

DESCRIPTION
COLORED RESIN COMPOSITION

TECHNICAL FIELD

[0001]

The present invention relates to a colored resin composition for forming blue pixels, a color filter produced by using the colored resin composition, and an electronic display device, such as 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. The improvement in brightness may suppress the light amount of a backlight to be a low level and reduce the power consumption. Therefore the technology is required even from an environmental perspective. To improve the color purity of a color filter, it is required to increase the content of a coloring pigment or to choose a pigment which has a better spectral waveform. Meanwhile, since it is necessary to increase a transmission to improve brightness, the pigment concentration should be lowered or the film thickness should be reduced. To satisfy these two different characteristics at the same time, a method of micronizing a pigment is carried out. However, since there are limitations in terms of resistance and dispersion stability, it is currently impossible to improve the resistance even when brightness is increased.

[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 color purity and brightness can be obtained at the same time, which is impossible to achieve

by using a pigment, and there is also an advantage that, not being a particle, it can suppress light scattering so that contrast can be also improved. However, for a display body like a TV which requires long term reliability, light resistance or heat resistance is particularly required. In this regard, most blue dyes have a significantly lower resistance than pigments. For example, disclosed in Patent Documents 1 and 2 is a color filter wherein triphenylmethane compounds are used. However, the triphenylmethane compounds have significantly low light resistance and heat resistance, and therefore they cannot be used at a practical level. Further, although it is disclosed in Patent Document 3 that xanthen compounds have excellent brightness, there is no description relating to resistance. Further, xanthen compounds are known as a fluorescent dye and have a potential for causing a decrease in contrast according to light scattering similar to pigments. Meanwhile, when a liquid crystal alignment film is formed on a color filter, a solvent having high dissolution power like N-methyl pyrrolidone is used as a solvent for an alignment film material. Thus, it is desired that no elution occurs even after immersion in the solvent and no spectral change is caused. Although it is not a significant problem for existing pigments, since dyes have a higher solubility in solvent than the pigments, it is especially required for the dyes to be resistant to a solvent.

For a color filter required to have high reliability, a colored resin composition containing color materials with various excellent resistances is waiting for, but very few is

practically usable. As such, for the next generation, a high quality color filter having excellent resistance is in need.

CITATION LIST

PATENT DOCUMENTS

[0005]

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

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

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

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0006]

An object of the invention is to provide color filter pixels having distinct and excellent color characteristics like contrast and also excellent heat resistance and solvent resistance, etc.

MEANS FOR SOLVING PROBLEM

[0007]

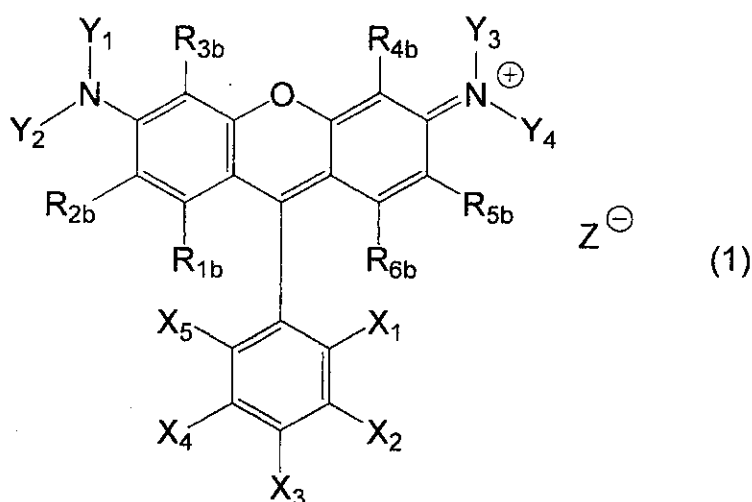
The present inventors have made extensive studies in order to solve the problems, and as a result, they have found that the problems can be solved by using a colored resin composition containing a specific dye-based colorant compound in a color filter pixel, and thus the invention has been achieved.

[0008]

Specifically, the invention relates to the following:

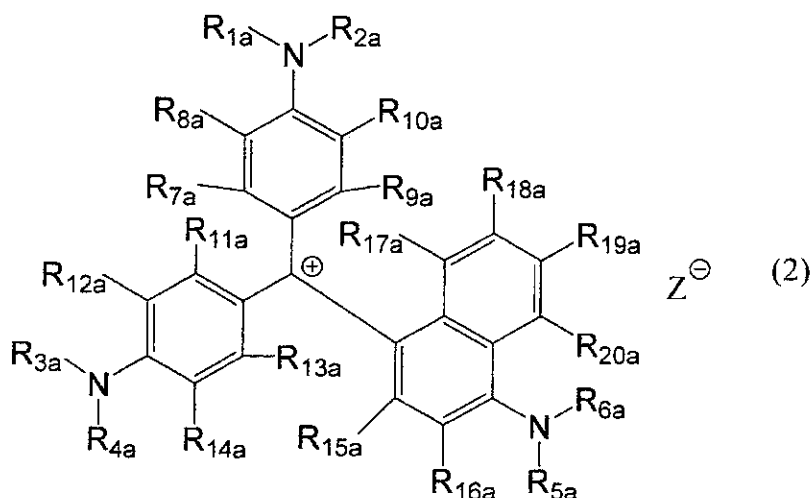
(1) A colored resin composition for color filters comprising a colorant compound represented by the following formula (1), a colorant compound represented by the following formula (2), a binder resin, a solvent, a photopolymerization initiator, a curing agent, and a curing promoter

[Chemical Formula 1]



(wherein R_{1b} to R_{6b} 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. Z^- represents an alkylsulfonyl methide anion, an alkylsulfonyl imide anion, or an alkylsulfonate each having a highly halogenated C1-C10 alkyl group),

[Chemical Formula 2]

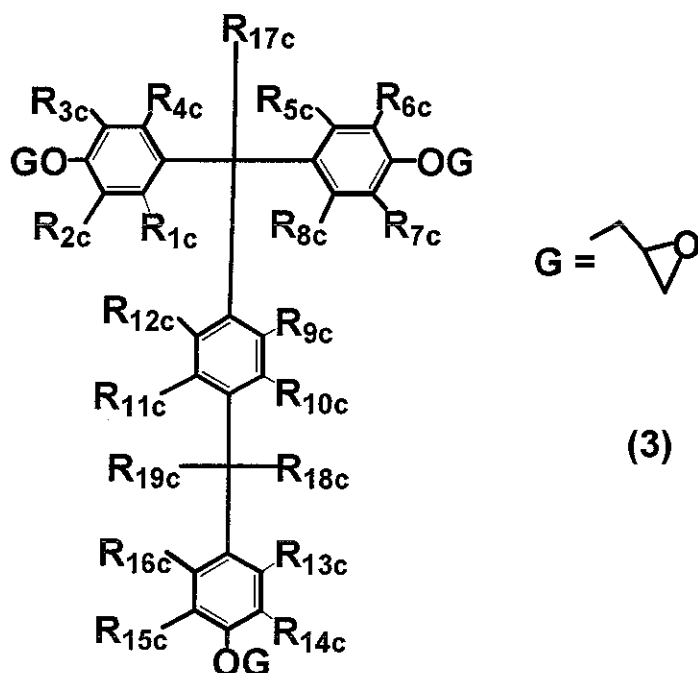


(wherein R_{1a} to R_{6a} each independently represent a hydrogen atom, a C1-C30 alkyl group, a phenyl group, or a benzyl group. R_{7a} to R_{20a} each independently represent a hydrogen atom, a halogen atom, or a C1-C6 alkyl group. Z^- has the same meanings as defined in the formula (1)),

(2) The colored resin composition described in the above (1), which comprises the colorant compound wherein Z^- in the formula (1) and the formula (2) each independently is a tristrifluoromethanesulfonyl methide anion, a bistrifluoromethanesulfonyl imide anion, or trifluoromethanesulfonate,

(3) The colored resin composition described in the above (1) or (2), which comprises an epoxy resin represented by the following formula (3) as a curing agent

[Chemical Formula 3]



(wherein R_{1c} to R_{19c} each independently represent a hydrogen atom, a C1-C12 alkyl group, a C1-C12 alkoxy group, or a halogen atom. G represents a glycidyl group),

(4) The colored resin composition described in any one of the above (1) to (3), which comprises a metal phthalocyanine pigment,

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

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

(7) A display device comprising the color filter described in the above (6), and

(8) A solid-state imaging device comprising the color filter described in the above (6).

EFFECT OF THE INVENTION

[0009]

According to the colored resin composition of the invention comprising a specific dye-based colorant compound, high quality color filter pixels for color filters having distinct color characteristics, good contrast characteristics, and excellent heat resistance and solvent resistance, etc. can be provided.

DETAILED DESCRIPTION OF THE INVENTION

[0010]

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

[0011]

As for the method for 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, a thermosetting resin composition is used rather

than the photopolymerization initiator which is not necessarily required.

[0012]

R_{1b} to R_{6b} in the specific dye-based colorant compound represented by the formula (1) 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. Y₁ to Y₄ each independently represent a hydrogen atom, a C1-C12 alkyl group, or an aryl group. X₁ to X₅ each independently may have 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, and of these, a carboxyl group and an alkoxycarbonyl group are preferable. The anion part Z⁻ represents an alkylsulfonyl methide anion, a sulfonyl imide anion, or an alkylsulfonate each having a highly halogenated C1-C10 alkyl group.

[0013]

Examples of the alkyl group include a C1-C12 alkyl group like a methyl group, an ethyl group, a n-propyl group, an iso-propyl group, a n-butyl group, a sec-butyl group, a t-butyl group, an iso-butyl group, a n-pentyl group, a n-hexyl group, a 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.

[0014]

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.

[0015]

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.

[0016]

Examples of the halogen atom in the formula (1) and the formula (2) include a fluorine atom, a chlorine atom, a bromine atom, and an iodine atom.

[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^- of a dye-based colorant compound represented by the formula (1) and the formula (2), which is included in the colored resin composition of the invention, each independently represent an alkylsulfonyl methide anion, an alkylsulfonyl imide anion, or an alkylsulfonate each having a highly halogenated C1-C10 alkyl group. Specific examples thereof include a tristrifluoromethanesulfonyl methide anion, a bistrifluoromethanesulfonyl imide anion,

trifluoromethylsulfonate, and nonafluorobutylsulfonate. The tristrifluoromethanesulfonyl methide anion is particularly preferable.

[0023]

Specific examples represented by the formula (1) are given in the following Table 1-1 to Table 1-4, but the invention is not limited by them.

[0024]

[Table 1]

Table 1-1

Compound No.	Chemical formula
1	
2	
3	
4	
5	
6	

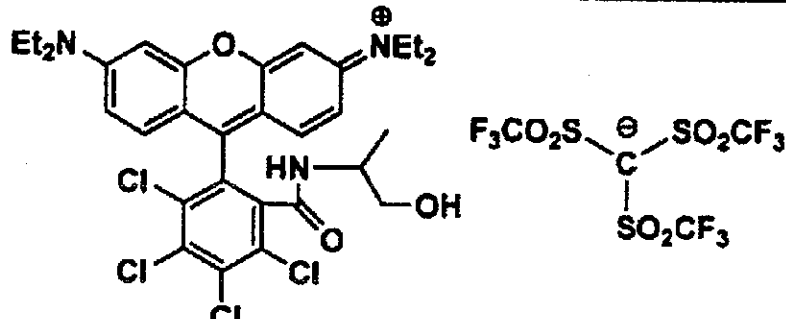
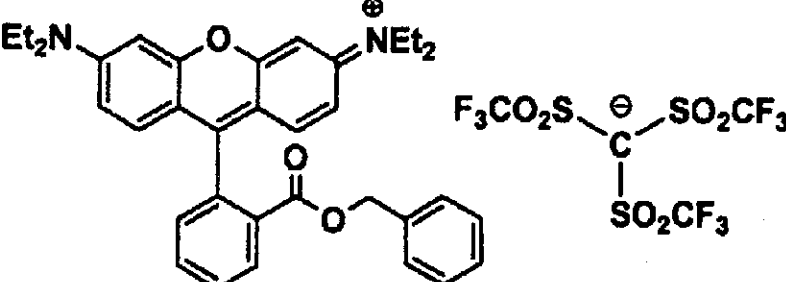
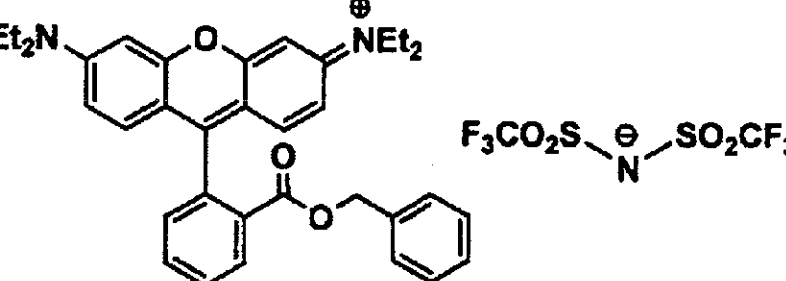
Table 1-2

Compound No.	Chemical formula
7	<chem>CCN(CC)c1ccc2c(c1)oc3ccc(cc23)C(=O)OCCc4ccccc4[N+](=O)[O-]S(=O)(=O)C(F)(F)F</chem>
8	<chem>CCN(CC)c1ccc2c(c1)oc3ccc(cc23)C(=O)OCc4ccccc4[N+](=O)[O-]S(=O)(=O)C(F)(F)F</chem>
9	<chem>CCN(CC)c1ccc2c(c1)oc3ccc(cc23)C(=O)Nc4ccccc4[N+](=O)[O-]S(=O)(=O)C(F)(F)F</chem>
10	<chem>CCN(CC)c1ccc2c(c1)oc3ccc(cc23)C(=O)OCCc4ccccc4[N+](=O)[O-]S(=O)(=O)C(F)(F)F</chem>
11	<chem>CCN(CC)c1ccc2c(c1)oc3ccc(cc23)c4ccccc4[N+](=O)[O-]S(=O)(=O)C(F)(F)F</chem>
12	<chem>CCN(CC)c1ccc2c(c1)oc3ccc(cc23)C(=O)OCCc4ccccc4[N+](=O)[O-]S(=O)(=O)C(F)(F)F</chem>

Table 1-3

Compound No.	Chemical formula
13	
14	
15	
16	
17	
18	

Table 1-4

Compound No.	Chemical formula
19	
20	
21	

[0025]

With respect to R_{1a} to R_{6a} in the dye-based colorant compound represented by the formula (2) of the invention, examples of the C1-C30 alkyl group include a methyl group, an ethyl group, a propyl group, an isopropyl group, a butyl group, a 1-methylpropyl group (s-butyl group), an isobutyl group, a

pentyl group, a 1-ethylpropyl group, a 1-methylbutyl group, a cyclopentyl group, a hexyl group, a 1-methylpentyl group, a 1-ethylbutyl group, a cyclohexyl group, a hydroxypropyl group, a 2-sulfoethyl group, a carboxyethyl group, a cyanoethyl group, a methoxyethyl group, an ethoxyethyl group, a butoxyethyl group, a trifluoromethyl group, a pentafluoroethyl group, a 2-heptyl group, a heptyl group, an octyl group, a nonyl group, a decyl group, an undecyl group, a dodecyl group, a tridecyl group, a tetradecyl group, a pentadecyl group, a hexadecyl group, a heptadecyl group, an octadecyl group, a nonadecyl group, an aralkyl group, an eicosyl group, a henicosylgroup, a docosyl group, a tricosyl group, a tetracosyl group, a pentacosyl group, a hexacosyl group, a heptacosyl group, an octacosyl group, a nonacosyl group, a triacontyl group, an isoheptyl group, an isooctyl group, an isononyl group, an isodecyl group, an isondecyl group, an isododecyl group, an isotridecyl group, an isotetradecyl group, an isopentadecyl group, an isohexadecyl group, an isoheptadecyl group, an isooctadecyl group, an isononadecyl group, an isoaralkyl group, an isoeicosyl group, an isohenicosylgroup, an isodocosyl group, an isotricosyl group, an isotetracosyl group, an isopentacosyl group, an isohexacosyl group, an isoheptacosyl group, an isooctacosyl group, an isononacosyl group, an isotriacontyl group, a 1-methylhexyl group, a 1-ethylheptyl group, a 1-methylheptyl group, a 1-cyclohexylethyl group, a 1-heptyloctyl group, a 2-methylcyclohexyl group, a 3-methylcyclohexyl group, a 4-methylcyclohexyl group, a 2,6-dimethylcyclohexyl group, a

2,4-dimethylcyclohexyl group, a 3,5-dimethylcyclohexyl group, a 2,5-dimethylcyclohexyl group, a 2,3-dimethylcyclohexyl group, a 3,3,5-trimethylcyclohexyl group, a 4-t-butylcyclohexyl group, a 2-ethylhexyl group, a 1-adamantyl group, and a 2-adamantyl group. Of these, an ethyl group, an isopropyl group, an isobutyl group, an isopentyl group, an isoheptyl group, and a 2-methylcyclohexyl group are more preferable. These alkyl groups may have a substituent group, and the examples of the substituent group include a hydroxy group, a sulfo group, a carboxyl group, a cyano group, an alkoxy group like a methoxy group and an ethoxy group, and a halogen, although not being specifically limited.

[0026]

With respect to R_{1a} to R_{6a} in the formula (2), the phenyl group or the benzyl group may have a substituent group, and the examples of the substituent group include a (C1-C5) alkyl group like a methyl group, an ethyl group, a propyl group, an isopropyl group, a butyl group, an isobutyl group, a t-butyl group, and a pentyl group, a halogen atom like a fluorine atom, a chlorine atom, a bromine atom, and an iodine atom, a sulfonate group, a (C1-C6) alkoxy group like a methoxy group, an ethoxy group, a propoxy group, a butoxy group, a t-butoxy group, and a hexyloxy group, a hydroxy (C1-C5) alkyl group like a hydroxyethyl group and a hydroxypropyl group, a (C1-C5) alkoxy (C1-C5) alkyl group like a methoxyethyl group, an ethoxyethyl group, an ethoxypropyl group, and a butoxyethyl group, a hydroxy (C1-C5) alkoxy group like a 2-hydroxyethoxy group, an alkoxy (C1-C5)

alkoxy group like a 2-methoxyethoxy group and a 2-ethoxyethoxy group, a 2-sulfoethyl group, a carboxyethyl group, and a cyanoethyl group.

[0027]

With respect to R_{7a} to R_{20a} in the formula (2), the C1-C6 alkyl group may be either unsubstituted or substituted. Examples of the C1-C6 alkyl group include a methyl group, an ethyl group, a propyl group, an isopropyl group, a butyl group, an isobutyl group, a pentyl group, a cyclopentyl group, a hexyl group, a cyclohexyl group, a hydroxypropyl 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.

[0028]

A hydrogen atom, a chlorine atom, and an unsubstituted C1-C6 alkyl group are preferable for R_{7a} to R_{20a} in the formula (2).

[0029]

Specific examples represented by the formula (2) are given in the following Table 2-1 to Table 2-2, but the invention is not limited by them.

[Table 2]

Table 2-1

[illegible]

Table 2-2

[illegible]

With respect to the substituent group R in the Table 2-1 and Table 2-2, Me represents a methyl group, Et represents an ethyl group, n-Bu represents a normal butyl group, i-Bu represents an isobutyl group, EtCN represents a cyanoethyl group, EtCl represents a chloroethyl group, Bz represents a benzyl group, Ph represents a phenyl group, and CH represents a cyclohexyl group, respectively. NR₂ represents an alkylamino group and R has the same meanings as the alkyl group above. Further, in a case wherein Z⁻ is α , it indicates a tristrifluoromethanesulfonyl methide anion, in a case wherein Z⁻ is β , it indicates a bistrifluoromethanesulfonyl imide anion, and in a case wherein Z⁻ is γ , it indicates a trifluoromethylsulfonate, respectively.

[0030]

The dye-based colorant compound of the formula (1) and the formula (2) 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 base or an acid to it for salt-exchange.

[0031]

When the dye-based colorant compound of the invention is synthesized by salt-exchange, a colorant compound in which the anion part Z⁻ in the formula (1) and the formula (2) 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 parts equivalents thereto, the mixture is stirred at a pre-determined temperature (for example 0 to 100°C), and precipitated crystals are filtered so that the target compound can be easily obtained.

[0032]

The content of the colorant compound represented by the formula (1) and the formula (2) in the total solid matter of the coloring resin composition of the invention (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) is preferably 0.1 to 60 parts by weight, and more preferably 3 to 30 parts by weight. 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.

[0033]

Further, with respect to the ratio between the formula (1) and the formula (2), it can be any ratio within the above range. However, in terms of contrast characteristics, content

of the formula (2) is preferably more than that of the formula (1). For example, when the content of the formula (1) is 1 to 30 parts by weight, content of the formula (2) is preferably 2 to 30 parts by weight from the viewpoint of contrast. When the content of the formula (1) is more than 30 parts by weight, it becomes difficult to add the same or more amount of the formula (2), and therefore it is preferable as much as possible to keep the ratio within the range described above. However, from the viewpoint of other characteristics like brightness and resistance, it is not necessarily the same, and higher content ratio of the formula (1) may exhibit better characteristics.

[0034]

When the dye-based colorant compound represented by the formula (1) and the formula (2) has a poor solubility in the colored resin composition, it can be dispersed with an aid of a dispersant or a dispersant aid, similar to a pigment as an optional component described below. The colorant compound represented by the formula (1) and the formula (2) may be used either singly or in combination of two or more, and it may also be mixed with other dye or pigment. As the invention relates to blue pixels, it is preferable that a known blue dye or violet dye, or a blue pigment or violet pigment is admixed therewith.

[0035]

The binder resin used in the invention preferably functions as a dispersant or a dispersant aid for giving dispersion stability at the time of pigment dispersion, and it is soluble in an alkali developing solution used for the

development process for producing a color filter according to photolithographic design and has sufficient curing property with a photopolymerization initiator or a photopolymerizable monomer to form favorable fine patterns. It is 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.

[0036]

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. 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.

[0037]

Examples of the 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, and ethacrylic acid,

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 like 2-(meth)acryloyloxyethyl hexahydrophthalic acid, 2-methacryloyloxyethyl-2-hydroxypropylphthalate, and 2-acryloyloxyethyl-2-hydroxyethyl phthalic acid. The ethylenically unsaturated monomer having carboxyl group may be used either singly or in combination of two or more.

[0038]

Examples of the 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. The ethylenically unsaturated

monomer having hydroxy group may be used either singly or in combination of two or more.

[0039]

Examples of an unsaturated monomer other than those described above include an aromatic vinyl compound like styrene, α -methylstyrene, o-vinyltoluene, m-vinyltoluene, p-vinyltoluene, 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-phenylphenolglycidyl 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
t-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,
lauroyloxypolyethylene 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 vinylidene 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. The unsaturated monomer may be used either singly or in combination of two or more.

[0040]

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, or 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), 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.

[0041]

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 Document 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).

[0042]

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. The ratio of the polymerization initiator used 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 the 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 ability to develop 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.

[0043]

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 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 alkali developability is impaired or surface contamination or film residue occurs in an area other than a pixel-forming part.

[0044]

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

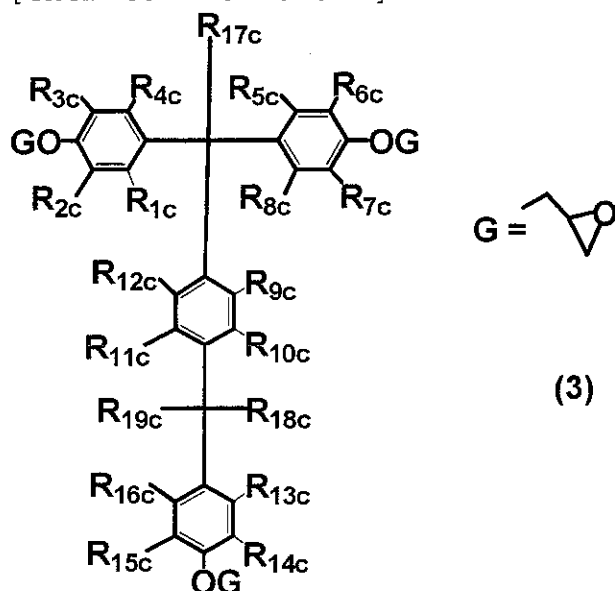
tri(meth)acrylate, propoxylated trimethylol propane
tri(meth)acrylate, ethoxylated glycerin tri(meth)acrylate,
ethoxylated isocyanuric acid tri(meth)acrylate, ditrimethylol
propane tetra(meth)acrylate, ethoxylated pentaerythritol
tetra(meth)acrylate,
9,9-bis[4-(2-acryloyloxyethoxy)phenyl]fluorene, Kayarad
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-6300, 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 CHEMICAL
INDUSTRIES, LTD., EPICOAT 828, EPICOAT YX8000, and EPICOAT
YX4000, all manufactured by Japan Epoxy Resins Co., Ltd.,
VG-3101L (trade name, manufactured by Printec 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.). It 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.

[0045]

Among the curing agents above, from the viewpoint of having improved solvent resistance, an epoxy resin having glycidyl group G represented by the following formula (3) is particularly preferable.

[Chemical Formula 4]



[0046]

In the formula (3), R_{1c} to R_{19c} each independently represent a hydrogen atom, a C1-C12 alkyl group, a C1-C12 alkoxy group, or a halogen atom. Of these, any one of a hydrogen atom, a methyl group, an ethyl group, and a methoxy group is preferable. It is particularly preferable that R_{1c} to R_{16c} are a hydrogen atom

and R_{17c}, R_{18c} and R_{19c} are a methyl group.

[0047]

The epoxy resin with the formula (3) is produced as a main product by reacting a phenol resin obtained from a reaction between 1-[4-(1-hydroxy-1-methyl-ethyl)-phenyl]ethanone and phenols (phenols that are either unsubstituted or have a C1-C12 alkyl group, a C1-C12 alkoxy group, or a halogen atom as a substituent group) and epihalohydrins (at least one selected from epichlorohydrin and epibromohydrin). Commercially available products include VG-3101L manufactured by Printec Co., Ltd. and NC-6000 and NC-6300 manufactured by NIPPON KAYAKU CO., LTD. The content is 1 to 80 parts by weight, and preferably 5 to 40 parts by weight compared to the 100 parts by weight of the total solid matter in the colored resin composition. When it is contained in a less amount than the range, the effect like solvent resistance is impaired. On the other hand, if the content in the mixture is too much, the ability to develop may become impaired so that development cannot be carried out, and therefore the too much content is undesirable.

[0048]

For curing, it is preferable to use a curing promoter in combination with the epoxy resin with the formula (3). As for the curing promoter that is used in the invention, a reaction catalyst which promotes ion curing is necessary, and examples thereof include a nitrogen-containing heterocyclic compound like a primary to tertiary amines or imidazole, a photo-acid generator or a thermal-acid generator for generating an acid,

a resin having acid anhydride or carboxylic acid, an acrylate monomer and an initiator. The resin having carboxylic acid and the monomer are as explained in the above, and the polymerization initiator is explained herein below.

[0049]

Specific examples of the amines as a curing promoter include triethylamine, triethanolamine, Kayahard A-A, KAYABOND C-100, KAYABOND C-200S, and KAYABOND C-300S manufactured by NIPPON KAYAKU CO., LTD. Specific examples of the imidazole include Curezol 2MZ-H, Curezol C11Z, Curezol C17Z, Curezol 1, 2DMZ, Curezol 2E4MZ, Curezol 2PZ, Curezol 2P4MZ, Curezol 1B2MZ, Curezol 1B2PZ, Curezol 2MZ-CN, Curezol C11Z-CN, Curezol 2E4MZ-CN, Curezol 2PZ-CN, Curezol C11Z-CNS, Curezol 2PZCNS-PW, Curezol 2MZ-A, Curezol C11Z-A, Curezol 2E4MZ-A, Curezol 2MA-OK, Curezol 2PZ-OK, Curezol 2PHZ-PW, Curezol 2P4MHZ-PW, Curezol TBZ, Curezol 2PZL-T, Curezol VT, and Curezol SFZ manufactured by SHIKOKU CHEMICALS CORPORATION. Examples of the acid anhydride include maleic anhydride, succinic anhydride, phthalic anhydride, tetrahydrophthalic anhydride, pyromellitic anhydride, and biphenyl tetracarboxylic acid dianhydride, and Kayahard MCD manufactured by NIPPON KAYAKU CO., LTD. Of these, preferred is the imidazole curing agent, and from the viewpoint of the reactivity, Curezol 1B2PZ, Curezol 2PZ, Curezol 1B2MZ, and Curezol 2E4MZ are preferable. The content is 0.01 to 50 parts by weight, and preferably 0.05 to 20 parts by weight compared to the 100 parts by weight of the total solid matter in the colored resin composition. When it

is contained in a less amount than the range, the curing property is impaired. On the other hand, when too much amount is contained, the storage stability is reduced.

[0050]

The additional colorant which can be used in combination in 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.

[0051]

The organic pigment that can be used in 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

dioxazine-based pigment, a quinacridone-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 and; Pigment Violet 3, 4, 27, 39. Pigment Blue 15:6 and Pigment Violet 23 are particularly preferable as they have favorable color and resistance, etc.

[0052]

Examples of the inorganic pigment that can be used in the invention are 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 sulfate.

[0053]

The dye which can be used in the invention is not specifically limited and examples thereof include an acidic dye,

a basic dye, a direct dye, a sulfide 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.

[0054]

It is well known that a dye insoluble in an organic solvent, for example an acidic dye or a basic dye, can be modified to an amine salt dye by reacting 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 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, Solvent Blue 2, 3, 4, 5, 6, 23, 35, 36, 37, 38, 43, 48, 58, 59, 67, 70, 78, 98, 102, 104; Basic Blue 7; Acid Blue 80, 83, 90; and, as a violet dye, Solvent Violet 8, 9; Violet 4, 5, 14 and; Basic Violet 10.

[0055]

As for the photopolymerization initiator added to 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 as 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, chlorothioxatone, methyl thioxatone, ethyl thioxatone, isopropyl thioxatone, dimethyl thioxatone, diethyl thioxatone, diisopropyl thioxatone, dimethylaminomethylbenzoate, 1-(4-dodecylphenyl)-2-hydroxy-2-methylpropane-1-one, 1-hydroxycyclohexylphenyl ketone, 2-hydroxy-2-methyl-1-phenylpropane-1-one, 1-(4-isopropylphenyl)-2-hydroxy-2-methylpropane-1-one, methylbenzoyl formate, 2-methyl-1-(4-methylthiophenyl)-2-morpholinopropane-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-phenylsulfanyphenyl)butane-1,2-dione-2-oxime-o-benzoate

e,

1-(4-methylsulfanylphenyl)butane-1,2-dione-2-oxime-o-acetate,
1-(4-methylsulfanylphenyl)butane-1-onoxime-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'-biimida-
zole, 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,
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.).

[0056]

For a thermosetting resin composition employed 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, such as
2,2'-azobisisobutyronitrile,
2,2'-azobis(2,4-dimethylvaleronitrile),
2,2'-azobis(2-methylbutyronitrile), di-t-butyl peroxide,
dibenzoyl peroxide, and cumyl peroxyneodecanoate.

[0057]

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.

[0058]

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.

[0059]

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.

[0060]

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

[0061]

The colored resin composition of the invention is produced by mixing and stirring a binder resin, a curing agent, a photopolymerization initiator, a specific dye-based 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.

[0062]

To the colored resin composition of the invention, various additives, for example, a filler, a surface active agent, a thermal 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.

[0063]

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 such as a glass substrate and a silicon plate to the film thickness of 0.1 to 20 μm , and preferably 0.5 to 5 μm depending on a method like spin coating, roll coating, slit and spinning, die coating, and bar coating. Then drying under reduced pressure is carried out according to the drying condition under the temperature range of 23 to 150°C for 1 to 60 min, more preferably at the temperature range of 60 to 120°C for 1 to 10 min. This is done 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 any combination thereof can be also employed. Non-exposed area is removed by the 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.

[0064]

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.

[0065]

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.

[0066]

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, an a polarizing film are laminated in this 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 disposing the color filter 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

[0067]

The invention is explained in greater detail in view of the following Examples, but it is not limited by the Examples. Spectral transmission characteristics were measured by using a spectrophotometer "Shimadzu Corporation UV-3150" and

chromaticity was estimated based on the XYZ Color System. Accordingly, the heat resistance and contrast, etc. of the colored material were evaluated.

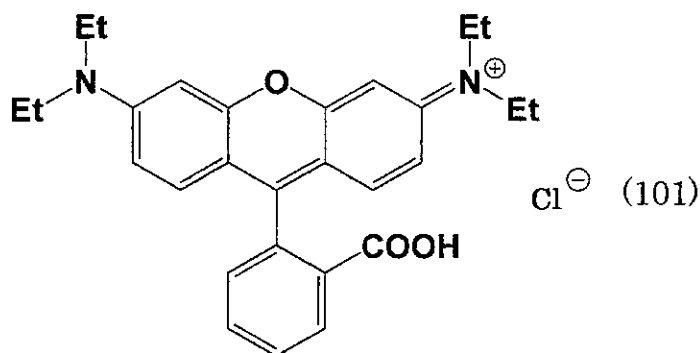
[0068]

Synthetic Example 1

To a 100 ml beaker, 1 g of rhodamin B (manufactured by Tokyo Chemical Industry Co., Ltd.) of the formula (101) below and 20 g of water were added and stirred at room temperature for 30 min. Then, a solution in which 1 g of tristrifluoromethanesulfonyl methide (TFSM) cesium 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 TFSM salt of rhodamin B (Compound No. 1).

Maximum absorption wavelength: 560 nm (cyclohexanone)

[Chemical Formula 5]



[0069]

Synthetic Example 2

To a 100 ml beaker, 1 g of rhodamin B of the formula (101) above 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 rhodamin B (Compound No. 2).

Maximum absorption wavelength: 560 nm (cyclohexanone)
[0070]

Synthetic Example 3

To a 2000 ml beaker, 4 g of rhodamin B (manufactured by Tokyo Chemical Industry Co., Ltd.) of the formula (101) above and 750 g of water were added and stirred at room temperature for 30 min. Then, a solution in which 1.5 g of lithium trifluoromethyl sulfonate is dissolved in 10 g of water was added dropwise thereto and stirred for 3 hours. The precipitated dye was filtered, washed with water, and dried to obtain 3.5 g trifluorosulfonate salt of rhodamin B (Compound No. 3).

Maximum absorption wavelength: 560 nm (cyclohexanone)
[0071]

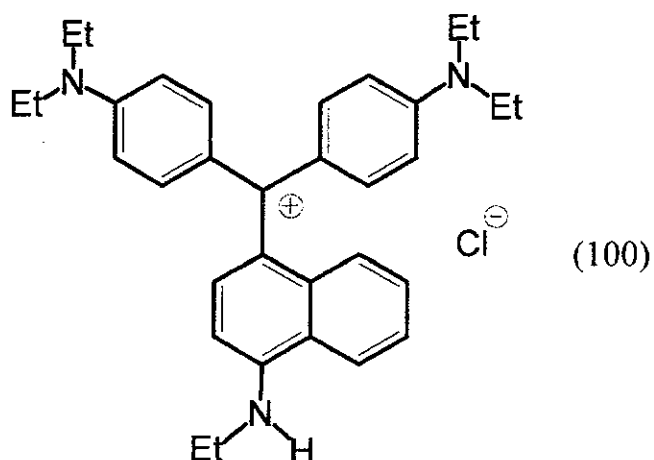
Synthetic Example 4

2 parts of Basic Blue 7 (manufactured by Tokyo Chemical Industry Co., Ltd., decomposition temperature of 217°C) of the formula (100) below was dissolved in 150 g of water and added with a solution in which 2.1 g of tristrifluoromethanesulfonyl methide cesium salt is dissolved in 30 g of acetonitrile while being stirred. After stirring for three hours, the

precipitated crystals were filtered, washed with water, and dried to obtain 1.5 g TFSM salt of Basic Blue 7 (Compound No. 2-1).

Maximum absorption wavelength: 610 nm (cyclohexanone)

[Chemical Formula 6]



[0072]

Synthetic Example 5

2 parts of Basic Blue 7 of the formula (100) above was dissolved in 150 g of water and added with a solution in which 1.2 g of bistrifluoromethanesulfonyl imide potassium salt is dissolved in 10 parts of water while being stirred. After stirring for three hours, the precipitated crystals were filtered, washed with water, and dried to obtain 0.7 g TFSI salt of Basic Blue 7 (Compound No. 2-2).

Maximum absorption wavelength: 610 nm (cyclohexanone)

[0073]

Synthetic Example 6

2 parts of Basic Blue 7 (manufactured by Tokyo Chemical Industry Co., Ltd., decomposition temperature of 217°C) of the

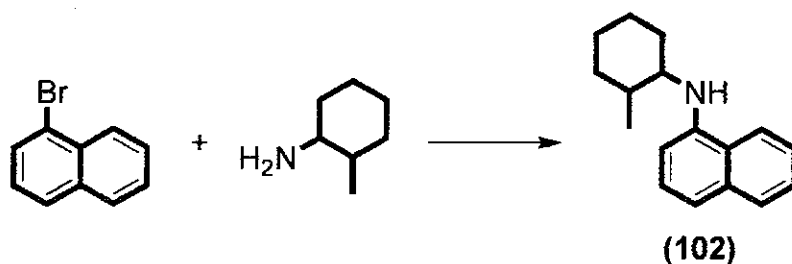
formula (100) above was dissolved in 150 g of water and added with a solution in which 0.8 g of trifluoromethane sulfonate lithium salt is dissolved in 10 g of water while being stirred. After stirring for three hours, the precipitated crystals were filtered, washed with water, and dried to obtain 0.8 g trifluorosulfonate salt of Basic Blue 7 (Compound No. 2-3).

Maximum absorption wavelength: 610 nm (cyclohexanone)

[0074]

Synthetic Example 7

[Chemical Formula 7]

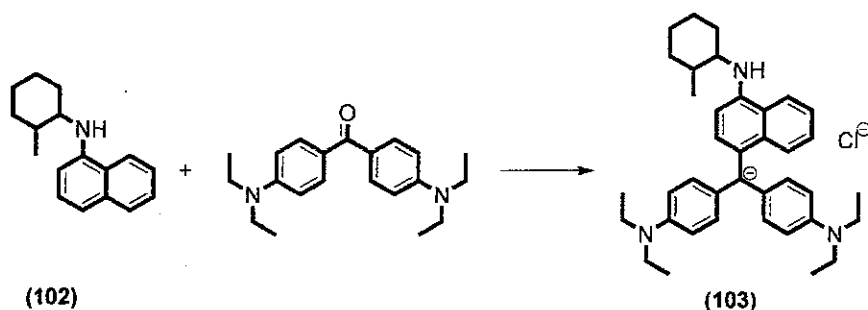


(1) 1-Bromonaphthalene (10.0 g, 0.05 mol) and 2-methylcyclohexylamine (6.0 g, 0.05 mol), sodium t-butoxide (6.5 g, 0.07 mol), $\text{Pd}_2(\text{dba})_3$ (same 0.003 eq.), and BINAP (same 0.008 eq.) were dissolved in 120 ml of toluene, and stirred for 3 hours at 80°C. After that, it was cooled to the room temperature and the reaction solution was filtered using a column. By distilling the filtrate under reduced pressure, 10.5 g (91%) of the formula (102) above was obtained.

[0075]

Synthetic Example 8

[Chemical Formula 8]



(2) Compound 102 (9.3 g, 0.04 mol) obtained from the Synthetic Example 7, 4,4'-bis(diethylamino)benzophenone (11.50 g, 0.04 mol), and oxyphosphorus chloride (6.0 g, 0.04 mol) were dissolved in 50 ml toluene, and the mixture solution was reacted for 3 hours at 60°C. After cooling to the room temperature, liquid separation was carried out by adding water. The organic layer was concentrated under reduced pressure to obtain 22.8 g (98%) of the formula (103) above.

[0076]

Synthetic Example 9

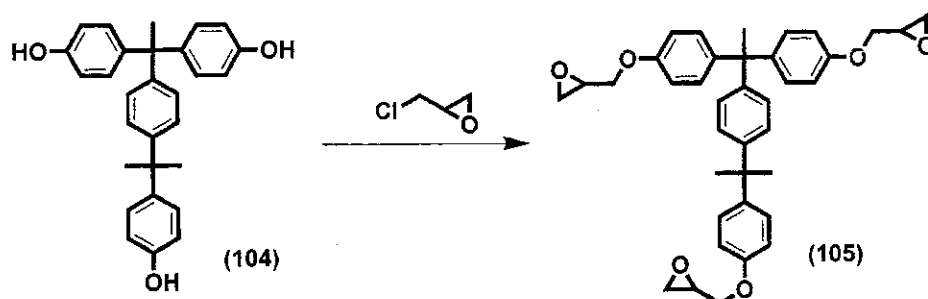
(3) Compound 103 (3.0 g, 0.005 mol) obtained from the Synthetic Example 8 was dissolved in a mixture solution of water (10 ml) and methanol (40 ml). While being stirred, a solution in which 2.8 g of tristrifluoromethanesulfonyl methide cesium salt is dissolved in a mixture solution of DMF (3 ml) and methanol (20 ml) was added thereto. After stirring for three hours while being heated at 60°C, the precipitated crystals were filtered, washed with water, and dried to obtain 3.2 g of the Compound No. 2-20.

Maximum absorption wavelength: 602 nm (cyclohexanone)

[0077]

Synthetic Example 10

[Chemical Formula 9]



To a flask equipped with a stirrer, a reflux condenser, and a stirring apparatus, 141.5 g of a trifunctional phenol compound 104 (trade name: TrisP-PA, manufactured by Honshu Chemical Industry Co., Ltd.), 463 g of epichlorohydrin, and 95 g of dimethyl sulfoxide were added while being purged with nitrogen. With dissolving under stirring, the temperature was raised to 45°C. Subsequently, 41 g of flaky sodium hydroxide was added in small portions over 90 min and the reaction was further carried out for 5 hours at 45°C and then further 2 hours at 60°C. Once the reaction is completed, the mixture was washed with 500 g of water and the solvents like excess epichlorohydrin, etc. were removed from the oil layer by using a rotary evaporator under reduced pressure. 500 g of methyl isobutyl ketone was added to dissolve the residues and the temperature was raised to 70°C. 10 g of 30% by weight aqueous solution of sodium hydroxide was added thereto while being stirred to allow the reaction to proceed for 1 hour. Thereafter, the resultant was washed with water until the solution obtained from the washing the oil layer becomes neutral. From the resulting solution, methyl isobutyl ketone, etc. was distilled off under reduced

pressure by using a rotary evaporator to obtain 190 g of the epoxy resin (105). Epoxy equivalent of the epoxy resin obtained was 201 g/eq. The softening point was 59°C.

[0078]

Synthetic Example 11 (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 while being stirred. 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) as converted to polystyrene was 18000 and the acid value was 152.

[0079]

Example 1

5.5 g of the copolymer (A) as a binder resin, 5.5 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.), 0.6 g of

Kayacure-DETX-S (trade name: manufactured by NIPPON KAYAKU CO., LTD.) as a photopolymerization initiator, 0.3 g of the Compound No. 1 of the Synthetic Example 1, 0.3 g of the Compound No. 2-1 of the Synthetic Example 4, 20 g of cyclohexanone and 8.6 g of propylene glycol monomethyl ether acetate as a solvent were mixed together to obtain the colored resin composition of the invention.

[0080]

Example 2

The colored resin composition was obtained with the same composition as the Example 1 except that the Compound No. 2-1 of the Synthetic Example 4 is changed to the Compound No. 2-2 of the Synthetic Example 5.

[0081]

Example 3

The colored resin composition was obtained with the same composition as the Example 1 except that the Compound No. 2-1 of the Synthetic Example 4 is changed to the Compound No. 2-3 of the Synthetic Example 6.

[0082]

Example 4

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 the Compound No. 2 of the Synthetic Example 2.

[0083]

Example 5

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 the Compound No. 3 of the Synthetic Example 3.

[0084]

Example 6

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 blue pigment dispersion 1 was obtained. To the Example 1, 22 g of the blue pigment dispersion 1 was added to obtain the colored resin composition of the invention.

[0085]

Example 7

The colored resin composition was obtained with the same composition as the Example 6 except that the Compound No. 2-1 of the Synthetic Example 4 is changed to the Compound No. 2-2 of the Synthetic Example 5.

[0086]

Example 8

The colored resin composition was obtained with the same composition as the Example 6 except that the Compound No. 2-1 of the Synthetic Example 4 is changed to the Compound No. 2-3 of the Synthetic Example 6.

[0087]

Example 9

The colored resin composition was obtained with the same composition as the Example 6 except that the Compound No. 1 of the Synthetic Example 1 is changed to the Compound No. 3 of the Synthetic Example 3.

[0088]

Example 10

The colored resin composition was obtained with the same composition as the Example 6 except that the Compound No. 2-1 of the Synthetic Example 4 is changed to the Compound No. 2-20 of the Synthetic Example 9.

[0089]

Example 11

The colored resin composition was obtained with the same composition as the Example 6 except that 2.4 g of the binder copolymer (A), 3.0 g of the epoxy resin 105 of the Synthetic Example 10 as a curing agent, and 0.1 g of 1B2PZ (trade name, manufactured by SHIKOKU CHEMICALS CORPORATION) as a curing promoter are used.

[0090]

Example 12

The colored resin composition was obtained with the same composition as the Example 1 except that 2.4 g of the binder copolymer (A), 3.0 g of the epoxy resin 105 of the Synthetic Example 10 as a curing agent, and 0.1 g of 1B2PZ (trade name, manufactured by SHIKOKU CHEMICALS CORPORATION) as a curing promoter are used.

[0091]

Comparative Example 1

The colored resin composition was obtained with the same composition as the Example 1 except that the Compound No. 2-1 of the Synthetic Example 4 described in the Example 1 is not used and the Compound No. 1 of the Synthetic Example 1 is 0.6 g.

[0092]

Comparative Example 2

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

[0093]

Comparative Example 3

The colored resin composition was obtained with the same composition as the Comparative Example 1 except that the Compound No. 1 of the Synthetic Example 1 is changed to the Compound No. 3 of the Synthetic Example 3.

[0094]

Comparative Example 4

The colored resin composition was obtained with the same composition as the Comparative Example 1 except that the Compound No. 1 of the Synthetic Example 1 is changed to rhodamin B.

[0095]

Comparative Example 5

The colored resin composition was obtained with the same

composition as the Comparative Example 1 except that the Compound No. 1 of the Synthetic Example 1 is changed to Basic Blue 7.

[0096]

Comparative Example 6

The colored resin composition was obtained with the same composition as the Example 6 except that the Compound No. 1 of the Synthetic Example 1 and the Compound No. 2-1 of the Synthetic Example 4 are used.

[0097]

Comparative Example 7

The colored resin composition was obtained with the same composition as the Example 6 except that the Compound No. 1 of the Synthetic Example 1 and the Compound No. 2-1 of the Synthetic Example 4 are changed to 0.6 g Basic Blue 7.

[0098]

The colored resin composition obtained from the above (Example 1 to 12) was coated on the substrate and subjected to pre-baking under the condition of 80°C × 100 sec. After that, it was cured by light exposure through a mask, developed with an aqueous alkali solution containing a surface active agent, rinsed with water, and heated at 200°C to obtain a colored pattern. The pattern obtained is a line and space pattern with the resolution of 5 μm and no residues or peelings of pixels were identified. Thus, it was found that it can be applied as a color filter for a solid-state imaging device wherein high resolution is required.

[0099]

Evaluation of heat resistance, contrast, and solvent resistance

Similar to those described above, the substrate for evaluation of spectral characteristics and 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. Color filter substrates all having distinct color characteristics were obtained. Thereafter, each evaluation was carried out as described below. For evaluation of heat resistance, the spectral transmission ratio of the substrate for evaluation was determined before and after the treatment at 200°C for 120 min and the color difference before and after the heat treatment (ΔE_{ab}) was also estimated. Contrast was obtained, by using the substrate for evaluation described above, from the ratio between the luminance (cd/cm^2) when two polarizing plates are parallel and the luminance (cd/cm^2) when two polarizing plates are perpendicular to each other (i.e. luminance at parallel state / luminance at perpendicular state), wherein the luminance is measured with a contrast tester (trade name: CT-1, manufactured by Tsubosaka Electric Co., Ltd.). Solvent resistance is measured by determining any spectral change after impregnation in N-methylpyrrolidone, which is used as a solvent for materials of a liquid crystal alignment film. Specifically, the spectral transmission ratio of the substrate for evaluation was measured and compared to the spectral transmission ratio which was

obtained after impregnation in N-methylpyrrolidone for 30 sec, 1 min, or 3 min, and the evaluation was made with the naked eye or based on a spectral color change. The results of heat resistance measurement are given in the Table 3, the results of contrast measurement are given in the Table 4, and the results of solvent resistance measurement are given in the Table 5.

[0100]

[Table 3]

Table 3 Results of heat resistance evaluation

	ΔE_{ab}
Example 1	5.0
Example 2	5.9
Example 3	6.1
Example 4	6.4
Example 5	7.1
Example 6	4.7
Example 7	4.9
Example 8	5.0
Example 9	6.3
Example 10	3.6
Example 11	2.6
Example 12	4.6
Comparative Example 4	—
Comparative Example 5	58.7

In the Comparative Example 4, during a pre-heat treatment for curing (at 200°C for 5 min) before a heat treatment, discoloration occurred, and heat resistance was found to be significantly poor so that the evaluation of color difference cannot be made.

[0101]

[Table 4]

Table 4 Results of contrast evaluation

	Contrast
Example 1	10100
Example 2	10200
Example 3	13000
Example 4	9700
Example 5	10700
Example 6	10200
Example 7	10200
Example 8	10400
Example 9	10000
Example 10	10200
Example 11	11000
Comparative Example 1	400
Comparative Example 2	400
Comparative Example 3	400
Comparative Example 4	300
Comparative Example 5	300
Comparative Example 6	8500

[0102]

[Table 5]

Table 5 Results of solvent resistance evaluation

ΔE_{ab}	After 30 sec	After 1 min	After 3 min
Example 11	0.1	0.1	0.2
Example 12	0.1	0.5	3.2
Comparative Example 5	—	—	—
Comparative Example 7	3.3	—	—

In the Comparative Example 5 and the Comparative Example 7, the dye was completely dissolved in N-methylpyrrolidone and the entire colored film was detached so that measurement of the spectral transmission ratio could not be carried out.

[0103]

From the evaluation results of the Table 3, it was found that Examples 1 to 12 of the invention show more remarkable, favorable effects than Comparative Example 4 or 5, which uses a conventional dye, and the colorant compound of the invention has significantly improved resistance. With respect to Examples 6 to 11 in which a pigment is further added, it remains in a good state without showing precipitation of insolubles even when it is admixed with a pigment, and it appears to demonstrate a wide range of applications of the dye-based colorant compound of the invention. From the contrast evaluation results of the Table 4, it was found that Examples 1 to 11 show remarkable and favorable effects than the dyes of the Comparative Examples 1 to 5 and the pigment of the Comparative Example 6. Further, from the solvent resistance evaluation results of the Table 5, it was found that Examples 11 and 12 containing the epoxy resin

of the invention show a significantly higher solvent resistance than Comparative Examples 5 and 7 not containing this resin. Conventional dye-based colored resin compositions were believed to have no practical value in terms of solvent resistance. However, from the results described above, it was confirmed that the colored resin composition of the invention is suitable for color filters,

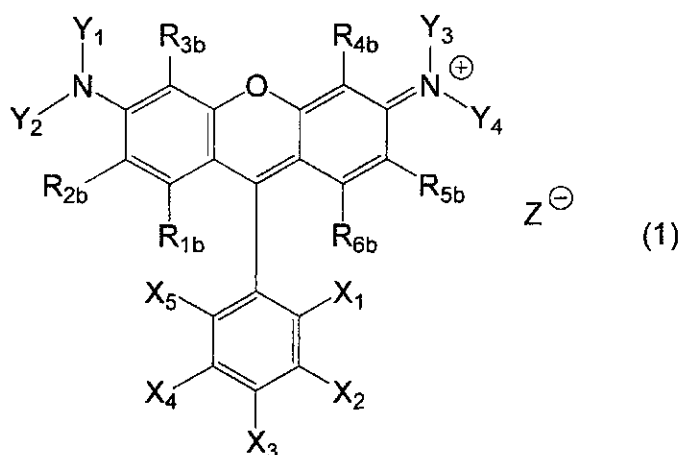
[0104]

Based on the results obtained above, it was found that the colored resin composition of the invention in which a specific dye-based colorant compound is used has distinct color characteristics and excellent resistance, and it can be used for producing high quality color filter pixels with high reliability that cannot be obtained from conventional products. Further, depending on specific use, it can be also easily mixed and used with a pigment, showing a wide-range of applicability. Thus, it is found to be industrially very useful.

CLAIMS

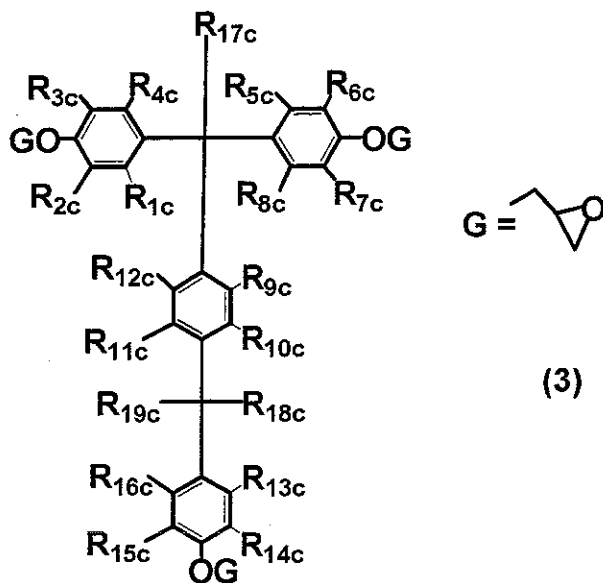
1. A colored resin composition for color filters comprising a colorant compound represented by the following formula (1), a colorant compound represented by the following formula (2), a binder resin, a solvent, a photopolymerization initiator, a curing agent, and a curing promoter.

[Chemical Formula 1]



(wherein R_{1b} to R_{6b} 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 sulfo group, a carbamoyl group, or a sulfamoyl group; Z^- represents an alkylsulfonyl methide anion, an alkylsulfonyl imide anion, or an alkylsulfonate each having a highly halogenated C1-C10 alkyl group),

[Chemical Formula 2]



(wherein R_{1c} to R_{19c} each independently represent a hydrogen atom, a C1-C12 alkyl group, a C1-C12 alkoxy group, or a halogen atom; and, G represents a glycidyl group).

4. The colored resin composition according to any one of Claims 1 to 3, which comprises a metal phthalocyanine pigment.

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

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

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

8. A solid-state imaging device comprising the color filter

according to Claim 6.