

DESCRIPTION

COLORED RESIN COMPOSITION

TECHNICAL FIELD

[0001]

The present invention relates to a colored resin composition for forming blue, red, and green pixels, a color filter produced by using the colored resin composition, and an electronic display device like a liquid crystal display device, an imaging device (CCD and CMOS), and an organic EL display that are produced by using the color filter.

BACKGROUND ART

[0002]

A color filter is necessary for colorization of a liquid crystal display element used in a liquid crystal display (LCD) such as a laptop PC, a liquid crystal television, a cellular phone, and the like, or for colorization of an imaging device (CCD, CMOS) used as an input device of a digital camera or a color printer. As a method of manufacturing a color filter used for a liquid crystal display device or for a solid-state imaging element, there are many method such as a staining method, an electrode position method, a printing method, and a pigment dispersion method, and the like. In recent days the pigment dispersion method is mostly used. As a method of patterning, photolithography is the most representative method. According to the method, a color filter is produced by using a mixture

of a photosensitive resin composition and a pigment dispersion. Recently, a method of producing a color filter by directly applying a coloring ink to a substrate with an ink jet printer without using a mask is also performed.

[0003]

Improvements in color purity, chroma, brightness, and contrast, which are the characteristics required for a color filter, are particularly important. With an improvement in brightness, the light amount of a backlight can be lowered and power consumption can be suppressed to a low level, and therefore such an improvement is also an environmentally-required technology. To improve the color purity of a color filter, it is necessary to increase the content of a coloring pigment or to choose a pigment which has a better spectral waveform. Meanwhile, since an improvement in brightness can be achieved by increasing the light transmittance, pigment concentration should be lowered or film thickness should be reduced. To satisfy these two contradicting characteristics at the same time, a pigment micronization is carried out. However, since resistance and dispersion stability approach certain limits as the micronization progresses, it is difficult to improve resistance even when brightness is increased at a current state.

[0004]

As another approach to solve the problems described above, an investigation of a color filter employing a dye is carried out. When a dye is used, both of the color purity and brightness

can be obtained at the same time, which is impossible to achieve when using a pigment, and there is also an advantage that, not being a particle, it can suppress light scattering so that contrast can also be improved. However, for a display body like a TV which requires long term reliability, light resistance or heat resistance is required. In this regard, many dyes, in particular blue dyes, have significantly a lower resistance than pigments. For example, disclosed in Patent Literatures 1 and 2 is a color filter wherein triphenylmethane compounds are used. However, the triphenylmethane compounds have significantly low light resistance or heat resistance, and therefore they cannot be used at a practical level. Further, although it is disclosed in Patent Literature 3 that xanthene compounds have excellent brightness, there is no description relating to resistance. For a color filter required to have high reliability, a colored resin composition containing colorant compounds with excellent resistances is waited for, but very few are practically available. As such, for a next generation, a high quality color filter having excellent brightness and excellent resistance is in need.

CITATION LIST

PATENT DOCUMENTS

[0005]

Patent Literature 1: Japanese Patent Application
Laid-Open (JP-A) No. 8-94826

Patent Literature 2: JP-A No. 2002-14222

Patent Literature 3: JP-A No. 2010-32999

Patent Literature 4: JP-A No. 63-172772

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0006]

An object of the invention is to provide a color filter having excellent color characteristics like brightness and excellent heat resistance and light resistance.

MEANS FOR SOLVING PROBLEM

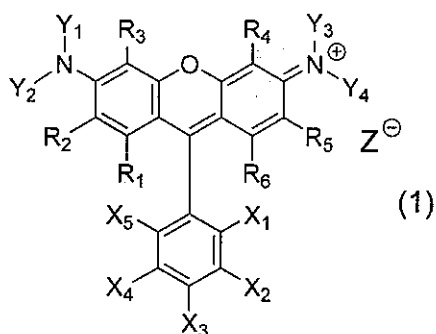
[0007]

The present inventors have made extensive studies in order to solve the problems described above, and as a result, they have found that the problems can be solved by using a colored resin composition containing a specific colorant compound for producing pixels of a color filter, and thus the invention has been achieved.

[0008]

Specifically, the invention relates to the following:

(1) A colored resin composition for color filters comprising a colorant compound represented by the following formula (1), a binder resin, a solvent, and a curing agent
[Chemical Formula 1]



(wherein R_1 to R_6 each independently represent a hydrogen atom, a halogen atom, a C1-C12 alkyl group, a C1-C12 alkoxy group, a nitro group, a carboxyl group, or an alkoxycarbonyl group. Y_1 to Y_4 each independently represent a hydrogen atom, a C1-C12 alkyl group, or an aryl group. X_1 to X_5 each independently represent a hydrogen atom, a C1-C12 alkyl group, a C1-C12 alkoxy group, a halogen atom, a nitro group, a phenoxy group, a carboxyl group, an alkoxycarbonyl group, a carbamoyl group, a sulfo group, or a sulfamoyl group. Anion part Z^- represents an alkylsulfonyl imide anion having a highly halogenated C1-C10 alkyl group),

(2) The colored resin composition described in the above (1), in which Z^- in the formula (1) is a bistrifluoromethanesulfonyl imide anion,

(3) The colored resin composition described in the above (1) or (2), which comprises a metal phthalocyanine pigment,

(4) A colored cured film for color filters obtained by patterning the colored resin composition described in any one of the above (1) to (3),

(5) A color filter consisting of the colored cured film for color filters described in the above (4),

(6) A display device comprising the color filter

described in the above (5), and

(7) A solid-state imaging device comprising the color filter described in the above (5).

EFFECT OF THE INVENTION

[0009]

According to the colored resin composition of the invention comprising a specific colorant compound, high quality color filters having excellent brightness and heat resistance can be provided.

DETAILED DESCRIPTION OF THE INVENTION

[0010]

The colored resin composition of the invention comprises a binder resin, a solvent, a curing agent, and a specific colorant compound, and if necessary, an additional colorant compound like other pigments and dyes and various additives like a surface active agent, a photopolymerization initiator, a thermal polymerization initiator, a polymerization inhibitor, and a UV absorbing agent, but not limited thereto. As for the component other than the specific colorant compound, it can be used without specific limitation.

[0011]

As for the method of manufacturing pixels by using the colored resin composition of the invention, there are photolithography and an ink jet method, etc. For the former, a light sensitive resin composition having excellent

developability using a photopolymerization initiator is used. For the latter, the photopolymerization initiator is not necessarily required so that a thermosetting resin composition is used.

[0012]

R_1 to R_6 in the colorant compound represented by the formula (1) above as used in the invention each independently represent a hydrogen atom, a halogen atom, a C1-C12 alkyl group, a C1-C12 alkoxy group, a nitro group, a carboxyl group, or an alkoxycarbonyl group. Y_1 to Y_4 each independently represent a hydrogen atom, a C1-C12 alkyl group, or an aryl group. X_1 to X_5 each independently may represent one or more of a hydrogen atom, a C1-C12 alkyl group, a C1-C12 alkoxy group, a halogen atom, a nitro group, a phenoxy group, a carboxyl group, an alkoxycarbonyl group, a carbamoyl group, a sulfo group, and a sulfamoyl group. The anion part Z^- represents a sulfonyl imide anion having a highly halogenated C1-C10 alkyl group.

[0013]

Examples of the halogen atom include a fluorine atom, a chlorine atom, a bromine atom, and an iodine atom.

[0014]

Examples of the alkyl group include a C1-C12 alkyl group like a methyl group, an ethyl group, an n-propyl group, an iso-propyl group, an n-butyl group, a sec-butyl group, a t-butyl group, an iso-butyl group, an n-pentyl group, an n-hexyl group, an n-octyl group, a 2-ethylhexyl group, and a cyclohexyl group. The alkyl group may have a substituent group, and examples of

the alkyl group having a substituent group include a hydroxyethyl group, a hydroxypropyl group, a hydroxybutyl group, a 2-sulfoethyl group, a carboxyethyl group, a cyanoethyl group, a methoxyethyl group, an ethoxyethyl group, a butoxyethyl group, a trifluoromethyl group, and a pentafluoroethyl group. Further, examples of the substituent group which may be contained in the alkyl group include a carbamoyl group and a carboxyl group.

[0015]

Examples of the alkoxy group include an alkoxy group having C1-C12 alkyl group as described above. Examples of the alkoxycarbonyl group include the alkoxycarbonyl group having C1-C12 alkyl group as described above.

[0016]

Examples of the aryl group include an aromatic hydrocarbon residue like a phenyl group, a naphthyl group, an anthryl group, a phenanthryl group, a pyrenyl group, and a benzopyrenyl group, and; an aromatic heterocyclic residue like a pyridyl group, a pyrazyl group, a pyrimidyl group, a quinolyl group, an isoquinolyl group, a pyrrolyl group, an indolyl group, an imidazolyl group, a carbazolyl group, a thienyl group, and a furyl group. These aryl groups may have a substituent group and examples of the substituent group include an alkyl group, an alkoxy group, a halogen atom, a sulfo group, a carboxyl group, an alkoxycarbonyl group, a carbamoyl group, and a cyano group.

[0017]

The phenoxy group may have a substituent group, and

examples of the substituent group include a linear or branched C1-C12 alkyl group, a halogen atom, an amino group, an alkylamino group, and a hydroxy group.

[0018]

Examples of the alkoxycarbonyl group include methyloxycarbonyl, ethyloxycarbonyl, propyloxycarbonyl, isopropyloxycarbonyl, butyloxycarbonyl, isobutyloxycarbonyl, pentyloxycarbonyl, isopentyloxycarbonyl, neopentyloxycarbonyl, cyclopentyloxycarbonyl, hexyloxycarbonyl, cyclohexyloxycarbonyl, heptyloxycarbonyl, cycloheptyloxycarbonyl, octyloxycarbonyl, 2-ethylhexyloxycarbonyl, cyclooctyloxycarbonyl, nonyloxycarbonyl, decanyloxycarbonyl, tricyclodecanyloxycarbonyl, methoxypropyloxycarbonyl, ethoxypropyloxycarbonyl, hexyloxypropyloxycarbonyl, 2-ethylhexyloxypropyloxycarbonyl, methoxyhexyloxycarbonyl, and benzyloxycarbonyl.

[0019]

The carbamoyl group may have a substituent group, and examples of the substituent group include a linear or branched C1-C12 alkyl group, a phenyl group, a tosyl group, and a pyrimidinyl group. Further, with respect to the carbamoyl group, two alkyl groups attached on the nitrogen may form, together with the nitrogen atom, a C3-C12 cycloalkyl ring or an aliphatic heterocycle having at least one heteroatom like nitrogen, oxygen and sulfur.

[0020]

Examples of the sulfo group include methanesulfonyl, ethanesulfonyl, hexanesulfonyl, and decanesulfonyl.

[0021]

Examples of the sulfamoyl group include sulfamoyl, methanesulfamoyl, ethanesulfamoyl, propanesulfamoyl, isopropanesulfamoyl, butanesulfamoyl, isobutanesulfamoyl, pentanesulfamoyl, isopentanesulfamoyl, neopentanesulfamoyl, cyclopentanesulfamoyl, hexanesulfamoyl, cyclohexanesulfamoyl, heptanesulfamoyl, cycloheptanesulfamoyl, octanesulfamoyl, 2-ethylhexanesulfamoyl, 1,5-dimethylhexanesulfamoyl, cyclooctanesulfamoyl, nonanesulfamoyl, decanesulfamoyl, tricyclodecanesulfamoyl, methoxypropanesulfamoyl, ethoxypropanesulfamoyl, propoxypropanesulfamoyl, isopropoxypropanesulfamoyl, hexyloxypropanesulfamoyl, 2-ethylhexyloxypropanesulfamoyl, methoxyhexanesulfamoyl, and 3-phenyl-1-methylpropanesulfamoyl.

[0022]

The anion part Z^- in the formula (1) represents an alkylsulfonyl imide anion having a highly halogenated C1-C10 alkyl group, and a bistrifluoromethanesulfonyl imide anion is particularly preferable.

[0023]

The colorant compound used for the colored resin composition of the invention is obtained according to a known synthetic method described in, for example, "Theoretical Production, Dye Chemistry" by Hosoda Yutaka (published by Gihodo Shuppan Co., Ltd., pp 373 to 375). However, it can be

also synthesized by obtaining a commercial product in which the anion part Z^- is a chloride anion and adding a corresponding base or acid for salt-exchange.

[0024]

When the colorant compound of the invention is synthesized by salt-exchange, a colorant compound in which the anion part Z^- is a chloride anion is dissolved in a reaction solvent (for example, water or a water-soluble polar solvent like methanol, ethanol, isopropanol, acetone, N,N-dimethylformamide (herein below, abbreviated as DMF), N-methyl-2-pyrrolidone (herein below, abbreviated as NMP), and the solvent may be used either singly or in a mixture thereof), a corresponding base or acid is added in an amount of 0.5 to 3 equivalents thereto, the mixture is stirred at a pre-determined temperature (for example 0 to 100°C), and precipitated crystals are filtered to easily obtain the target compound.

[0025]

Specific examples represented by the formula (1) above are given in the following Table 1, but the invention is not limited by them.

[0026]

[Table 1]

Table 1

1	<chem>CCN(CC)c1ccc2c(c1)oc3cc(ccc3[n+]2(CC)CC)C4=CC=CC=C4C(=O)O.[O-]S(=O)(=O)C(F)(F)F</chem>
2	<chem>CCN(CC)c1ccc2c(c1)oc3cc(C)c(C)[n+]2(CC)CC)C4=CC=CC=C4C(=O)OCC.[O-]S(=O)(=O)C(F)(F)F</chem>
3	<chem>CCN(CC)c1ccc2c(c1)oc3cc(ccc3[n+]2(CC)CC)C4=CC=CC=C4C(=O)OCC.[O-]S(=O)(=O)C(F)(F)F</chem>
4	<chem>CCN(CC)c1ccc2c(c1)oc3cc(ccc3[n+]2(CC)CC)C4=CC=CC=C4C(=O)OC.[O-]S(=O)(=O)C(F)(F)F</chem>
5	<chem>CCN(CC)c1ccc2c(c1)oc3cc(ccc3[n+]2(CC)CC)C4=CC=CC=C4C(=O)OCC5=CC=CC=C5.[O-]S(=O)(=O)C(F)(F)F</chem>

[0027]

The colored resin composition of the invention is a composition which contains the colorant compound represented by the formula (1) in an amount of preferably 1 to 60 parts by weight, and more preferably 5 to 30 parts by weight compared to the total solid matter (indicating the total amount of a solid

matter consisting of a colorant compound, a binder resin, and a curing agent, etc., and the same shall apply herein below). When the content is above the range, problems like precipitation and aggregation occur and adhesiveness to a substrate may decrease due to insufficient curing. On the other hand, when it is below the range, there is a tendency that sufficient color purity cannot be obtained as color characteristics, although it may not cause a big problem.

[0028]

When the colorant compound represented by the formula (1) has a poor solubility in the colored resin composition, it can be dispersed with an aid of a dispersant, similar to a pigment as an optional component described below. The colorant compound represented by the formula (1) may be used either singly or in combination of two or more, and it may be also mixed with other dye or pigment. As the invention mostly relates to blue pixels or red pixels, it is preferable that a known blue dye, violet dye, red dye or yellow dye, or blue pigment, violet pigment, red pigment, or yellow pigment is admixed therewith.

[0029]

The binder resin used in the invention is preferably soluble in an alkali developing solution used in a development process for producing a color filter according to photolithographic design and has a sufficient curing property with a photopolymerization initiator or a photopolymerizable monomer to form favorable fine patterns. It is also required for the pigment dispersant resin composition to have good

compatibility with a constitutional material like photopolymerization initiator, photopolymerizable monomer, and pigment dispersion and good stability not to cause any precipitation or aggregation. In an ink jet method, alkali solubility is not particularly required, and therefore a resin having good compatibility with other colorant compound or additives can be selected.

[0030]

Any resin known in the art can be used as a binder resin. However, it is preferably a copolymer of an ethylenically unsaturated monomer having at least one carboxyl group or a hydroxy group or an ethylenically unsaturated monomer having other copolymerizable aromatic hydrocarbon group or aliphatic hydrocarbon group as described below. Further, a resin having an epoxy group in a side chain or terminal or an epoxy acrylate resin added with acrylate can be also used. The monomer may be used either singly or in combination of two or more.

[0031]

Examples of the ethylenically unsaturated monomer having carboxyl group that can be used in the invention include unsaturated monocarboxylic acids like acrylic acid, methacrylic acid, crotonic acid, α -chloroacrylic acid, ethacrylic acid, and cinnamic acid; unsaturated dicarboxylic acids (anhydride) like maleic acid, maleic anhydride, fumaric acid, itaconic acid, itaconic anhydride, citraconic acid, citraconic anhydride, and mesaconic acid; unsaturated polycarboxylic acids (anhydride) having valency of 3 or more,

2-(meth)acryloyloxyethyl hexahydrophthalic acid,
2-methacryloyloxyethyl-2-hydroxypropylphthalate, and
2-acryloyloxyethyl-2-hydroxyethyl phthalic acid. They may be
used either singly or in combination of two or more.

[0032]

Examples of the ethylenically unsaturated monomer having
hydroxy group that can be used in the invention include
2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl
(meth)acrylate, 3-hydroxypropyl (meth)acrylate,
4-hydroxybutyl (meth)acrylate, 3-hydroxybutyl (meth)acrylate,
5-hydroxypentyl (meth)acrylate, 4-hydroxypentyl
(meth)acrylate, 3-hydroxypentyl (meth)acrylate,
6-hydroxyhexyl (meth)acrylate, 5-hydroxyhexyl (meth)acrylate,
4-hydroxyhexyl (meth)acrylate, 5-hydroxy-3-methyl-pentyl
(meth)acrylate, cyclohexane-1,4-dimethanol
mono(meth)acrylate, 2-(2-hydroxyethoxy)ethyl
(meth)acrylate, glycerin monomethacrylate, and polyalkylene
glycol mono(meth)acrylate having terminal hydroxy group like
polyethylene glycol mono(meth)acrylate, polypropylene glycol
mono(meth)acrylate, and poly(ethylene glycol-propylene
glycol)monomethacrylate. They may be used either singly or in
combination of two or more.

[0033]

Examples of an ethylenically unsaturated monomer that is
copolymerizable other than those described above include an
aromatic vinyl compound like styrene, α -methylstyrene,
o-vinytoluene, m-vinytoluene, p-vinytoluene,

o-chlorostyrene, m-chlorostyrene, p-chlorostyrene, and
 p-methoxystyrene; unsaturated carboxylic acid esters like
 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, benzyl (meth)acrylate, paracumyl
 phenoxyethylene glycol (meth)acrylate,
 2-hydroxy-3-phenoxypropyl (meth)acrylate, o-phenylphenol
 glycidyl ether (meth)acrylate, hydroxyethyl-o-phenylphenol
 (meth)acrylate, and phenoxyethyl (meth)acrylate; alicyclic
 skeletons like cyclopentyl (meth)acrylate, cyclohexyl
 (meth)acrylate, trimethylcyclohexyl (meth)acrylate,
 norbornyl (meth)acrylate, norbornylmethyl (meth)acrylate,
 phenylnorbornyl (meth)acrylate, cyanonorbornyl
 (meth)acrylate, isobornyl (meth)acrylate, bornyl
 (meth)acrylate, menthyl (meth)acrylate, pentyl (meth)acrylate,
 adamantyl (meth)acrylate, dimethyladamantyl (meth)acrylate,
 tricyclo[5.2.1.0^{2,6}]deca-8-yl=(meth)acrylate,
 tricyclo[5.2.1.0^{2,6}]deca-4-methyl=(meth)acrylate,
 cyclodecyl (meth)acrylate,
 2-(meth)acryloyloxyethylhexahydrophthalic acid, and
 tert-butylcyclohexyl (meth)acrylate; polyalkylene glycol
 mono(meth)acrylates having a terminal hydroxy group like
 polyethylene glycol mono(meth)acrylate, polypropylene glycol
 mono(meth)acrylate, and poly(ethylene glycol-propylene
 glycol)monomethacrylate; polyalkylene glycol

mono(meth)acrylates having a terminal alkyl group like
 methoxypolyethylene glycol monomethacrylate,
 lauroxypolyethylene glycol mono(meth)acrylate,
 octoxypolyethylene glycol polypropylene glycol
 mono(meth)acrylate, nonylphenoxypolyethylene glycol mono
 acrylate, nonylphenoxypolypropylene glycol mono acrylate, and
 aryloxypolyethylene glycol polypropylene glycol
 mono(meth)acrylate; unsaturated carboxylic acid aminoalkyl
 esters like 2-aminoethyl acrylate, 2-aminoethyl methacrylate,
 2-aminopropyl acrylate, 2-aminopropyl methacrylate,
 3-aminopropyl acrylate, and 3-aminopropyl methacrylate;
 unsaturated carboxylic acid glycidyl esters like glycidyl
 acrylate, glycidyl methacrylate, 3,4-epoxybutyl
 (meth)acrylate, (3,4-epoxycyclohexyl)methyl (meth)acrylate,
 and 4-hydroxybutyl (meth)acrylate glycidyl ether; carboxylic
 acid vinyl esters like vinyl acetate, vinyl propionate, vinyl
 butyrate, and vinyl benzoate; unsaturated ethers like vinyl
 methyl ether, vinyl ethyl ether, aryl glycidyl ether, and
 methallyl glycidyl ether; cyano vinyl compounds like
 acrylonitrile, methacrylonitrile, α -chloroacrylonitrile, and
 cyano vinylidene; unsaturated amides or unsaturated imides like
 acrylamide, methacrylamide, α -chloroacrylamide, N-phenyl
 maleimide, N-cyclohexyl maleimide,
 N-(meth)acryloylphthalimide, N-(2-hydroxyethyl)acrylamide,
 N-(2-hydroxyethyl)methacrylamide, and maleimide; aliphatic
 conjugated dienes like 1,3-butadiene, isoprene, and
 chloroprene, and; macromonomers having a monoacryloyl group or

a monomethacryloyl group at the terminal of a polymer molecular chain like polystyrene, polymethyl acrylate, polymethyl methacrylate, poly n-butyl acrylate, poly n-butyl methacrylate, and polysilicone. They may be used either singly or in combination of two or more.

[0034]

Further, a polymer having an additional unsaturated double bond in the copolymer side chain is also useful. Examples thereof include a compound which is obtained by reaction of a maleic anhydride part of a copolymer between maleic anhydride and a copolymerizable styrene, vinyl phenol, acrylic acid, acrylic acid ester, or acrylamide with an acrylate having an alcoholic hydroxy group like hydroxyethyl acrylate or an acrylate having an epoxy group like glycidyl methacrylate followed by half-esterification, and a compound which is obtained by reacting acrylic acid with a hydroxy group of a copolymer between acrylic acid or acrylic acid ester and an acrylate having an alcoholic hydroxy group like hydroxyethyl acrylate. Further, a urethane resin, a polyamide resin, a polyimide resin, a polyester resin, and commercially available ACA-200M (trade name, manufactured by Daicel Corporation), ORGA-3060 (trade name, manufactured by OSAKA ORGANIC CHEMICAL INDUSTRY LTD.), AX3-BNX02 (trade name, manufactured by NIPPON SHOKUBAI CO., LTD.), UXE-3024 (trade name, manufactured by NIPPON KAYAKU CO., LTD.), UXE-3000 (trade name, manufactured by NIPPON KAYAKU CO., LTD.), ZGA-287H (trade name, manufactured by NIPPON KAYAKU CO., LTD.), TCR-1338H (trade name,

manufactured by NIPPON KAYAKU CO., LTD.), ZXR-1722H (trade name, manufactured by NIPPON KAYAKU CO., LTD.), ZFR-1401H (trade name, manufactured by NIPPON KAYAKU CO., LTD.), and ZCR-1642 (trade name, manufactured by NIPPON KAYAKU CO., LTD.) can be also used.

[0035]

For dispersing a pigment, a dispersant or a dispersant aid is generally used, and there is a pigment-based dispersant, a resin-based dispersant, or a surface active agent which have a good adsorptivity to a pigment. With respect to the pigment-based dispersant, a method of mixing a sulfonate or a metal salt of a pigment with a pigment as disclosed in Patent Literature 4 or a method of mixing with a substituted aminomethyl derivative is known, for example. As for the resin-based dispersant, there is a non-polar and non-ionic dispersant. However, a polymer resin with an acid value or an amine value to give a good pigment adsorptivity is more general. Examples thereof include an acryl resin, a polyurethane resin, polycarboxylic acid, a polyamide resin and a polyester resin. Specific examples thereof include ED211 (trade name, manufactured by Kusumoto Chemicals, Ltd.), AJISPER-PB821 (trade name, manufactured by Ajinomoto Fine-Techno Co., Inc.) and SOLSPERSE 71000 (trade name, manufactured by Avecia).

[0036]

For producing the binder resin (i.e. copolymer) that is used in the invention, a polymerization initiator is used. Specific examples of the polymerization initiator that is used for synthesis of a copolymer include α, α' -azobis

(isobutyronitrile), 2,2'-azobis(2-methylbutyronitrile), t-butyl peroctoate, di-t-butyl peroxide peroxo benzoyl methyl ethyl ketone peroxide. Use ratio of the polymerization initiator is 0.01 to 25 parts by weight compared to the total of monomers used for synthesis of a copolymer. Further, it is preferable to use an organic solvent explained below for synthesis of a copolymer. However, a solvent having sufficient dissolving power for a monofunctional monomer or a polymerization initiator should be employed. The reaction temperature for synthesis of a copolymer is preferably 50 to 120°C, and particularly preferably 80 to 100°C. Further, the reaction time is preferably 1 to 60 hours, and more preferably 3 to 20 hours. The preferred acid value of the copolymer is 10 to 300 (mgKOH/g), and the preferred hydroxy value is 10 to 200 (mgKOH/g). When the acid value or the hydroxy value is 10 or less, the developability is impaired. The weight average molecular weight (Mw) of the copolymer is preferably 2000 to 400000, and more preferably 3000 to 100000. When the weight average molecular weight is less than or equal to 2000 or more than or equal to 400000, the sensitivity and the developability, etc. are impaired.

[0037]

According to the invention, the binder resin may be used either singly or in combination of two or more. The content of the binder resin of the invention is generally 0.5 to 99 parts by weight, and preferably 5 to 50 parts by weight compared to the 100 parts by weight of the total solid matter in the colored

resin composition. When the content of the binder resin is less than 0.5 parts by weight, problems may arise that impair alkali developability is impaired or creates surface contamination or film residue occurs in an area other than a pixel-forming part.

[0038]

In case of radical polymerization, examples of the curing agent used in the invention include a photopolymerization monomer. In case of ion curing, examples include an epoxy resin as well as a melamine curing agent. Specific examples thereof include 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, ethylene glycol di(meth)acrylate, diethylene glycol di(meth)acrylate, triethylene glycol (meth)acrylate, tetraethylene glycol (meth)acrylate, trimethylol propane tri(meth)acrylate, pentaerythritol di(meth)acrylate, pentaerythritol tri(meth)acrylate, pentaerythritol tetra(meth)acrylate, dipentaerythritol hexa(meth)acrylate, glycerol (meth)acrylate, bisphenol-A type epoxy di(meth)acrylate, bisphenol-F type epoxy di(meth)acrylate, bisphenol-fluorene type epoxy di(meth)acrylate, ethoxylated trimethylol propane tri(meth)acrylate, propoxylated trimethylol propane tri(meth)acrylate, ethoxylated glycerin tri(meth)acrylate, ethoxylated isocyanuric acid tri(meth)acrylate, ditrimethylol propane tetra(meth)acrylate, ethoxylated pentaerythritol tetra(meth)acrylate,

9,9-bis[4-(2-acryloyloxyethoxy)phenyl]fluorene, Kayarad RP-1040 (trade name, manufactured by NIPPON KAYAKU CO., LTD.),

Kayarad DPCA-30 (trade name, manufactured by NIPPON KAYAKU CO., LTD.), UA-33H (trade name, manufactured by Shin Nakamura Chemical Co., Ltd.), UA-53H (trade name, manufactured by Shin Nakamura Chemical Co., Ltd.), M-8060 (trade name, manufactured by TOAGOSEI CO., LTD.); as a thiol-based monomer for polymerization, TEMPIC (trade name, manufactured by Sakai Chemical Industry Co., Ltd.), TMMP (trade name, manufactured by Sakai Chemical Industry Co., Ltd.), PEMP (trade name, manufactured by Sakai Chemical Industry Co., Ltd.), and DPMP (trade name, manufactured by Sakai Chemical Industry Co., Ltd.); as an epoxy resin, NC-6000, NC-3000, EOCN-1020, XD-1000, EPPN-501H, BREN-S, and NC-7300L, all manufactured by NIPPON KAYAKU CO., LTD., CELLOXIDE 2021P, EHPE3150, CYCLOMER M100, and EPOLEAD PB3600, all manufactured by Daicel Corporation, EPICOAT 828, EPICOAT YX8000, and EPICOAT YX4000, all manufactured by Japan Epoxy Resins Co., Ltd., Sila-Ace S510 (trade name, manufactured by Chisso Corporation), and TEPIC (trade name, manufactured by Nissan Chemical Industries, Ltd.), etc., and; as a melamine curing agent, methyolated melamine and Mw-30 (trade name, manufactured by SANWA Chemical Co., Ltd.). They may be used either singly or in combination of two or more. The content is 1 to 80 parts by weight, and preferably 5 to 30 parts by weight compared to the 100 parts by weight of the total solid matter in the colored resin composition.

[0039]

The pigment which can be used in combination with the essential components of the colored resin composition of the

invention preferably has spectral characteristics that are suitable for color filters. It may be suitably selected from a dye, an organic pigment and an inorganic pigment. If necessary, it may be used either singly or in combination of two or more. The content is 0 to 60 parts by weight, and preferably 5 to 30 parts by weight compared to the 100 parts by weight of the total solid matter in the colored resin composition. Various pigments and dyes are described herein under.

[0040]

The organic pigment that can be used in combination with the essential components of the colored resin composition of the invention is not specifically limited, and the examples thereof include a pigment like an anthraquinone-based pigment, a phthalocyanine-based pigment, a triphenylmethane-based pigment, a benzimidazolone-based pigment, a quinacridone-based pigment, an azo chelate-based pigment, an azo-based pigment, an isoindoline-based pigment, an isoindolinone-based pigment, a pyranthrone-based pigment, an indanthrone-based pigment, an anthrapyrimidine-based pigment, a dibromoanthanthrone-based pigment, a flavanthrone-based pigment, a perylene-based pigment, a perinone-based pigment, a quinophthalone-based pigment, a thioindigo-based pigment, a dioxadine-based pigment, a quinarcradone-based pigment, and a xanthene-based pigment, and; a lake pigment and a dyed lake pigment which is obtained by insolubilization of an acidic dye, a basic dye, or a direct dye with a precipitating agent therefor.

More specific examples include, in terms of Color Index, Pigment Blue 1, 1:2, 9, 14, 15, 15:1, 15:2, 15:3, 15:4, 15:6, 16, 17, 19, 25, 27, 28, 29, 33, 35, 36, 56, 56:1, 60, 61, 61:1, 62, 63, 66, 67, 68, 71, 72, 73, 74, 75, 76, 78, 79; Pigment Violet 1, 1:1, 2, 2:2, 3, 3:1, 3:3, 5, 5:1, 14, 15, 16, 19, 23, 25, 27, 29, 31, 32, 37, 39, 42, 44, 47, 49, 50; Pigment Violet 3, 4, 27, 39; Pigment Red 7, 14, 41, 48:1, 48:2, 48:3, 48:4, 57:1, 81, 81:1, 81:2, 81:3, 81:4, 81:5, 122, 146, 168, 177, 178, 184, 185, 187, 200, 202, 208, 210, 246, 254, 255, 264, 270, 272, 279; Pigment Orange 43, 71, 73; Pigment Yellow 1, 2, 3, 4, 5, 6, 10, 12, 13, 14, 15, 16, 17, 18, 24, 31, 32, 34, 35, 35:1, 36, 36:1, 37, 37:1, 40, 42, 43, 53, 55, 60, 61, 62, 63, 65, 73, 74, 77, 81, 83, 93, 94, 95, 97, 98, 100, 101, 104, 106, 108, 109, 110, 113, 114, 115, 116, 117, 118, 119, 120, 123, 126, 127, 128, 129, 138, 139, 147, 150, 151, 152, 153, 154, 155, 156, 161, 162, 164, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 179, 180, 181, 182, 185, 187, 188, 193, 194, 198, 199, 213, 214, and Pigment Green 7, 36, 58. Of these, metal phthalocyanine pigments like Pigment Blue 15, 15:1, 15:2, 15:3, 15:4, 15:6, 16, 17, 75, 76, 79; Pigment Violet 23, Pigment Red 177, 254, and Pigment Yellow 83, 138, 139, 150 which have good color and resistance, etc., are preferable. Pigment Blue 15:6 as a copper phthalocyanine pigment is particularly preferable.

[0041]

Examples of the inorganic pigment that can be used in combination with the essential components of the colored resin composition of the invention is not specifically limited, and

the examples thereof include a metal oxide, a metal sulfide, a sulfate salt, a metal hydroxide, and a metal carbonate like complex metal oxide pigment, carbon black, lowly oxidized black titan, titan oxide, barium sulfate, zinc oxide, lead sulfate, yellow-colored lead, bengara, deep navy, navy, chromium oxide, antimony white, black iron, red lead, zinc sulfide, cadmium yellow, cadmium red, zinc, manganese purple, cobalt purple, barium sulfate, and magnesium carbonate.

[0042]

The dye which can be used in combination with the essential components of the colored resin composition of the invention is not specifically limited and examples thereof include an acidic dye, a basic dye, a direct dye, a sulfur dye, a dye for dry-dyeing, a naphthol dye, a reactive dye and a dispersion dye. Of these, any dye soluble in an organic solvent can be suitably used. However, a dye insoluble in an organic solvent can be also suitably used after it is prepared as a dispersion. It is well known that a dye insoluble in an organic solvent, for example an acidic dye, can be modified to an amine salt dye by reacting it with an organic amine compound (for example, n-propylamine and ethylhexyl propionic acid amine) or to a dye having a sulfonamide group by reacting the sulfonic acid group with the same organic amine compound. The amine-modified dyes can be also used for the colored resin composition of the invention. More specific examples of the dye include, in terms of Color Index Number, Basic Blue 7, Acid Blue 1, 7, 9, 15, 18, 23, 25, 27, 29, 40, 42, 45, 51, 62, 70, 80, 83, 86, 87, 90, 92,

96, 103, 112, 113, 120, 129, 138, 147, 150, 158, 171, 182, 192, 210, 242, 243, 249, 256, 259, 267, 278, 280, 285, 290, 296, 315, 324, 335, 340; Basic Blue 7, 11, 15, 26; Solvent Blue 2, 3, 4, 5, 6, 23, 25, 35, 37, 38, 43, 55, 59, 67, 72, 124; Basic Violet 10; Acid Violet 17, 49; Solvent Violet 4, 5, 14; Basic Red 1, 10, 29; Acid Red 91, 92, 97, 114, 138, 151, 289; Solvent Red 45, 49, 127; Acid Yellow 17, 23, 25, 29, 38, 40, 42, 76; Solvent Yellow 4, 14, 15, 24, 76, 81, 82, 94, 98, 162; Solvent Orange 2, 7, 11, 15, 26, 56, and; Acid Green 9, 16.

[0043]

As for the photopolymerization initiator used for the colored resin composition of the invention, that is used for photography method, an initiator having sufficient sensitivity toward UV light emitted from a ultrahigh pressure mercury lamp generally used as a light source for exposure is preferable. Examples thereof include a radical polymerizable photoradical initiator and an ion curable photo-acid generator or a photo-base generator. For the photopolymerization, a polymerization promoter component, which is called a sensitizer to cause curing even with small exposure energy, can be used in combination. Examples of the photopolymerization initiator that can be used include, although not specifically limited, benzil, benzoin ether, benzoin butyl ether, benzoin propyl ether, benzophenone, 3,3'-dimethyl-4-methoxybenzophenone, benzoyl benzoate, ester product of benzoyl benzoate, 4-benzoyl-4'-methyl diphenyl sulfide, benzyl dimethyl ketal, 2-butoxyethyl-4-methylaminobenzoate, chlorothioxanthone,

methyl thioxanthone, ethyl thioxanthone, isopropyl thioxanthone, dimethyl thioxanthone, diethyl thioxanthone, diisopropyl thioxanthone, dimethylaminomethylbenzoate, 1-(4-dodecylphenyl)-2-hydroxy-2-methylpropan-1-one, 1-hydroxycyclohexylphenyl ketone, 2-hydroxy-2-methyl-1-phenylpropan-1-one, 1-(4-isopropylphenyl)-2-hydroxy-2-methylpropan-1-one, methylbenzoyl formate, 2-methyl-1-(4-methylthiophenyl)-2-morpholinopropan-1-one, 2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)-butanone-1, 2,4-bis(trichloromethyl)-6-(4-methoxyphenyl)-1,3,5-s-triazine, 2,4,6-tris(trichloromethyl)-1,3,5-s-triazine, 2,4-bis(tribromomethyl)-6-(4'-methoxyphenyl)-1,3,5-s-triazine, 2,4,6-tris(tribromomethyl)-1,3,5-s-triazine, 2,4-bis(trichloromethyl)-6-(1,3-benzodioxolan-5-yl)-1,3,5-s-triazine, benzophenone, benzoyl benzoate, 1-(4-phenylsulfanylphenyl)butane-1,2-dione-2-oxime-o-benzoate, 1-(4-methylsulfanylphenyl)butane-1,2-dione-2-oxime-o-acetate, 1-(4-methylsulfanylphenyl)butan-1-one-2-oxime-o-acetate, 4,4'-bis(diethylamino)benzophenone, P-dimethylamino benzoic acid isoamyl ester, P-dimethylamino benzoic acid ethyl ester, 2,2'-bis(o-chlorophenyl)-4,4',5,5'-tetraphenyl-1,2'-biimidazole, diazonaphthoquinone-based initiator, and commercially available Kayacure-DMBI, Kayacure-BDMK, Kayacure-BP-100, Kayacure-BMBI, Kayacure-DETX-S, Kayacure-EPA (trade names, all manufactured by NIPPON KAYAKU CO., LTD.), Darocure 1173 and

Darocure 1116 (trade names, all manufactured by Merck Japan Co. Ltd.), Irgacure 907 (trade name, manufactured by BASF Japan Ltd.), Irgacure 369 (trade name, manufactured by BASF Japan Ltd.), Irgacure 379 EG ((trade name, manufactured by BASF Japan Ltd.), Irgacure OXE-01 (trade name, manufactured by BASF Japan Ltd.), Irgacure OXE-02 (trade name, manufactured by BASF Japan Ltd.), Irgacure PAG103 (trade name, manufactured by BASF Japan Ltd.), TME-triazine (trade name, manufactured by SANWA Chemical Co., Ltd.), biimidazole (manufactured by Kurogane Kasei Co., Ltd.), and STR-110 and STR-1 (trade names, all manufactured by Respe Chemical Co., Ltd.).

[0044]

For a thermosetting resin composition for use in an ink jet method, etc., a thermo-polymerization initiator is generally used. However, if necessary, a photopolymerization initiator can be also used in combination. Examples of the thermo-polymerization initiator include an azo-based compound and an organic peroxide compound and specific examples thereof include 2,2'-azobisisobutyronitrile, 2,2'-azobis(2,4-dimethylvaleronitrile), 2,2'-azobis(2-methylbutyronitrile), di-t-butyl peroxide, dibenzoyl peroxide, and cumyl peroxyneodecanoate.

[0045]

The polymerization initiator may be used either singly or in combination of two or more, if necessary. The content is 0.5 to 50 parts by weight, and preferably 1 to 25 parts by weight compared to the 100 parts by weight of the total solid

matter in the colored resin composition.

[0046]

As for the organic solvent used in the invention, a solvent having sufficient solubility for the constitutional components of the colored resin composition, such as a binder resin, a photopolymerizable monomer, and a photopolymerization initiator, and also for the monofunctional monomer or the polymerization initiator used for the synthesis of a binder resin can be used. In addition, a solvent capable of maintaining the dispersion stability even when a pigment dispersion is prepared can be used.

[0047]

The organic solvent used in the invention is not specifically limited, as long as it is usable. Specific examples thereof include benzenes like benzene, toluene, and xylene; cellosolves like methyl cellosolve, ethyl cellosolve, and butyl cellosolve; cellosolve acetic acid esters like methyl cellosolve acetate, ethyl cellosolve acetate, and butyl cellosolve acetate; propylene glycol monoalkyl ether acetic acid esters like propylene glycol monomethyl ether acetate, propylene glycol monoethyl ether acetate, and propylene glycol monobutyl ether acetate; propionic acid esters like methyl methoxypropionic acid, ethyl methoxypropionic acid, methyl ethoxypropionic acid, and ethyl ethoxypropionic acid; lactic acid esters like methyl lactate, ethyl lactate, and butyl lactate; diethylene glycols like diethylene glycol monomethyl ether and diethylene glycol monoethyl ether; acetic acid esters

like methyl acetate, ethyl acetate, and butyl acetate; ethers like dimethyl ether, diethyl ether, tetrahydrofuran, and dioxane; ketones like acetone, methyl ethyl ketone, methyl butyl ketone, and cyclohexanone, and; alcohols like methanol, ethanol, butanol, isopropyl alcohol, and benzyl alcohol.

[0048]

It may be used either singly or in combination of two or more. The use amount of the organic solvent is preferably 40 to 10000 parts by weight, and more preferably 100 to 1000 parts by weight compared to the 100 parts by weight of the total solid matter in the colored resin composition.

[0049]

The colored resin composition of the invention is produced by mixing and stirring a binder resin, a curing agent, a specific colorant compound, and an organic solvent, etc. with a dissolver or a homomixer. In addition, other pigments or dyes can be added, if necessary. However, a pigment or a dye having low solubility is first converted into a dispersion by using an appropriate dispersant with a disperser like paint shaker, and then added and mixed with the colored resin composition.

[0050]

To the colored resin composition of the invention, various additives, for example, a filler, a surface active agent, a photopolymerization initiator, a thermal polymerization initiator, a polymerization inhibitor, an adhesion promoter, an anti-oxidant, a UV absorbing agent, and an aggregation inhibitor, can be further added, if necessary. Further, to

remove impurities, etc., the colored resin composition of the invention may be subjected to microfiltration using a filter, etc. after production.

[0051]

Herein below, a method of producing a cured product from the colored resin composition of the invention is explained. First, the colored resin composition of the invention is coated on a substrate like a glass substrate and a silicon plate to the film thickness of 0.1 to 20 μm , and preferably 0.5 to 5 μm according to a method such as a spin coating, a roll coating, a slit and spinning, a die coating, and a bar coating. Then drying under reduced pressure is carried out according to the drying condition under the temperature of 23 to 150°C for 1 to 60 min, more preferably the temperature of 60 to 120°C for 1 to 10 min, in a reduced pressure chamber, if necessary. Further, a pre-baking treatment is carried out by using a hot plate or a clean oven, etc. to form a film. Next, radiation (for example, electronic beam or UV light can be considered, and UV light is preferable) is applied through a certain mask pattern by a commonly-used photolithography method, and development using an aqueous solution of surface active agent, an aqueous alkali solution, or an aqueous mixture solution of a surface active agent and an alkali agent is carried out. Development method includes a dipping method, a spraying method, a shower method, a paddle method, and an ultrasonication method, and a combination thereof can be also employed. Non-exposed area is removed by development process, rinsed with water, and

post-baking treatment, for example, at the temperature of 130 to 300°C for 1 to 120 min, and more preferably at the temperature of 150 to 250°C for 1 to 30 min, is carried out to obtain the pixels consisting of the colored curable film of the invention.

[0052]

Examples of the surface active agent that can be used include polyoxyethylene alkyl ether and polyoxyalkylene alkyl ether. Examples of the alkali agent that can be used include sodium carbonate, potassium carbonate, sodium hydroxide, potassium hydroxide, diethanolamine, and tetramethylammonium hydroxide. In the invention, use of an aqueous solution containing both the alkali agent and surface active agent is preferable. Development process is typically carried out at the treatment temperature of 10 to 50°C, preferably 20 to 40°C, for treatment time of 30 to 600 sec, more preferably 30 to 120 sec.

[0053]

The cured product of the colored resin composition of the invention is useful for color filters of a liquid crystal display device, an organic EL display, or a solid-state imaging device used in a digital camera, etc. and the color filters have patterned pixels consisting of the colored resin composition of the invention that is produced as described above.

[0054]

Among the display devices of the invention, the liquid crystal display device is produced to have a structure in which a back light, a polarizing film, a display electrode, a liquid

crystal, an alignment film, a common electrode, the color filter of the invention, and a polarizing film are laminated in the order. Further, the organic EL display is produced by disposing the color filter of the invention either above or below a multilayered organic light emitting device. For example, the solid-state imaging device is produced by forming the color filter layer of the invention on a silicon wafer on which a transport electrode and a photodiode are formed, and then laminating a micro lens thereon.

Examples

[0055]

The invention is explained in greater detail in view of the following Examples, but the invention is not limited by the Examples. As spectroscopic characteristics, spectral transmission ratio was measured by using a spectrophotometer "Shimadzu Corporation UV-3150" and chromaticity was estimated based on the XYZ Color System. Accordingly, the resistance of the colored material was evaluated.

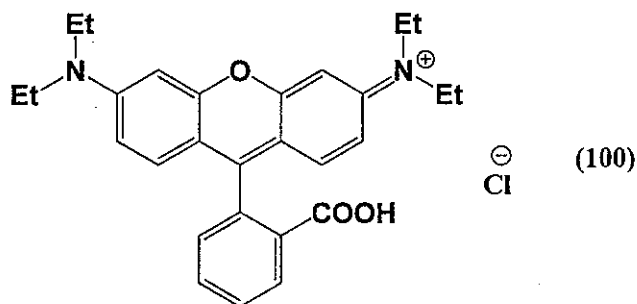
[0056]

Synthetic Example 1

To a 100 ml beaker, 1 g of Rhodamine B (manufactured by Tokyo Chemical Industry Co., Ltd.) of the following formula (100) and 20 g of water were added and stirred at room temperature for 30 min. Then, a solution in which 1 g of bistrifluoromethanesulfonyl imide (TFSI) potassium salt is dissolved in 1 g of DMF was added dropwise thereto and stirred

for 3 hours. The precipitated dye was filtered, washed with water, and dried to obtain 0.7 g TFSI salt of Rhodamine B (Compound No. 1). Maximum absorption wavelength: 560 nm (cyclohexanone)

[Chemical Formula 2]

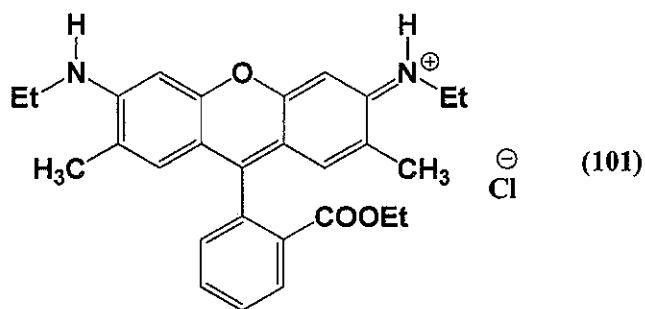


[0057]

Synthetic Example 2

To a 100 ml beaker, 1 g of Rhodamine 6G (manufactured by Tokyo Chemical Industry Co., Ltd.) of the following formula (101) and 20 g of water were added and stirred at room temperature for 30 min. Then, a solution in which 1 g of bistrifluoromethanesulfonyl imide potassium salt is dissolved in 1 g of DMF was added dropwise thereto and stirred for 3 hours. The precipitated dye was filtered, washed with water, and dried to obtain 0.8 g TFSI salt of Rhodamine 6G (Compound No. 2). Maximum absorption wavelength: 531 nm (cyclohexanone)

[Chemical Formula 3]



[0058]

Synthetic Example 3 (production of binder resin
(copolymer))

To a 500 ml four neck flask, 160 g of methyl ethyl ketone, 10 g of methacrylic acid, 33 g of benzyl methacrylate, and 1 g of α, α' -azobis(isobutyronitrile) were added and nitrogen gas was introduced to the flask for 30 min under stirring. The temperature was then raised to 80°C and the stirring was continued for four hours at 80 to 85°C. Once the reaction is completed, the mixture was cooled to the room temperature to obtain a colorless, transparent, and homogeneous copolymer solution. The copolymer solution was then precipitated in 1 : 1 mixture solution containing isopropyl alcohol and water and filtered. The solid matter was extracted and dried to obtain the copolymer (A). Weight average molecular weight of the copolymer (A) obtained as converted to polystyrene was 18000 and the acid value was 152.

[0059]

Example 1

5.4 g of the copolymer (A) as a binder resin, 6 g of Kayarad DPHA (trade name, manufactured by NIPPON KAYAKU CO., LTD.) as a photopolymerizable monomer, 1.5 g of Irgacure 907 (trade name,

manufactured by BASF Japan Ltd.), 0.3 g of Irgacure OXE-02 (trade name, manufactured by BASF Japan Ltd.), and 0.6 g of Kayacure-DETX-S (trade name, manufactured by NIPPON KAYAKU CO., LTD.) as a photopolymerization initiator, 0.6 g of the Compound No. 1 obtained from the Synthetic Example 1 as a dye, and 20 g of cyclohexanone and 8.6 g of propylene glycol monomethyl ether acetate as solvents were admixed with one another to obtain the colored resin composition of the invention.

[0060]

Example 2

The colored resin composition was obtained with the same composition as the Example 1 except that, as a dye, the Compound No. 1 of the Synthetic Example 1 is changed to the Compound No. 2 of the Synthetic Example 2.

[0061]

Example 3

After mixing with composition ratio of C. I. Pigment Blue 15:6/AJISPER-PB821/SOLSPERSE 5000/PGMEA = 15.0/6.0/1.0/78.0 (weight ratio), 400 g of zirconia beads (0.3 mm) were added. After treating for 60 min using a paint shaker followed by filtration, the pigment dispersion 1 was obtained. To the Example 1, 19 g of the pigment dispersion 1 was added to obtain the colored resin composition of the invention.

[0062]

Comparative Example 1

The colored resin composition was obtained with the same composition as the Example 1 except that the Compound No. 1 of

the Synthetic Example 1 is changed to Rhodamine B.

[0063]

Comparative Example 2

The colored resin composition was obtained with the same composition as the Example 1 except that the Compound No. 1 of the Synthetic Example 1 is changed to Rhodamine 6G.

[0064]

Evaluation of patterning

The colored resin composition obtained from the above (Examples 1 to 3) was coated on the substrate and subjected to pre-baking under condition of 80°C × 100 sec. After that, it was cured by light exposure through a mask, developed with an aqueous alkali solution, rinsed with water, and heated at 200°C to obtain a colored pattern. The colored pattern obtained is a line and space pattern with resolution of 5 μm and no residues or peeling of pixels was identified. Thus, a high resolution property for color filters of a solid-state imaging device was confirmed.

[0065]

Evaluation of heat resistance

Similar to those described above, the substrate for evaluation of heat resistance was prepared by coating each composition on a glass substrate, carrying out whole exposure, and treating the substrate at 200°C for 5 min for post-baking. Thereafter, each evaluation was carried out as described below. First, for determination of heat resistance, spectral transmission ratio of the substrate for evaluation was measured

by using a spectrophotometer. Thereafter, the substrate for evaluation was treated at 200°C for 120 min and spectral transmission ratio was measured again. Finally, the color difference (ΔE_{ab}) was estimated. Results of heat resistance are given in the Table 2.

[0066]

[Table 2]

Table 2 Evaluation results of heat resistance

	ΔE_{ab}
Example 1	5.0
Example 2	6.5
Example 3	5.8
Comparative Example 1	-
Comparative Example 2	37.4

In the Comparative Example 1, discoloration of the dyes occurred during curing bake before heat treatment, and heat resistance was significantly low.

[0067]

According to the Table 2 in which results of the heat resistance evaluation are given, it was found that the Examples 1 to 3 of the invention show significantly improved results than the conventional dyes of the Comparative Examples 1 and 2. The Example 3, in which a mixture with a pigment is used in combination, also showed good result without yielding any precipitation even when the colorant compound of the invention is mixed with a pigment.

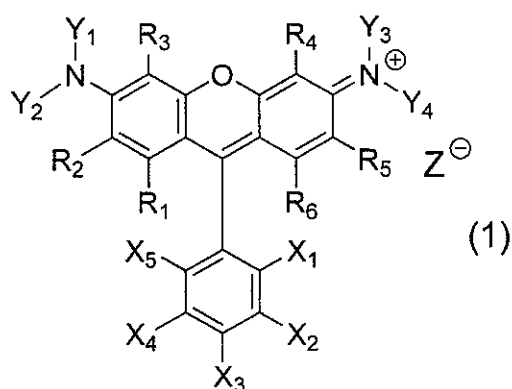
[0068]

Based on the results obtained above, it was found that the colored resin composition of the invention in which a specific colorant compound can be used for producing a color filter, wherein the color filter produced includes a dye and has sufficient resistance, and therefore it can be used for obtaining sharp pixels with high quality and high reliability. Further, depending on specific use, it can be also easily mixed and used with a pigment or other dyes. Thus, it is found to be industrially very useful.

CLAIMS

1. A colored resin composition for color filters comprising a colorant compound represented by the following formula (1), a binder resin, a solvent, and a curing agent

[Chemical Formula 1]



(wherein R_1 to R_6 each independently represent a hydrogen atom, a halogen atom, a C1-C12 alkyl group, a C1-C12 alkoxy group, a nitro group, a carboxyl group, or an alkoxycarbonyl group; Y_1 to Y_4 each independently represent a hydrogen atom, a C1-C12 alkyl group, or an aryl group; X_1 to X_5 each independently represent a hydrogen atom, a C1-C12 alkyl group, a C1-C12 alkoxy group, a halogen atom, a nitro group, a phenoxy group, a carboxyl group, an alkoxycarbonyl group, a carbamoyl group, a sulfo group, or a sulfamoyl group; and anion part Z^- represents an alkylsulfonyl imide anion having a highly halogenated C1-C10 alkyl group).

2. The colored resin composition according to Claim 1, wherein Z^- in the formula (1) is a bistrifluoromethanesulfonyl imide anion.

3. The colored resin composition according to Claim 1 or 2, which comprises a metal phthalocyanine pigment.

4. A colored cured film for color filters obtained by patterning of the colored resin composition according to any one of Claims 1 to 3.

5. A color filter comprising the colored cured film for color filters according to Claim 4.

6. A display device comprising the color filter according to Claim 5.

7. A solid-state imaging device comprising the color filter according to Claim 5.