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A PROCESS FOR PRODUCING A COLOR FILTER

TECHNICAL FIELD

The present invention relates to a process for producing a color filter used in liquid crystal display devices and solid state image pick-up devices.

5 BACKGROUND ART

For making a liquid crystal display device or a solid state image pick-up device into a color display device, there has been employed a method of combining color filters of the three primary colors, i.e., red, green and blue, or yellow, magenta and cyan. There are several methods for producing these color filters, and the most fundamental method is a so-called dyeing method. This method comprises forming a transparent and dyeable resin in a mosaic form on a substrate, dyeing the resin by immersion in a dye bath, washing the substrate with water, carrying out a fixing treatment, and then forming an anti-dyeing film to accomplish the formation of one color. The above procedure is repeated three times to form a color filter having a fine color pattern of the three primary colors.

The dyeing method is characterized in that a very fine color pattern can be freely formed. But it involves a large number of complicated steps for

production, such as a photolithography step, dyeing
step, washing and fixing step, and anti-dyeing step, and
the number of repetitions of these steps depends on the
number of colors in which the resin is dyed. Moreover,
5 the yield tends to be decreased by adhesion of dust
during the production, etc. In addition, since the
coloring density is substantially proportional to the
thickness of the dyed resin film, the change of the film
thickness causes color nonuniformity to deteriorate the
10 quality of a product. In some cases, color non-
uniformity is caused by contamination with or coming-off
of other colors, etc., depending on the order of dyeing.
Furthermore, liquid crystal display device makers
eagerly desire a process which reduces steps in color
15 filter production, increases the yield, and permits
production at a lower cost.

DISCLOSURE OF THE INVENTION

The present inventors conducted various
researches for solving such problems and consequently
20 found that a color filter having a colored pattern with
high density and precision and having excellent heat
resistance, chemical resistance, light resistance, etc.
can be produced by forming a photosensitive resin film
having a specific dyeability on a substrate, curing the
25 resin film, and spouting predetermined dye solutions
onto predetermined areas of the cured photosensitive
resin film by an ink-jet technique to form a desired

colored pattern, whereby the present invention has been accomplished.

BEST MODE FOR CARRYING OUT THE INVENTION

The present invention relates to:

5 (1) a process for producing a color filter, characterized by forming on a substrate a photosensitive resin thin film having the dyeability described in (a) or (b) below, curing the thin film by irradiation with energy rays, and then spouting dye solutions onto
10 predetermined areas of the cured film by an ink-jet technique to form a desired colored pattern:

 (a) after a photosensitive resin thin film of 0.6 μ m in thickness is immersed in a 4% aqueous solution of a dye with a molecular weight of 1000 or more at a
15 room temperature for 15 minutes, the transmittance of the thin film at the wavelength of maximum absorption of the dye is 5% or less, or

 (b) after a photosensitive resin thin film of 0.6 μ m in thickness is immersed in a 0.2% aqueous
20 solution of a dye with a molecular weight of 1000 or more at 60°C for 10 minutes, the transmittance of the thin film at the wavelength of maximum absorption of the dye is 5% or less;

 (2) a process for producing a color filter
25 according to the above item (1), wherein the photosensitive resin thin film described in the above item (1) is formed out of a photosensitive resin composition

containing an anionic-dye-dyeable polymer and a photo-sensitive compound;

(3) a process for producing a color filter according to the above item (2), wherein the anionic-dye-dyeable polymer is a polymer obtained from a composition containing an anionic-dye-dyeable monomer having tertiary nitrogen atom or quaternary nitrogen atom, and a hydrophilic monomer other than said monomer;

(4) a process for producing a color filter according to the above item (2), wherein the anionic-dye-dyeable polymer is a polymer obtained from a composition comprising 20 to 70% by weight of an anionic-dye-dyeable monomer having tertiary nitrogen atom or quaternary nitrogen atom, 10 to 60% by weight of a hydrophilic monomer other than said monomer, and 10 to 50% by weight of a hydrophobic monomer;

(5) a process for producing a color filter according to the above item (4), wherein both the anionic-dye-dyeable monomer having tertiary nitrogen atom or quaternary nitrogen atom and the hydrophobic monomer are (meth)acrylic monomers;

(6) a process for producing a color filter according to the above item (3) or (4), wherein the anionic-dye-dyeable monomer is 3-(N,N-dimethylamino)-propylacrylamide or 3-(N,N-dimethylamino)propylmethacrylamide;

(7) a process for producing a color filter

according to the above item (4), wherein the anionic-dye-dyeable monomer is 3-(N,N-dimethylamino)propyl-acrylamide or 3-(N,N-dimethylamino)propylmethacrylamide, the hydrophilic monomer other than said monomer is 2-
5 hydroxyethyl methacrylate, vinylpyrrolidone or dimethylaminoacrylamide, and the hydrophobic monomer is methyl methacrylate or methyl acrylate;

(8) a process for producing a color filter according to the above item (2), wherein the water
10 content of a resin solution obtained by dissolving the photosensitive resin composition is 1 w/w% or less; and

(9) a process for producing a color filter according to the above item (2), characterized by using solutions each obtained by dissolving a dye composed of
15 a single component in a solvent, as the dye solutions.

The process for producing a color filter of the present invention is practiced, for example, as follows. That is, a highly dyeable, photosensitive resin is dissolved in a solvent such as Methyl
20 Cellosolve, after which a substrate is coated with the photosensitive resin solution by a method such as spin coating technique, dried and then exposed to light by irradiation with energy rays such as ultraviolet rays to cure the photosensitive resin. In the curing of the
25 photosensitive resin thin film, the thin film may be exposed to light through a mask so as to form a predetermined pattern, may be cured by light exposure on the whole surface without forming a pattern, or may be

exposed to light on the back surface through a black matrix. When a pattern is formed, partitions may be formed as black matrices in spaces in the pattern. The thickness of the light-cured film obtained is usually
5 approximately 0.3 - 2 μm , preferably approximately 0.3 - 1.5 μm , more preferably approximately 0.3 - 1 μm . When a black dye is used, the film thickness is preferably large. If necessary, the light-cured film thus obtained is heat-treated at a temperature of 100°C to 160°C.
10 Although the heat treatment time is not critical, it is usually sufficient that the heat treatment is carried out for approximately 15 - 50 minutes. The heat treatment may be carried out by a conventional method by the use of a hot plate, an oven or the like. Then,
15 predetermined volumes of dye solutions are adhered to predetermined areas of the photosensitive resin thin film subjected or not subjected to the heat-treatment, by an ink-jet technique at room temperature to 70°C, preferably at room temperature. The ink-jet technique
20 is a method in which ink is adhered to the thin film by spouting small drops of the ink through a nozzle. The dyeing (coloring) by this method may be carried out so as to give multiple colors one by one or at the same time. After the dyeing, a heating and drying treatment
25 is conducted by the use of a hot plate or oven at 70 - 180°C for 3 to 15 minutes, whereby a color filter is obtained. Subsequently, if necessary, a fixing treatment in an aqueous solution of tannic acid and

tartar emetic and washing may be carried out in order to prevent the dissolution of the dyes. In addition, if necessary, the whole surface of the dyed thin film may be coated with a transparent protective layer in order
5 to protect the color filter layer.

The substrate used in the present invention is not particularly limited so long as it is a colorless and transparent plate. There can be exemplified plates of, for example, glass, polyesters, polycarbonates,
10 polyacrylates and polyether sulfones. The thickness of the substrate is preferably approximately 0.5 - 1.5 mm.

The highly dyeable, photosensitive resin used in the present invention is preferably (a) a photosensitive resin having such a dyeability that after a
15 thin film of the photosensitive resin of 0.6 μ m in thickness is immersed in a 4% aqueous solution of a dye with a molecular weight of 1000 or more at a room temperature for 15 minutes, the transmittance of the thin film at the wavelength of maximum absorption of the
20 dye is 5% or less, or (b) a photosensitive resin having such a dyeability that after a thin film of the photosensitive resin of 0.6 μ m in thickness is immersed in a 0.2% aqueous solution of a dye with a molecular weight of 1000 or more at 60°C for 10 minutes, the trans-
25 mittance of the thin film at the wavelength of maximum absorption of the dye is 5% or less. The dye with a molecular weight of 1000 or more includes, for example, PC Green FOP (mfd. by Nippon Kayaku Co., Ltd.).

As the highly dyeable, photosensitive resin satisfying the conditions described in (a) or (b) above, there are exemplified those comprising an anionic-dye-dyeable polymer and a photosensitive compound as essential constituents. The anionic-dye-dyeable polymer is obtained using an anionic-dye-dyeable monomer and a hydrophilic monomer other than the anionic-dye-dyeable monomer (hereinafter referred to merely as "hydrophilic monomer") as essential components. The anionic-dye-dyeable polymer can be produced by a conventional solution polymerization method.

Here, the anionic-dye-dyeable monomer is, for example, a monomer having tertiary nitrogen atom or quaternary nitrogen atom in the molecule which has a property of imparting dyeability for anionic dyes to the polymer. Specific examples of the anionic-dye-dyeable monomer are (N,N-di(C₁-C₄)alkylamino)(C₁-C₄)alkyl (meth)acrylates such as (N,N-dimethylamino)ethyl acrylate, (N,N-dimethylamino)ethyl methacrylate, (N,N-diethylamino)ethyl acrylate, (N,N-diethylamino)ethyl methacrylate, 3-(N,N-dimethylamino)propyl acrylate, 3-(N,N-dimethylamino)propyl methacrylate, etc.; (N,N-di(C₁-C₄)alkylamino)(C₁-C₄)alkyl(meth)acrylamides such as 3-(N,N-dimethylamino)propylacrylamide, 3-(N,N-dimethylamino)propylmethacrylamide, etc.; (N,N-diethylamino)ethyl vinyl ether; 4-vinylpyridine; diarylamines; 2-hydroxy-3-methacryloyloxypropyltrimethylammonium chloride; and methacryloyloxyethyltrimethylammonium chloride. From

the viewpoint of stability and the like, the (meth)-
acrylamide type monomers are preferable. In particular,
3-(N,N-dimethylamino)propylacrylamide and 3-(N,N-
dimethylamino)propylmethacrylamide are the most
5 preferable in view of the dyeability for anionic dyes.
The above anionic-dye-dyeable monomers are used singly
or as a mixture of two or more thereof.

The hydrophilic monomer includes, for example,
hydroxy(C₁-C₄)alkyl (meth)acrylates such as hydroxyethyl
10 acrylate, hydroxyethyl methacrylate, etc.; (meth)acryl-
amides which may have one or two (C₁-C₄)alkyl groups
attached thereto, such as acrylamide, methacrylamide,
dimethylaminoacrylamide, methylaminoacrylamide, etc.;
and vinylpyrrolidone. These hydrophilic monomers are
15 used singly or as a mixture of two or more thereof.

The blending proportions of the anionic-dye-
dyeable monomer and the hydrophilic monomer are as
follows: the anionic-dye-dyeable monomer 25 to 85% by
weight, preferably 30 to 80% by weight, and the hydro-
20 philic monomer 15 to 75% by weight, preferably 20 to 70%
by weight.

As the photosensitive compound, there are
exemplified azide compounds including diazidochalcone,
4,4'-diazidostilbene-2,2'-disulfonic acid, sodium 4,4'-
25 diazidostilbene-2,2'-disulfonate, and 4,4'-diazido-
stilbene-2,2'-disulfon(mono or bis(C₁-C₄)alkoxy(C₁-C₄)-
alkyl))amides such as 4,4'-diazidostilbene-2,2'-
disulfon(bis(methoxyethyl))amide, 4,4'-diazidostilbene-

2,2'-disulfon(bis(ethoxyethyl))amide, etc.; and

heretofore well-known acrylic compounds having two or more functional groups. These photosensitive compounds are used singly or as a mixture of two or more thereof.

5 When an azide compound is used as the photosensitive compound, it is used in an amount of preferably about 2 - 15% by weight, particularly preferably about 3 - 8% by weight, based on the weight of the anionic-dye-dyeable polymer.

10 It is preferable to add a compound having one or more (meth)acryloyl groups which is other than the above-mentioned anionic-dye-dyeable monomer and hydrophilic monomer, in an amount of 0.1 - 10 parts by weight, in particular, approximately 0.5 - 6 parts by
15 weight, per 100parts by weight of the anionic-dye-dyeable polymer because the addition increases the curing rate. The compound having one or more (meth)acryloyl groups includes, for example, spiroglycol diacrylate, [3,9-bis(2-acryloyloxy-1,1-dimethyl)-
20 2,4,8,10-tetraoxaspiro[5,5]undecane]cyclohexanedi-methylol diacrylate, ethylene glycol diacrylate, diethylene glycol diacrylate, triethylene glycol diacrylate, polyethylene glycol diacrylates, polypropyleneglycol diacrylates, butylene glycol
25 diacrylate, neopentylglycol diacrylate, 1,4-butanediol diacrylate, 1,6-hexanediol diacrylate, pentaerythritol diacrylate, pentaerythritol triacrylate, trimethylol-propane triacrylate, novolak type epoxyacrylates,

bisphenol A type epoxyacrylates, alkylene glycol
diepoxyacrylates, glycidyl ester acrylates, polyester
type diacrylates, bisphenol A type diacrylates, urethane
type diacrylates, methylenebisacrylamide, ethylene
5 glycol dimethacrylate, diethylene glycol dimethacrylate,
triethylene glycol dimethacrylate, polyethylene glycol
dimethacrylates, propylene glycol dimethacrylate,
butylene glycol dimethacrylate, neopentyl glycol
dimethacrylate, 1,4-butanediol dimethacrylate, 1,6-
10 hexanediol dimethacrylate, trimethylolpropane
trimethacrylate, etc.

When a heretofore well-known acrylic compound
having two or more functional groups is used as the
photosensitive compound, it is used in an amount of
15 preferably about 10 - 40% by weight, particularly
preferably about 15 - 35% by weight, based on the weight
of the anionic-dye-dyeable polymer. In this case, a
photosensitizer may be co-used.

If the strength of a light-cured product of
20 the anionic-dye-dyeable polymer composed of a copolymer
of the anionic-dye-dyeable monomer and the hydrophilic
monomer is not sufficient, co-use of a hydrophobic
monomer as a monomer which constitutes the polymer
permits improvement of the strength. The hydrophobic
25 monomer includes, for example, alkyl esters of
(meth)acrylic acid, such as methyl acrylate, methyl
methacrylate, ethyl acrylate, butyl acrylate, butyl
methacrylate, 2-ethylhexyl acrylate, 2-ethylhexyl

methacrylate, etc.; styrene; and p-methylstyrene. The blending proportions of the anionic-dye-dyeable monomer, the hydrophilic monomer and the hydrophobic monomer are as follows: the anionic-dye-dyeable monomer 20 to 70% by weight, preferably 25 to 60% by weight; the hydrophilic monomer 10 to 60% by weight, preferably 20 to 50% by weight; and the hydrophobic monomer 10 to 50% by weight, preferably 20 to 40% by weight. The molecular weight of the anionic-dye-dyeable polymer thus produced is preferably 5,000 - 200,000, more preferably approximately 10,000 - 100,000.

The photosensitive resin composition having the above-mentioned make-up is used usually after being diluted with an organic solvent or the like. The organic solvent includes, for example, Methyl Cellosolve, Ethyl Cellosolve, Isopropoxy Cellosolve, ethylene glycol monoethyl ether acetate, diethylene glycol dimethyl ether, diethylene glycol diethyl ether, methyl ethyl ketone and methoxyisopropyl glycol. From the viewpoint of coating properties and the like, Isopropoxy Cellosolve and diethylene glycol dimethyl ether are preferable. These organic solvents are used singly or as a mixture of two or more thereof. Although the content of such organic solvents in the photosensitive resin solution is varied depending on their proportions in the resin solution and hence cannot be unequivocally determined, it is preferably adjusted so as to give a viscosity at which the resin solution can be applied

on the surface of a substrate. When an azide compound is used as the photosensitive compound, the water content of the photosensitive resin solution is preferably 1 w/w% or less for avoiding the decomposition and side reaction of the azide compound. As the photosensitive resin solution, there are exemplified CFR 633 DHP and CFR 633 L1 (both mfd. by Nippon Kayaku Co., Ltd.).

The dyes used in the dye solutions for ink-jet are preferably anionic dyes. The anionic dyes include, for example, acid dyes, direct dyes and reactive dyes. Specifically, as yellow dyes, there are exemplified C.I. Acid Yellow 3, ditto 17, ditto 38, ditto 40:1, ditto 42, ditto 44:1, ditto 49, ditto 61, ditto 65, ditto 67, ditto 72, ditto 79, ditto 110, ditto 114, ditto 116, ditto 117, ditto 119, ditto 121, ditto 127, ditto 129, ditto 135, ditto 141, ditto 143, ditto 155, ditto 158, ditto 161, ditto 194, ditto 204, ditto 207, ditto 220, ditto 232, ditto 235 and ditto 241; C.I. Direct Yellow 12, ditto 86, ditto 87, ditto 130 and ditto 142; C.I. Reactive Yellow 84, ditto 102 and the like; and PC Yellow 42P, a dye for color filter manufactured by Nippon Kayaku Co., Ltd. As orange dyes, there are exemplified C.I. Orange 10, ditto 19, ditto 33, ditto 50, ditto 56, ditto 67, ditto 80, ditto 108, ditto 122, ditto 142, ditto 166 and ditto 130; C.I. Direct Orange 26 and ditto 39; and C.I. Reactive Orange 1 and ditto 4.

As red dyes, there are exemplified C.I. Acid Red 1, ditto 6, ditto 9, ditto 14, ditto 18, ditto 35,

ditto 37, ditto 42, ditto 50, ditto 52, ditto 57, ditto
73, ditto 87, ditto 88, ditto 89, ditto 92, ditto 97,
ditto 106, ditto 111, ditto 114, ditto 118, ditto 128,
ditto 134, ditto 138, ditto 143, ditto 143:1, ditto 145,
5 ditto 158, ditto 183, ditto 186, ditto 211, ditto 214,
ditto 215, ditto 217, ditto 219, ditto 225, ditto 226,
ditto 249, ditto 254, ditto 256, ditto 257, ditto 259,
ditto 260, ditto 261, ditto 263, ditto 266, ditto 274,
ditto 276, ditto 278, ditto 289, ditto 299, ditto 301,
10 ditto 303, ditto 307, ditto 315, ditto 316, ditto 317,
ditto 336, ditto 337, ditto 341, ditto 355, ditto 357,
ditto 359, ditto 362, ditto 366, ditto 383, ditto 399,
ditto 405, ditto 407, ditto 414, ditto 416 and ditto
426; C.I. Direct Red 2, ditto 23, ditto 24, ditto 31,
15 ditto 39, ditto 54, ditto 79, ditto 83:1, ditto 89,
ditto 224, ditto 225, ditto 226, ditto 227, ditto 242
and ditto 243; C.I. Reactive Red 5, ditto 8, ditto 43
and the like; and PC Red 21P, PC Red 136P, PC Red 137P
and PC Magenta 10P which are dyes for color filter
20 manufactured by Nippon Kayaku Co., Ltd. As purple dyes,
there are exemplified C.I. Acid Violet 21, ditto 42,
ditto 43, ditto 47, ditto 48, ditto 49, ditto 54, ditto
97 and ditto 102.

As blue dyes, there are exemplified C.I. Acid
25 Blue 7, ditto 9, ditto 15, ditto 22, ditto 23, ditto 25,
ditto 40, ditto 45, ditto 47, ditto 59, ditto 61:1,
ditto 62, ditto 78, ditto 80, ditto 83, ditto 90, ditto
104, ditto 109, ditto 112, ditto 127, ditto 127:1, ditto

129, ditto 138, ditto 140, ditto 203, ditto 204, ditto
207, ditto 227, ditto 228, ditto 232, ditto 247, ditto
260, ditto 264, ditto 277, ditto 278, ditto 280, ditto
283, ditto 290, ditto 333 and ditto 343; C.I. Direct
5 Blue 106, ditto 108 and the like; and PC Blue 43P and PC
Cyan 2P which are dyes for color filter manufactured by
Nippon Kayaku Co., Ltd. As green dyes, there are
exemplified C.I. Acid Green 3, ditto 5, ditto 22, ditto
25, ditto 27, ditto 28, ditto 41 and the like; and PC
10 Green FOP and PC Green 100P which are dyes for color
filter manufactured by Nippon Kayaku Co., Ltd.

As black dyes, there are exemplified C.I. Acid
Black 1, ditto 26, ditto 31, ditto 48, ditto 50, ditto
52, ditto 52:1, ditto 58, ditto 60, ditto 63:2, ditto
15 64, ditto 107, ditto 109, ditto 110, ditto 112, ditto
113, ditto 118, ditto 140, ditto 155, ditto 170, ditto
172, ditto 177, ditto 187, ditto 188, ditto 194, ditto
207 and ditto 222; C.I. Direct Black 17, ditto 19, ditto
22, ditto 51, ditto 62, ditto 91, ditto 112, ditto 117,
20 ditto 118, ditto 122, ditto 132, ditto 146, ditto 154,
ditto 159, ditto 169 and ditto 173.

Of these dyes, the acid dyes and the dyes for
color filter are preferable. The dyes are used singly
or as a mixture in the form of ink. If the mixture
25 tends to cause color nonuniformity, it is preferable to
use a dye composed of a single component singly. As a
solvent used for preparing the ink, there is used water
or an aqueous solution of an organic solvent miscible

with water. The organic solvent includes methanol, ethanol, butanol, Methyl Cellosolve, Ethyl Cellosolve, ethylene glycol, diethylene glycol, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, 5 dimethylformamide, dimethylacetamide, N-methylpyrrolidone, etc. The dye concentration in the ink is preferably 0.5 to 20%, particularly preferably 3 to 10%. If necessary, the dye solution may be used after being filtered through a membrane filter or the like.

10 The present invention is concretely illustrated below with referential examples and examples.

Referential Example

Preparation of the dyeable and photosensitive
15 resin solution used in the present invention

3-(N,N-dimethylamino)propylacrylamide	38 parts
2-Hydroxyethyl methacrylate	15 parts
Dimethylaminoacrylamide	10 parts
Vinylpyrrolidone	7 parts
20 Methyl methacrylate	8 parts
Methyl acrylate	22 parts

According to the above recipe, the monomers are polymerized by a conventional solution polymerization method, and poured into a large volume of isopropyl
25 ether to precipitate the polymer, after which the polymer (average molecular weight: 90000) is taken

out and then dried until the water content becomes 1 w/w% or less.

With 100 parts of the dried polymer are mixed 2 parts of 4,4'-diazidochalcone, 6 parts of 4,4'-
5 diazidostilbene-2,2'-disulfon(bis(ethoxyethyl))amide, 2 parts of a silane coupler KBM 603 (Shin-Etsu Chemical Co., Ltd.), 450 parts of Isopropoxy Cellosolve and 450 parts of diethylene glycol dimethyl ether to effect dissolution, whereby a dyeable and photosensitive resin
10 solution having a water content of 1 w/w% or less is obtained.

Example 1

0.05 Part of a silane coupler KBM 603 (mfd. by Shin-Etsu Chemical Co., Ltd.) is mixed with 100 parts of
15 a dyeable, photosensitive resin composition type resin solution CFR 633 DHP manufactured by Nippon Kayaku Co., Ltd. by dissolving in a solvent an anionic-dye-dyeable polymer obtained by copolymerization of an anionic-dye-dyeable monomer, a hydrophilic monomer and a hydrophobic
20 monomer and an azide compound. A glass plate is coated with the resulting mixture by a spin coating technique, dried at 110°C for 3 minutes and then passed through a belt conveyor type UV irradiator to cure the coating by light exposure on the whole surface at an exposure dose
25 of 150 mJ/cm². The thickness of the cured film is 0.6 μm. When the cured film is dyed by the method described in (a) above by the use of PC Green FOP, a dye with a

molecular weight of 1000 or more, the transmittance of the cured film at the wavelength of absorption maximum (660 nm) of the dye is 0.2% or less.

The glass substrate having the thus formed

5 thin film to be dyed is set in an ink-jet printer at a position accurately located by an optical method. A 4% aqueous solution of PC Blue 43P (a dye for color filter mfd. by Nippon Kayaku Co., Ltd) is passed through a membrane filter of 0.2 μ m, spouted as a dye solution by

10 an ink-jet technique, and thereby adhered to an area to be colored in blue of the thin film to be dyed. Next, a 4% aqueous solution of PC Green FOP (a dye for color filter mfd. by Nippon Kayaku Co., Ltd) is passed through a membrane filter of 0.2 μ m, spouted onto the dye thin

15 film as a dye solution by an ink-jet technique, and thereby adhered to an area to be colored in green of the dyed thin film. Finally, a 4% solution of PC Red 21P (a dye for color filter mfd. by Nippon Kayaku Co., Ltd) in an aqueous Methyl Cellosolve solution is passed through

20 a membrane filter of 0.2 μ m, spouted onto the dyed thin film as a dye solution by an ink-jet technique, and thereby adhered to an area to be colored in red of the dyed thin film. The dyed thin film is dried for 10 minutes by heating on a hot plate heated to 150°C.

25 Then, the following dye-fixing treatment is carried out: the dyed glass substrate is immersed in a solution of 3 g of tannin, 1 g of tartaremetic and 3 g of acetic acid in 1 liter of water and treated at 70°C for 7 minutes.

Thereafter, the dyed glass substrate is washed with water and dried at 130°C for 10 minutes to obtain a color filter of the three colors R·G·B. The color filter of the three colors R·G·B has a pattern of about 150 μm each in length and breadth and is equal in quality to a conventional color filter produced by a so-called dip dyeing method.

Example 2

0.05 Part of a silane coupler KBM 603 (mfd. by Shin-Etsu Chemical Co., Ltd.) is mixed with 100 parts of a dyeable, photosensitive resin composition type resin solution CFR 633 L1 manufactured by Nippon Kayaku Co., Ltd. by dissolving in a solvent an anionic-dye-dyeable polymer obtained by copolymerization of an anionic-dye-dyeable monomer, a hydrophilic monomer and a hydrophobic monomer, an azide compound and a compound having one or more (meth)acryloyl groups which is other than the anionic-dye-dyeable monomer and the hydrophilic monomer. The resulting mixture is coated on a glass substrate having black stripes made of a resist having a pigment dispersed therein, by a spin coating technique, dried at 110°C for 3 minutes, and then exposed to light on the whole surface from the glass side to be cured. Subsequently, the glass substrate is immersed in a 2% aqueous tetramethyl hydroxide to carry out development, washed with water, and then dried at 150°C for 20 minutes to obtain a highly dyeable resin film with black

stripes on the substrate. The thickness of this cured film is 0.6 μm . When the cured film is dyed by the method described in (b) above by the use of PC Green FOP, a dye with a molecular weight of 1000 or more, the transmittance of the cured film at the wavelength of absorption maximum (660 nm) of the dye is 0.4% or less.

The glass substrate is set in an ink-jet printer. A 2% aqueous solution of PC Magenta 41P (a dye for color filter mfd. by Nippon Kayaku Co., Ltd) is passed through a membrane filter of 0.2 μm , spouted as a dye solution by an ink-jet technique, and thereby adhered to an area to be colored in magenta of the thin film to be dyed. Next, a 2% aqueous solution of PC Yellow 42P (a dye for color filter mfd. by Nippon Kayaku Co., Ltd) is passed through a membrane filter of 0.2 μm , spouted onto the dyed thin film as a dye solution by an ink-jet technique, and thereby adhered to an area to be colored in yellow of the dyed thin film. Finally, a 2% aqueous solution of PCC yan 2P (a dye for color filter mfd. by Nippon Kayaku Co., Ltd) is passed through a membrane filter of 0.2 μm , spouted onto the dyed thin film as a dye solution by an ink-jet technique, and thereby adhered to an area to be colored in cyan. Thereafter, drying by heating and dye-fixing treatment are carried out in the same manner as in Example 1 to obtain a color filter of the three colors Y-M-C.

Example 3

0.05 Part of a silane coupler KBM 603 (mfd. by Shin-Etsu Chemical Co., Ltd.) is mixed with 100 parts of CFR 633 L1 (mfd. by Nippon Kayaku Co., Ltd.). The

5 resulting mixture is spin-coated on a glass substrate to a thickness of 1.5 μm by the use of a spinner, dried at 90°C for 20 minutes, exposed to light through a mask, and then developed to form a stripe pattern with a line width of 20 μm and a distance between lines of 120 μm .

10 The thus obtained substrate having the stripe pattern is set in an ink-jet printer at a position accurately located. A 4% solution of PC Black 181P (a dye for color filter mfd. by Nippon Kayaku Co., Ltd) in an aqueous Ethyl Cellosolve solution is passed through a

15 membrane filter of 0.2 μm and spouted as a dye solution by an ink-jet technique to dye the stripe pattern in black. The substrate is dried at 150°C for 10 minutes, immersed in a solution of 3 g of tannin, 1 g of tartar emetic and 3 g of acetic acid in 1 liter of water to

20 carry out fixing treatment, and then dried. Subsequently, CFR 633 L1 is applied on the substrated having black stripes and subjected to the same procedure as described in Example 2 to obtain a color filter.

INDUSTRIAL APPLICABILITY

25 According to the present invention, patterning, and dyeing and fixing treatment which are carried out in conventional dyeing need not be carried out three

times each, resulting in a markedly simplified
procedure. Moreover, the yield decrease heretofore
caused by the adherence of dust in a development step or
a dyeing step becomes very slight. Areas onto which the
5 solutions are spouted by an ink-jet technique are easily
controlled and the precision of the areas is
sufficiently high to meet users' need. The highly
dyeable, photosensitive resin thin film used in the
present invention has a very high affinity for dyes, and
10 colors very rarely run on the thin film. Therefore, a
color filter having a colored pattern with high density
and precision can be obtained. In addition, a color
filter good in heat resistance, chemical resistance,
light resistance and color characteristics can be
15 obtained by the process of the present invention.

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CLAIMS:

1. A process for producing a color filter, characterized by forming on a substrate a photosensitive resin thin film having the dyeability described in (a) or (b) below, curing the thin film by irradiation with energy rays, and then spouting dye solutions onto predetermined areas of the cured film by an ink-jet technique to form a desired colored pattern:
 - (a) after a photosensitive resin thin film of 0.6 μm in thickness is immersed in a 4% aqueous solution of a dye with a molecular weight of 1000 or more at a room temperature for 15 minutes, the transmittance of the thin film at the wavelength of maximum absorption of the dye is 5% or less, or
 - (b) after a photosensitive resin thin film of 0.6 μm in thickness is immersed in a 0.2% aqueous solution of a dye with a molecular weight of 1000 or more at 60°C for 10 minutes, the transmittance of the thin film at the wavelength of maximum absorption of the dye is 5% or less.
2. A process for producing a color filter according to claim 1, wherein the photosensitive resin thin film described in claim 1 is formed out of a photosensitive resin composition containing an anionic-dye-dyeable polymer and a photosensitive compound.
3. A process for producing a color filter according to claim 2, wherein the anionic-dye-dyeable polymer is a polymer obtained from a composition





containing an anionic-dye-dyeable monomer having tertiary nitrogen atom or quaternary nitrogen atom, and a hydrophilic monomer other than said monomer.

4. A process for producing a color filter
5 according to claim 2, wherein the anionic-dye-dyeable polymer is a polymer obtained from a composition comprising 20 to 70% by weight of an anionic-dye-dyeable monomer having tertiary nitrogen atom or quaternary nitrogen atom, 10 to 60% by weight of a hydrophilic
10 monomer other than said monomer, and 10 to 50% by weight of a hydrophobic monomer.

5. A process for producing a color filter according to claim 4, wherein both the anionic-dye-dyeable monomer having tertiary nitrogen atom or
15 quaternary nitrogen atom and the hydrophobic monomer are (meth)acrylic monomers.

6. A process for producing a color filter according to claim 3 or 4, wherein the anionic-dye-dyeable monomer is 3-(N,N-dimethylamino)propylacrylamide
20 or 3-(N,N-dimethylamino)propylmethacrylamide.

7. A process for producing a color filter according to claim 4, wherein the anionic-dye-dyeable monomer is 3-(N,N-dimethylamino)propylacrylamide or 3-(N,N-dimethylamino)propylmethacrylamide, the hydrophilic
25 monomer other than said monomer is 2-hydroxyethyl methacrylate, vinylpyrrolidone or dimethylaminoacrylamide, and the hydrophobic monomer is methyl methacrylate or methyl acrylate.





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8. A process for producing a color filter according to claim 2, wherein the water content of a resin solution obtained by dissolving the photosensitive resin composition is 1 w/w% or less.
- 5 9. A process for producing a color filter according to claim 1, characterized by using solutions each obtained by dissolving a dye composed of a single component in a solvent, as the dye solutions.

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