other than a biimidazole-based compound is used.

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-based hydrogen donor and at least one amine-based hydrogen donor is preferably used because the formed pixels hardly fall off from the 15 substrate during development and have high strength and sensitivity.

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

The weight ratio of the mercaptan-based hydrogen donor

to the amine-based hydrogen donor in the combination of the mercaptan-based hydrogen donor and the amine-based hydrogen donor is preferably 1:1 to 1:4, more preferably 1:1 to 1:3.

When the hydrogen donor is used in conjunction with
 5 the biimidazole-based compound in the present invention, the amount of the hydrogen donor is preferably 0.01 to 40 parts by weight, more preferably 1 to 30 parts by weight, particularly preferably 1 to 20 parts by weight based on 100 parts by weight of the total of the polyfunctional monomer
 10 and the monofunctional monomer. When the amount of the hydrogen donor is smaller than 0.01 part by weight, its effect of improving sensitivity may lower. When the amount is larger than 40 parts by weight, the formed pixels may fall off from the substrate during development.

15 Examples of the above triazine-based compound include triazine-based compounds having a halomethyl group such as 2,4,6-tris(trichloromethyl)-s-triazine, 2-methyl-4,6-bis(trichloromethyl)-s-triazine, 2-[2-(5-methylfuran-2-yl)ethenyl]-4,6-bis
 20 (trichloromethyl)-s-triazine, 2-[2-(furan-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
 25 (trichloromethyl)-s-triazine, 2-(4-methoxyphenyl)-4,6-bis(trichloromethyl)-s-triazine, 2-(4-ethoxystyryl)-4,6-bis(trichloromethyl)-s-triazine and 2-(4-n-butoxyphenyl)-4,6-bis(trichloromethyl)-s-
 30 triazine.

Out of these triazine-based compounds, 2-[2-(3,4-dimethoxyphenyl)ethenyl]-4,6-bis (trichloromethyl)-s-triazine is particularly preferred.

The above triazine-based compounds may be used alone

or in combination of two or more.

When the triazine-based compound is used as the radiation sensitive radical generator in the present invention, the amount of the triazine-based compound is preferably 0.01 to 40 parts by weight, more preferably 1 to 30 parts by weight, particularly preferably 1 to 20 parts by weight based on 100 parts by weight of the total of the polyfunctional monomer (D) and the monofunctional monomer. When the amount of the triazine-based compound is smaller than 0.01 part by weight, it may be difficult to obtain a colored layer having a predetermined pixel pattern due to incomplete curing by exposure. When the amount is larger than 40 parts by weight, the formed pixels may fall off from the substrate during development.

15

- additives -

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

20

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 suppress the existence of the undissolved product residue after development.

25

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.

30

Examples of the aliphatic carboxylic acid include aliphatic monocarboxylic acids such as formic acid, acetic acid, propionic acid, butyric acid, valeric acid, pivalic acid, caproic acid, diethylacetic acid, ethantic acid and caprylic acid; aliphatic 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, 5 itaconic acid, citraconic acid, maleic acid, fumaric acid and mesaconic acid; and aliphatic tricarboxylic acids such as tricarballic acid, aconitic acid and camphoronic acid.

The above phenyl group-containing carboxylic acid is, for example, a compound having a carboxyl group directly 10 bonded to a phenyl group or a compound having a carboxyl group bonded to a phenyl group through a divalent 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 15 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, 20 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 25 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 30 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

combination of two or more.

The amount of the organic acid is preferably 15 parts or less by weight, more preferably 10 parts or less by weight based on 100 parts by weight of the total of the components
 5 (A) to (E) and additives. When the amount of the organic acid is larger than 15 parts by weight, the adhesion of the formed pixels to the substrate may lower.

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

Examples of the above aliphatic amine include mono(cyclo)alkylamines such as n-propylamine, i-propylamine, n-butylamine, i-butylamine, sec-butylamine, t-butylamine, n-pentylamine and n-hexylamine;
 15 di(cyclo)alkylamines such as methyl·ethylamine, diethylamine, methyl·n-propylamine, ethyl·n-propylamine, di-n-propylamine, di-i-propylamine, di-n-butylamine, di-i-butylamine, di-sec-butylamine and di-t-butylamine; tri(cyclo)alkylamines such as dimethyl·ethylamine,
 20 methyl·diethylamine, triethylamine, 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 and tri-t-butylamine;
 25 mono(cyclo)alkanolamines such as 2-aminoethanol, 3-amino-1-propanol, 1-amino-2-propanol and 4-amino-1-butanol; di(cyclo)alkanolamines such as diethanolamine, di-n-propanolamine, di-i-propanolamine, di-n-butanolamine and di-i-butanolamine;
 30 tri(cyclo)alkanolamines such as triethanolamine, tri-n-propanolamine, tri-i-propanolamine, tri-n-butanolamine and tri-i-butanolamine; 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, 3-dimethylamino-1,2-propanediol, 3-diethylamino-1,2-propanediol, 2-dimethylamino-1,3-propanediol and 2-diethylamino-1,3-propanediol; and aminocarboxylic acids
 5 such as β -alanine, 2-aminobutyric acid, 3-aminobutyric acid, 4-aminobutyric acid, 2-aminoisobutyric acid and 3-aminoisobutyric acid.

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

Examples of the phenyl group-containing amine include aromatic amines such as aniline, o-methylaniline, m-methylaniline, p-methylaniline, p-ethylaniline,
 15 1-naphthylamine, 2-naphthylamine, N,N-dimethylaniline, N,N-diethylaniline and p-methyl-N,N-dimethylaniline; aminobenzyl alcohols such as o-aminobenzyl alcohol, m-aminobenzyl alcohol, p-aminobenzyl alcohol, p-dimethylaminobenzyl alcohol and p-diethylaminobenzyl
 20 alcohol; aminophenols such as o-aminophenol, m-aminophenol, p-aminophenol, p-dimethylaminophenol and p-diethylaminophenol; and aminobenzoic acids such as m-aminobenzoic acid, p-aminobenzoic acid, p-dimethylaminobenzoic acid and p-diethylaminobenzoic
 25 acid.

Out of these organic amino compounds, mono(cyclo)alkanolamines and amino(cyclo)alkanediols are preferred, and 2-aminoethanol, 3-amino-1-propanol, 5-amino-1-pentanol, 3-amino-1,2-propanediol,
 30 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 on the substrate and light screening layer of an unexposed

portion. Aminophenols are preferred, and o-aminophenol, m-aminophenol and p-aminophenol are particularly preferred as the phenol group-containing amine.

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

The amount of the organic amino compound is preferably 15 parts or less by weight, more preferably 10 parts or less by weight based on 100 parts by weight of the total of the components (A) to (E) and additives. When the amount of the
10 organic amino compound is larger than 15 parts by weight, the adhesion of the formed pixels to the substrate may lower.

Additives other than the above additives include a dispersion aid such as a blue pigment derivative or yellow pigment derivative, e.g., a copper phthalocyanine
15 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 triethoxysilane, vinyl
20 tris(2-methoxyethoxy)silane, N-(2-aminoethyl)-3-aminopropyl·methyl·dimethoxysilane, N-(2-aminoethyl)-3-aminopropyltrimethoxysilane, 3-aminopropyltriethoxysilane, 3-glycidoxypropyltrimethoxysilane,
25 3-glycidoxypropyl·methyl·dimethoxysilane, 2-(3,4-epoxycyclohexyl)ethyltrimethoxysilane, 3-chloropropyl·methyl·dimethoxysilane, 3-chloropropyltrimethoxysilane, 3-methacryloyloxypropyltrimethoxysilane or
30 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

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.

5 (F) solvent

As a solvent of the present invention, a suitable solvent may be used as far as it disperses or dissolves the components (A) to (E) and additives constituting the radiation sensitive composition, does not react with these
10 and has suitable volatility.

Examples of the solvent include alcohols such as methanol, ethanol and benzyl alcohol; (poly)alkylene glycol monoalkyl ethers such as ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol
15 mono-n-propyl ether, ethylene glycol mono-n-butyl ether, 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,
20 propylene glycol monomethyl ether, propylene glycol monoethyl 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 tripropylene glycol
25 monoethyl ether; (poly)alkylene glycol monoalkyl ether acetates such as ethylene glycol monomethyl ether acetate, ethylene glycol monoethyl ether acetate, ethylene glycol mono-n-propyl ether acetate, ethylene glycol mono-n-butyl ether acetate, diethylene glycol monomethyl ether acetate,
30 diethylene glycol monoethyl ether acetate, diethylene glycol mono-n-propyl ether acetate, diethylene glycol mono-n-butyl ether acetate, propylene glycol monomethyl ether acetate, propylene glycol monoethyl ether acetate and 3-methoxybutyl 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, 3-heptanone, diacetone alcohol

- 5 (4-hydroxy-4-methylpentan-2-one) and 4-hydroxy-4-methylhexan-2-one; alkyl lactates such as methyl lactate and ethyl lactate; other esters such as ethyl acetate, n-propyl acetate, i-propyl acetate, n-butyl acetate, i-butyl acetate, n-pentyl formate, i-pentyl acetate,
- 10 3-methyl-3-methoxybutyl acetate, n-butyl propionate, 3-methyl-3-methoxybutyl propionate, ethyl butyrate, n-propyl butyrate, i-propyl butyrate, n-butyl butyrate, ethyl hydroxyacetate, ethyl ethoxyacetate, methyl 3-methoxypropionate, ethyl 3-methoxypropionate, methyl
- 15 3-ethoxypropionate, ethyl 3-ethoxypropionate, methyl pyruvate, ethyl pyruvate, n-propyl pyruvate, methyl acetoacetate, ethyl acetoacetate, ethyl 2-hydroxy-2-methylpropionate, methyl 2-hydroxy-3-methylbutyrate and ethyl 2-oxobutyrate;
- 20 aromatic hydrocarbons such as toluene and xylene; and amides such as N-methylpyrrolidone, N,N-dimethylformamide and N,N-dimethylacetamide.

- Out of these solvents, benzyl alcohol, ethylene glycol mono-n-butyl ether, propylene glycol monomethyl ether,
- 25 propylene glycol monoethyl ether, ethylene glycol monomethyl ether acetate, ethylene glycol mono-n-butyl ether acetate, diethylene glycol mono-n-butyl ether acetate, propylene glycol monomethyl ether acetate, propylene glycol monoethyl ether acetate, diethylene glycol dimethyl ether, diethylene
 - 30 glycol methyl ethyl ether, cyclohexanone, 2-heptanone, 3-heptanone, n-butyl acetate, i-butyl acetate, n-pentyl formate, i-pentyl acetate, 3-methoxybutyl acetate, n-butyl propionate, ethyl butyrate, i-propyl butyrate, n-butyl butyrate, ethyl 3-methoxypropionate, methyl

3-ethoxypropionate, ethyl 3-ethoxypropionate, 3-methyl-3-methoxybutyl propionate and ethyl pyruvate are particularly preferred from the viewpoints of solubility, pigment dispersibility and coatability.

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

 Further, a high-boiling solvent such as benzyl ethyl ether, dihexyl ether, acetonylacetone, isophorone, caproic acid, caprylic acid, 1-octanol, 1-nonanol, benzyl acetate, 10 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 15 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 composition is preferably 5 to 50 wt%, particularly 20 preferably 10 to 40 wt% from the viewpoints of the coatability and storage stability of the obtained radiation sensitive composition.

- method for the preparation of a radiation sensitive 25 composition for color filters -

 Although the method for the preparation of the radiation sensitive composition for color filters of the present invention is not particularly limited, the pigment (A) is preferably dispersed in a medium containing the 30 dispersant (B), alkali-soluble resin (C) and solvent (F) in advance.

 The step of dispersing the pigment (A) in the above medium is called "pre-dispersion step" and the dispersion obtained by dispersing the pigment (A) in the above medium

is called "pre-dispersion".

In the pre-dispersion step, the amount of the alkali-soluble resin (C) is preferably 5 to 100 wt%, more preferably 10 to 50 wt% based on the content of the alkali-soluble resin (C) in the radiation sensitive composition for color filters. When the amount of the alkali-soluble resin (C) is smaller than 5 wt%, the storage stability of the obtained composition may lower or the residue may be produced on the substrate.

10 The pre-dispersion step may be carried out by mixing the above components by a mixer such as a dissolver, bead mill or rod mill.

After the pre-dispersion step, the radiation sensitive composition for color filters of the present invention can be obtained by mixing the pre-dispersion with the polyfunctional monomer (D), the radiation sensitive radical generator (E) and the rests of the alkali-soluble resin (C) and the solvent (F) if there are in accordance with a commonly used method.

20

Method of forming a color filter

A description is subsequently given of the method of forming the color filter of the present invention by using the radiation sensitive composition for color filters of the present invention (may be simply referred to as "radiation sensitive composition" hereinafter).

The method of forming the color filter of the present invention comprises at least the following steps (1) to (4):

- (1) forming a coating film of the radiation sensitive composition of the present invention on a substrate;
- (2) exposing at least part of the coating film to radiation;
- (3) developing the coating film after exposure; and
- (4) post-baking the coating film after development.

Each of the above steps will be described hereinbelow.

- step (1)-

A light screening layer for defining a portion for forming pixels is first formed on the surface of the substrate as required, and then the radiation sensitive composition of the present invention is applied to the substrate and prebaked to evaporate the solvent so as to form a coating film.

The substrate used in this step is made of glass, silicon, polycarbonate, polyester, aromatic polyamide, polyamide-imide, polyimide, polyether sulfone, ring open polymer of a cyclic olefin or hydrogenated product thereof.

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

To apply the radiation sensitive composition to the substrate, a known coating technique such as rotational coating, cast coating or roll coating may be employed. Coating with a spin coater or a split die coater is preferred.

As for prebaking conditions, the radiation sensitive composition is preferably heated at 70 to 110°C for 2 to 4 minutes.

The thickness of the coating film is preferably 0.1 to 8.0 μm , more preferably 0.2 to 6.0 μm , particularly preferably 0.2 to 4.0 μm as the thickness of the film after drying.

- step (2) -

Thereafter, at least part of the formed coating film is exposed to radiation. To expose part of the coating film in this step, a photomask having a predetermined pattern is preferably used.

The radiation used for exposure is suitably selected

from visible radiation, ultraviolet radiation, far ultraviolet radiation, electron radiation and X-radiation. Radiation having a wavelength of 190 to 450 nm is preferred.

The dose of the radiation is preferably about 10 to 5 10,000 J/m².

- step (3) -

Thereafter, the coating film after exposure is developed with a developer, preferably an alkali developer 10 to dissolve and remove an unexposed portion of the coating film so as to form a predetermined pattern.

The above alkali developer is preferably an aqueous solution of sodium carbonate, sodium hydroxide, potassium hydroxide, tetramethylammonium hydroxide, choline, 15 1,8-diazabicyclo-[5.4.0]-7-undecene or 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 20 preferably rinsed with water after alkali development.

Shower development, spray development, dip (immersion) development or puddle development may be employed.

As for development conditions, the coating film is 25 preferably developed at normal temperature for about 5 to 300 sec.

- step (4) -

By post-baking the developed coating film, a substrate 30 having a predetermined pixel pattern can be obtained.

As for post-baking conditions, the coating film is preferably heated at 180 to 240°C for about 15 to 90 minutes.

The film thickness of the formed pixels is preferably 0.1 to 6.0 µm, more preferably 0.5 to 3.0 µm.

Thereafter, by repeating the above steps (1) to (4) for each of the radiation sensitive compositions of the present invention containing red, green and blue pigments, red, green and blue pixel patterns are formed on the same substrate, thereby making it possible to form a colored layer consisting of predetermined red, green and blue pixel patterns on the substrate.

The order of forming these pixel patterns is arbitrary in the present invention.

10

Color filter

The color filter of the present invention is formed from the radiation sensitive composition for color filters of the present invention.

15

The 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.

20 Color liquid crystal display device

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

The color liquid crystal display device of the present invention may have a suitable structure. For example, it may have a structure that the color filter is formed on a substrate separate from a drive substrate having a thin film transistor (TFT), and the drive substrate and the substrate having the color filter are opposed to each other with a liquid crystal layer interposed therebetween. Alternatively, it may have a structure that a substrate manufactured by forming the color filter on a drive substrate having a thin film transistor (TFT) and a substrate having ITO (tin doped indium oxide) electrodes are opposed to each other with a liquid

crystal layer interposed therebetween. The latter structure can significantly improve the numerical aperture, thereby making it possible to obtain a bright high-definition liquid crystal display device.

5 The radiation sensitive composition for color filters of the present invention has rheological characteristics suitable for the application of a large-sized substrate and can provide red pixels having high transmittance and high contrast ratio.

10 Therefore, the radiation sensitive composition for color filters of the present invention can be advantageously used to form color filters including a color filter for color liquid crystal display devices in the field of the electronic industry.

15

Examples

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

20

Synthetic Example 1

2.7 parts by weight of 2,2'-azobis(2,4-dimethylvaleronitrile) and 200 parts by weight of diethylene glycol monomethyl ether acetate were
25 fed to a flask equipped with a cooling tube and a stirrer, 15 parts by weight of methacrylic acid, 25 parts by weight of N-phenylmaleimide, 45 parts by weight of benzyl methacrylate, 15 parts by weight of styrene and 5 parts by weight of α -methylstyrene dimer (chain transfer agent) were
30 then fed to the flask, the inside of the flask was substituted by nitrogen, and the reaction solution was heated at 80°C while it was gently stirred to be polymerized by maintaining that temperature for 3 hours. Thereafter, the reaction solution was further heated at 100°C, 0.5 part by weight of

2,2'-azobis(2,4-dimethylvaleronitrile) was added, and polymerization was continued for another 1 hour to obtain a resin solution (solid content of 33.1 wt%). The obtained resin had an Mw of 15,000 and an Mn of 7,000. This resin
5 was designated as resin (B-1).

Synthetic Example 2

1.5 parts by weight of 2,2'-azobis(2,4-dimethylvaleronitrile) and 200 parts by weight of diethylene glycol monomethyl ether acetate were
10 fed to a flask equipped with a cooling tube and a stirrer, 20 parts by weight of methacrylic acid, 25 parts by weight of N-phenylmaleimide, 30 parts by weight of benzyl methacrylate, 10 parts by weight of glycerol
15 monomethacrylate, 15 parts by weight of styrene and 2.5 parts by weight of α -methylstyrene dimer (chain transfer agent) were then fed to the flask, the inside of the flask was substituted by nitrogen, and the reaction solution was heated at 80°C while it was gently stirred to be polymerized by
20 maintaining that temperature for 3 hours. Thereafter, the reaction solution was further heated at 100°C, 0.3 part by weight of 2,2'-azobis(2,4-dimethylvaleronitrile) was added, and polymerization was continued for another 1 hour to obtain a resin solution (solid content of 33.0 wt%). The obtained
25 resin had an Mw of 20,000 and an Mn of 9,000. This resin was designated as resin (B-2).

Synthetic Example 3

2.7 parts by weight of 2,2'-azobis(2,4-dimethylvaleronitrile) and 200 parts by weight of diethylene glycol monomethyl ether acetate were
30 fed to a flask equipped with a cooling tube and a stirrer, 25 parts by weight of methacrylic acid, 75 parts by weight of benzyl methacrylate and 5 parts by weight of

α -methylstyrene dimer (chain transfer agent) were then fed to the flask, the inside of the flask was substituted by nitrogen, and the reaction solution was heated at 80°C while it was gently stirred to be polymerized by maintaining that temperature for 3 hours. Thereafter, the reaction solution was further heated at 100°C, 0.3 part by weight of 2,2'-azobis(2,4-dimethylvaleronitrile) was added, and polymerization was continued for another 1 hour to obtain a resin solution (solid content of 33.2 wt%). The obtained resin had an Mw of 17,000 and an Mn of 8,600. This resin was designated as resin (B-3).

Example 1

A mixed solution consisting of 30 parts by weight of a mixture of C.I. Pigment Red 242 and C.I. Pigment Red 254 in a weight ratio of 70/30 as a pigment (A), 10 parts by weight (100.0 wt% in terms of solid content) of Adisper PB821 as a dispersant (B), 10 parts by weight of the resin (B-1) as an alkali-soluble resin (C) and 100 parts by weight of ethyl 3-ethoxypropionate as a solvent was mixed and dispersed with Diamond Fine Mill (trade name, bead mill of Mitsubishi Material Co., Ltd., bead diameter of 1.0 mm) for 5 hours to prepare a pigment dispersion.

When the average pigment particle diameter of the obtained pigment dispersion was measured by the dynamic light scattering method, it was 140 nm.

The average particle diameter was measured by the dynamic light scattering method under the following conditions in this text.

Name of the apparatus: FPAR-1000 (Fiber-Optics Particle Analyzer) of Otsuka Denshi Co., Ltd.)

Experimental conditions: The pigment dispersion was diluted with propylene glycol monomethyl ether acetate to a pigment content of 5 % based on the resulting solution to measure

the average particle diameter.

Calculation method: calculated by a cumulant method

Thereafter, 400 parts by weight of this pigment
5 dispersion, 200 parts by weight of the resin (B-2) as an
alkali-soluble resin (C), 60 parts by weight of
dipentaerythritol hexaacrylate as a polyfunctional monomer
(D), 40 parts by weight of
2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)butanone-
10 1 as a radical generator (E) and 1,000 parts by weight of
propylene glycol monomethyl ether acetate as a solvent were
mixed together to prepare a liquid composition (R1).

Evaluation of rheological characteristics

15 The viscosity of the obtained liquid composition (R1)
was measured continuously at 23°C at a shear rate of 0.5 to
500 (1/s) with the ARES100FRT viscoelasticity measuring
instrument (of TA Instrument Co., Ltd.) (rheology
measurement). A rheology parameter (= {viscosity at a shear
20 rate of 1.0 (1/s)}/{viscosity at a shear rate of 100 (1/s)})
was calculated from the obtained measurement result.

When the rheology parameter is large, the difference
in film thickness between the center portion and the end
portion of the substrate, that is, between a portion at a
25 low shear rate and a portion at a high shear rate tends to
become large with the result of a coating failure.

When the rheology parameter was evaluated, it was 1.25.
It can be said that when the rheology parameter falls within
the range of 1.0 to 1.5, rheology characteristics are
30 satisfactory.

Evaluation of storage stability

The viscosity of the obtained liquid composition (R1)
was measured with the ELD viscometer of Tokyo Keiki Co., Ltd.

The viscosity of the composition which was left at 40°C for 1 week and the viscosity of the composition which was left at 23°C for 1 month were measured. As a result, the viscosity of the composition right after preparation was 7.5 mPa·s, that of the composition which was left at 40°C for 1 week was 8.0 mPa·s, and that of the composition which was left at 23°C for 1 month was 7.8 mPa·s. It can be said that when the change from the viscosity right after preparation is 20 % or less, storage stability is satisfactory.

10 Thereafter, this liquid composition (R1) was applied to 15 cm × 15 cm soda-lime glass substrates having an SiO₂ film for preventing the elution of sodium ions on the surface with a spin coater and prebaked in a clean oven heated at 90°C for 10 minutes to form a 1.8 μm-thick coating film.

15 Thereafter, the substrates were cooled to room temperature, and one of the substrates was exposed to 5,000 J/m² of radiation having wavelengths of 365 nm, 405 nm and 436 nm through a photomask with a high-pressure mercury lamp. This substrate was then immersed in a 0.04 wt% aqueous solution of potassium hydroxide at 23°C for 1 minute to be developed, rinsed with super pure water and dried with air. Thereafter, the substrate was post-baked at 230°C for 30 minutes to form a red striped pixel pattern on the substrate. The film thickness of the pixels was 1.50 μm. This substrate was used as a substrate for evaluating foreign matter, chromaticity and ΔEab* characteristics.

25 Further, the other substrate was exposed to 5,000 J/m² of radiation having wavelengths of 365 nm, 405 nm and 436 nm with a high-pressure mercury lamp without using a photomask. It was then post-baked at 230°C for 30 minutes to form a solid red film on the substrate. The film thickness of the pixels was 1.50 μm. This substrate was used as a substrate for evaluating contrast ratio.

Evaluation of foreign matter and chromaticity

When the formed pixel pattern was observed through an optical microscope, no foreign matter was seen on the pixels.

When the chromaticity of the pixels was evaluated with
5 the MCPD2000 color analyzer (of Otsuka Denshi Co., Ltd.),
it was $(x, y, Y) = (0.598, 0.354, 31.2)$.

Evaluation of contrast ratio

The obtained substrate was sandwiched between two
10 depolarizing plates, and the depolarizing plate on the front
side was turned while it was illuminated by a fluorescent
lamp from the back (wavelength of 380 to 780 nm) to measure
the maximum value and minimum value of transmitted light
intensity with the LS-100 luminance meter (of Minolta Co.,
15 Ltd.). When the contrast ratio was evaluated as a value
obtained by dividing the maximum value by the minimum value,
it was 700. It can be said that when the contrast value is
larger than 600, the contrast ratio is satisfactory.

20 Evaluation of ΔE_{ab}^* characteristics

The chromaticities of a center portion and a portion
5.5 cm from the center portion in a diagonal direction of
the substrate having a red striped pixel pattern were
measured with a color analyzer to calculate the difference
25 ΔE_{ab}^* in chromaticity between the two portions.

When ΔE_{ab}^* was evaluated, it was 1.75. It can be said
that when ΔE_{ab}^* is 3 or less, the ΔE_{ab}^* characteristics are
satisfactory.

30 Example 2

A liquid composition (R2) was prepared in the same
manner as in Example 1 except that 30 parts by weight of a
mixture of C.I. Pigment Red 242 and C.I. Pigment Red 254 in
a weight ratio of 50/50 was used as the pigment (A).

When the pigment average particle diameter of the obtained pigment dispersion was measured by the dynamic light scattering method, it was 130 nm. Its rheology parameter was 1.21 and its viscosity was 6.5 mPa·s right after
5 preparation, 6.9 mPa·s after 1 week at 40°C and 6.7 mPa·s after 1 month at 23°C.

A red striped pixel pattern having a film thickness of 1.50 μm was formed on the substrate and evaluated in the same manner as in Example 1 except that the liquid composition
10 (R2) was used.

As a result, no foreign matter was seen on the pixels. The chromaticity of the pixels was $(x,y,Y) = (0.598, 0.346, 29.2)$, the contrast ratio was 850, and ΔE_{ab}^* was 2.10.

15 Comparative Example 1

A liquid composition (r1) was prepared in the same manner as in Example 1 except that 10 parts by weight of Solsperse S28000 (100.0 wt% in terms of solid content) was used in place of PB821 as the dispersant (B) and the resin
20 (B-3) was used in place of the resin (B-1) as the alkali-soluble resin (C).

When the pigment average particle diameter of the obtained pigment dispersion was measured by the dynamic light scattering method, it was 250 nm. The rheology parameter
25 of the pigment dispersion was 6.23, and its viscosity was 13.0 mPa·s right after preparation, 25.0 mPa·s after 1 week at 40°C and 20.0 mPa·s after 1 month at 23°C.

A red striped pixel pattern having a film thickness of 1.50 μm was formed on the substrate and evaluated in the same manner as in Example 1 except that the liquid composition
30 (r1) was used.

As a result, no foreign matter was seen on the pixels. The chromaticity of the pixels was $(x,y,Y) = (0.598, 0.353, 30.0)$, the contrast ratio was 350, and ΔE_{ab}^* was 8.05.

Comparative Example 2

A liquid composition (r2) was prepared in the same manner as in Example 1 except that the resin (B-3) was used
5 in place of the resin (B-1) as the alkali-soluble resin (C).

When the pigment average particle diameter of the obtained pigment dispersion was measured by the dynamic light scattering method, it was 180 nm. The rheology parameter of the pigment dispersion was 2.01, and its viscosity was
10 9.5 mPa·s right after preparation, 14.0 mPa·s after 1 week at 40°C and 12.5 mPa·s after 1 month at 23°C.

A red striped pixel pattern having a film thickness of 1.50 μm was formed on the substrate and evaluated in the same manner as in Example 1 except that the liquid composition
15 (r2) was used.

As a result, no foreign matter was seen on the pixels. The chromaticity of the pixels was $(x, y, Y) = (0.598, 0.354, 30.5)$, the contrast ratio was 500, and ΔE_{ab}^* was 3.01.

What is claimed is:

1. A radiation sensitive composition for color filters, comprising (A) a pigment, (B) a dispersant, (C) an alkali-soluble resin comprising a copolymer of (c1) a
5 carboxyl group-containing unsaturated monomer comprising (meth)acrylic acid, (c2) an N-substituted maleimide and (c3) at least one selected from the group consisting of styrene, α -methylstyrene, p-hydroxy- α -methylstyrene, methyl (meth)acrylate, 2-hydroxyethyl (meth)acrylate, allyl
10 (meth)acrylate, benzyl (meth)acrylate, glycerol mono(meth)acrylate, polystyrene macromonomer and polymethyl methacrylate macromonomer, (D) a polyfunctional monomer, (E) a radiation sensitive radical generator and (F) a solvent, wherein
15 the pigment (A) contains 20 wt% or more of C.I. Pigment Red 242 and has an average particle diameter "r" (nm) of 50 to 200.
2. A method for the preparation of the above radiation
20 sensitive composition for color filters, comprising the steps of:
dispersing (A) a pigment which contains 20 wt% or more of C.I. Pigment Red 242 and has an average particle diameter larger than 200 nm in a medium containing (B) a dispersant,
25 (C) an alkali-soluble resin and (F) a solvent; and
mixing the obtained dispersion with (D) a polyfunctional monomer, (E) a radiation sensitive radical generator and optionally (C) the alkali-soluble resin and (F) the solvent.
30
3. A color filter formed from the radiation sensitive composition for color filters of claim 1.
4. A liquid crystal display device comprising the color

filter of claim 3.