(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 969 316 A2

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.01.2000 Bulletin 2000/01

(51) Int. Cl.⁷: **G03C 1/825**, G03C 1/835,
C08J 3/20

(21) Application number: **99201942.2**

(22) Date of filing: **17.06.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **29.06.1998 US 106640**

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(54) Visible light absorbing polymer particles and photographic elements comprising them

(57) The present invention is a photographic element which includes a support, at least one silver halide light sensitive emulsion layer and an antihalation layer. The antihalation layer includes a hydrophilic binder and a polymer particle having a size greater than 0.01 µm. The polymer particle is composed of a polymer derived from monomer A comprising ethylenically unsaturated monomers which form water insoluble homopolymers and monomer B comprising ethylenically unsaturated monomers which form water soluble homopolymers wherein monomer B is less than 10 weight percent of the polymer and a visible light absorbing dye.

Printed by Xerox (UK) Business Services
2.16.7/3.6

Description

FIELD OF THE INVENTION

[0001] This invention relates to a silver halide photographic element, and in particular to a multilayer, multicolor silver halide photographic element having a light-insensitive antihalation layer which contains a visible light absorbing polymer particle.

BACKGROUND OF THE INVENTION

[0002] It is customary to incorporate into a silver halide photographic element, especially a multilayer, multicolor photographic element, materials or preformed dyes that absorb light at specific wavelengths to provide an overall color to the image or to adjust the overall filter pack required to produce a photographic print. While the preformed dyes may be placed in any layer closer to the support than the layer that is sensitive to the light absorbed by the preformed dyes, it is common to place all such preformed dyes in the layer adjacent to the support (e.g. antihalation undercoat layer). In so doing, none of the light required to expose a light sensitive layer is diminished. Moreover, when these preformed dyes are incorporated in a family of photographic materials, for example, different ISO speeds, in order to have a common printer set-up, it is desirable that the preformed dyes have very similar light absorption spectra as the imaging dye clouds in the imaging forming layers.

[0003] These preformed dyes are made by reacting imaging forming couplers and oxidized developers so that their light absorption spectra overlap those of imaging dye clouds in the imaging forming layers. In order to provide a coating solution, these so called preformed dyes are mixed with organic solvent and gelatin to create a material compatible with aqueous coating solutions. A typical method for incorporating these dyes into a photographic element consists of dissolving the dyes in a high boiling organic solvent, and mixing the resultant organic phase under high shear or turbulence together with an aqueous medium, which may also contain a surfactant, in order to break the organic phase into submicron particles dispersed in the continuous aqueous phase. However, when such dispersions are used in the antihalation undercoat, the layer becomes soft, the cohesion strength of the layer is lowered.

[0004] In recent years, government regulation on air pollution and on working environment have created a definite need for technologies that are non-polluting and have low toxicity. The challenge for incorporating these preformed dyes into photographic elements is to develop a technology that is manufacturable at a lower or comparable cost, that brings very little or no organic solvent to the final products, and that does not affect photographic performance.

SUMMARY OF THE INVENTION

[0005] The present invention is a photographic element which includes a support, at least one silver halide light sensitive emulsion layer and an antihalation layer. The antihalation layer includes a hydrophilic binder and a polymer particle having a size greater than 0.01 μm. The polymer particle is composed of a polymer derived from monomer A comprising ethylenically unsaturated monomers which form water insoluble homopolymers and monomer B comprising ethylenically unsaturated monomers which form water soluble homopolymers wherein monomer B is less than 10 weight percent of the polymer and a visible light absorbing dye.

DETAILED DESCRIPTION OF THE INVENTION

[0006] Photographic elements according to this invention can differ widely in structure and composition. For example, they can vary in regard to the type of the support, the number and composition of the imaging forming layers, and the kinds of auxiliary layers that are included in the elements. The invention is particularly applicable to photographic elements comprising polymeric film supports. Typical polymeric film supports include cellulose nitrate film, cellulose acetate film, poly(vinyl acetal) film, polystyrene film, polyester film such as poly(ethylene terephthalate) film and poly(ethylene naphthalate) film, polycarbonate film, and the like. The support may be annealed.

[0007] The photographic element of the present invention has an antihalation undercoat layer located between the support and the light-sensitive emulsion layer. The support can be treated with other adhesion promotion undercoat layers before applying the antihalation undercoat layer. For example, a polyester film support can employ an undercoat layer that comprises a vinylidene chloride/acrylonitrile/acrylic acid terpolymer and an undercoat layer that includes gelatin. The antihalation undercoat layer comprises a hydrophilic binder and a visible light absorbing polymer particle. The thickness of the antihalation undercoat layer ranges from 0.1 to 6 μm, and preferably from 0.3 to 4 μm, and most preferably from 0.5 to 3 μm. The term of "thickness" used here refers to the thickness of the portion in which no matte particles are present and is measured, for example, by an electron micrograph of a non-swollen cross-section of the light sensitive material.

[0008] The visible light absorbing particle of the present invention is composed of a physical mixture of a polymer and a visible light absorbing dye. The polymer comprises units derived from monomer A and less than 10 weight % of monomer B, where A represents ethylenically unsaturated monomers which form substantially water insoluble homopolymers, and B represents ethylenically unsaturated monomers capable of forming water soluble homopolymers. The visible light absorbing dye being a reaction product of an imaging forming coupler and an oxidized developer. The visible light absorbing particle has a mean size of greater than 0.01 μm, preferably from 0.01 to 10 μm, and most preferably from 0.02 to 0.5 μm. In general, the weight ratio of visible light absorbing dye to polymer in the visible light absorbing particle can be anywhere within the range of 1:40 to 3:1, preferably from 1:10 to 2:1.

[0009] Any suitable ethylenically unsaturated monomers may be used for the preparation of the polymers contained in the visible light absorbing polymer particles of the present invention as long as the stated monomer ratios and percentages are maintained. In accordance with the invention, A represents "hydrophobic monomers" which would form a substantially water insoluble homopolymer, and B represents "hydrophilic monomers" which are capable of forming substantially water soluble homopolymers.

[0010] Suitable ethylenically unsaturated monomers which can be used as component A of the present invention include, for example, the following monomers and their mixtures: alkyl esters of acrylic or methacrylic acid such as methyl methacrylate, ethyl methacrylate, butyl methacrylate, ethyl acrylate, butyl acrylate, hexyl acrylate, n-octyl acrylate, lauryl methacrylate, 2-ethylhexyl methacrylate, nonyl acrylate, benzyl methacrylate, the hydroxyalkyl esters of the same acids such as 2-hydroxyethyl acrylate, 2-hydroxyethyl methacrylate, and 2-hydroxypropyl methacrylate, and the nitrile and amides of the same acids such as acrylonitrile, methacrylonitrile, and butyl acrylamide, vinyl acetate, vinyl propionate, vinylidene chloride, vinyl chloride, and vinyl aromatic compounds such as styrene, t-butyl styrene, ethyl vinyl benzene, vinyl toluene, dialkyl maleates, dialkyl itaconates and dialkyl malonates. Crosslinking or grafting monomers which may be used together with the foregoing monomers to crosslink the ultraviolet ray absorbing polymer particles are polyfunctional with respect to the polymerization reaction, and may include, for example, esters of unsaturated monohydric alcohols with unsaturated monocarboxylic acids, such as allyl methacrylate, allyl acrylate, butenyl acrylate, undecenyl acrylate, undecenyl methacrylate, vinyl acrylate, and vinyl methacrylate, dienes such as butadiene and isoprene, esters of saturated glycols or diols with unsaturated monocarboxylic acids, such as ethylene glycol diacrylate, ethylene glycol dimethacrylate, triethylene glycol dimethacrylate, 1,4-butanediol dimethacrylate, 1,3-butanediol dimethacrylate, and polyfunctuional aromatic compounds such as divinyl benzene.

[0011] Suitable ethylenically unsaturated nonionic hydrophilic monomers which can be used as component B of the present invention include, for example, (meth)acrylamides such as acrylamide, methacrylamide, N,N-dimethyl acrylamide, N-methylol acrylamide, and isopropyl acrylamide. Additional suitable hydrophilic monomers include poly(ethylene glycol)(meth)acrylates, N-vinyl-2-pyrrolidone, vinylimidazole, and the like.

[0012] Ethylenically unsaturated ionic monomers which can be used as component B of the present invention include, for example, monomers containing carboxylic acid, sulfo, or oxysulfo pendent groups, or salts of such groups. Representative monomers include acrylic acid, methacrylic acid, and sodium acrylamido-2-methylpropane sulfonate.

[0013] The visible light absorbing dyes of the present invention are reaction products of imaging forming couplers and developers in an appropriate solvent using an oxidant such as ammonium peroxydisulfate. For example, indoaniline dyes (cyan dyes) are formed from the reaction of oxidized developers and naphthols, azomethine dyes (magenta) are formed from the reaction of oxidized developers and pyrazolones. And yellow dyes are formed when the oxidized developers react with couplers having reactive methylene groups such as 1,3 diketones. Couplers useful for the practice of the present invention have been described in detail in Research Disclosure No. 38957 September 1997 Published by Kenneth Mason Publications Ltd., Hampshire, England, page 616-618. Typical color developers useful for the practice of the present invention have been described in detail in Research Disclosure No. 38957 September 1997 Published by Kenneth Mason Publications Ltd., Hampshire, England, page 633-634. Particular useful developers are primary aromatic amino color developing agents such as p-phenylenediamine and especially the N,N-dialkyl-p-pheneylenediamines in which the aromatic nucleus can be substituted or unsubstituted.

[0014] The visible light absorbing polymer particle of the invention can also be prepared by loading a preformed visible light absorbing dye into a preformed polymer particle. The polymer particle can be made by various well-known techniques in the art, such as, for example, emulsion polymerization, dispersion polymerization, suspension polymerization, and the like (see, for example, Padget, J. C. in Journal of Coating Technology, Vol 66, No. 839, pages 89-105, 1994; El-Aasser, M. S. and Fitch, R. M. Ed. Future Directions in Polymer Colloids, NATO ASI Series, No 138, Martinus Nijhoff Publishers, 1987; Arshady, R. Colloid & Polymer Science, 1992, No 270, pages 717-732; Odian, G. Principles of Polymerization, 2nd Ed. Wiley(1981); and Sorenson, W. P. and Campbell, T. W. Preparation Method of Polymer Chemistry, 2nd Ed, Wiley (1968)). The polymerization process is initiated in general with free radical initiators. Free radicals of any sort may be used. Preferred initiators include persulfates (such as ammonium persulfate, potassium persulfate, etc.), peroxides (such as hydrogen), azo compounds (such azobiscyanovaleric acid), and redox initiators (such as hydrogen peroxide-iron(II) salt, potassium persulfate-sodium hydrogen sulfate, etc.). Surfactants which can be used include, for example, a sulfate, a sulfonate, a cationic compound, an amphoteric compound, and a polymeric protective colloid.

Specific examples are described in "McCUTCHEON'S Volume 1: Emulsifiers & Detergents, 1995, North American Edition". Chain transfer agents may also be used to control the properties of the polymer particles formed.

[0015] In a typical loading process, the visible light absorbing dye is first dissolved in an organic solvent such as butoxyethoxy ethyl acetate. An aqueous solution composed of gelatin, a surfactant and a preformed polymer particle is mixed with the visible light absorbing dye solution using a premixer. The resultant mixture is then passed once through a Microfluidizer to form a fine dispersion. The resulting dispersion is quick chilled on a cold block and formed into noodles using a hydraulic press. The resultant noodled dispersion is finally washed with water to remove the organic solvent.

[0016] Any suitable hydrophilic binder can be used in practice of this invention, such as naturally occurring substances such as proteins, protein derivatives, cellulose derivatives (e.g. cellulose esters), polysaccharides, casein, and the like, and synthetic water permeable colloids such as poly(vinyl lactams), acrylamide polymers, poly(vinyl alcohol) and its derivatives, hydrolyzed polyvinyl acetates, polymers of alkyl and sulfoalkyl acrylates and methacrylates, polyamides, polyvinyl pyridine, acrylic acid polymers, maleic anhydride copolymers, polyalkylene oxide, methacrylamide copolymers, polyvinyl oxazolidinones, maleic acid copolymers, vinyl amine copolymers, methacrylic acid copolymers, acryloyloxyalkyl sulfonic acid copolymers, vinyl imidazole copolymers, vinyl sulfide copolymers, homopolymer or copolymers containing styrene sulfonic acid, and the like. Gelatin is the most preferred hydrophilic binder.

[0017] The antihalation layer may include other addenda, for example colloidal filamentary metallic silvers, sequestration agents, thickners, hardeners, coating aids, ultraviolet ray absorbers, and inorganic oxide particles.

[0018] The photographic element of the present invention can contain at least one electrically conductive layer, which can be either surface protective layer or a sub layer. The surface resistivity of at least one side of the support is preferably less than $1\text{x}10^{12}\Omega$/square, more preferably less than $1\text{x}10^{11}\Omega$/square at 25 °C and 20 percent relative humidity. To lower the surface resistivity, a preferred method is to incorporate at least one type of electrically conductive material in the electrically conductive layer. Such materials include both conductive metal oxides and conductive polymers or oligomeric compounds. Such materials have been described in detail in, for example, U.S. Patent Nos. 4,203,769; 4,237,194; 4,272,616; 4,542,095; 4,582,781; 4,610,955; 4,916,011; 5,340,676; 5,719,016 and 5,731,119.

[0019] The light insensitive layer of the invention can be applied by any of a number of well-know techniques, such as dip coating, rod coating, blade coating, air knife coating, gravure coating and reverse roll coating, extrusion coating, slide coating, curtain coating, and the like. The core/shell polymer particles and the binder are mixed together in an aqueous medium to form a coating composition. After coating, the layer is generally dried by simple evaporation, which may be accelerated by known techniques such as convection heating. Known coating and drying methods are described in further detail in Research Disclosure No. 308, Published Dec. 1989, pages 1007 to 1008.

[0020] The present invention is also directed to a single use camera having incorporated therein a photographic element as described above. Single use cameras are known in the art under various names: film with lens, photosensitive material package unit, box camera and photographic film package. Other names are also used, but regardless of the name, each shares a number of common characteristics. Each is essentially a photographic product (camera) provided with an exposure function and preloaded with a photographic material. The photographic product comprises an inner camera shell loaded with the photographic material, a lens opening and lens, and an outer wrapping(s) of some sort. The photographic materials are exposed in camera, and then the product is sent to the developer who removes the photographic material and develop it. Return of the product to the consumer does not normally occur.

[0021] Single use camera and their methods of manufacture and use are described in U.S. Patent Nos. 4,801,957; 4,901,097; 4,866,459; 4,849,325; 4,751,536; 4,827,298; European Patent Applications 460,400; 533,785; 537,225.

[0022] The photographic processing steps to which the raw film may be subject may include, but are not limited to the following:

1.) color developing → bleach-fixing → washing/stabilizing;

2.) color developing → bleaching → fixing → washing/stabilizing;

3.) color developing → bleaching → bleach-fixing → washing/stabilizing;

4.) color developing → stopping → washing → bleaching → washing → fixing → washing/stabilizing;

5.) color developing → bleach-fixing → fixing → washing/stabilizing;

6.) color developing → bleaching → bleach-fixing → fixing → washing/stabilizing;

[0023] Among the processing steps indicated above, the steps 1), 2), 3), and 4) are preferably applied. Additionally, each of the steps indicated can be used with multistage applications as described in Hahm, U.S. Pat. No. 4,719,173, with co-current, counter-current, and contraco arrangements for replenishment and operation of the multistage processor.

[0024] Any photographic processor known to the art can be used to process the photosensitive materials described herein. For instance, large volume processors, and so-called minilab and microlab processors may be used. Particularly advantageous would be the use of Low Volume Thin Tank processors as described in the following references: WO 92/10790; WO 92/17819; WO 93/04404; WO 92/17370; WO 91/19226; WO 91/12567; WO 92/07302; WO 93/00612; WO 92/07301; WO 02/09932; U.S. 5,294,956; EP 559,027; U.S. 5,179,404; EP 559,025; U.S. 5,270,762; EP 559,026; U.S. 5,313,243; U.S. 5,339,131.

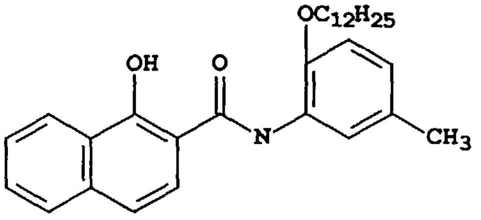
[0025] The present invention is also directed to photographic systems where the processed element may be re-introduced into the cassette. These system allows for compact and clean storage of the processed element until such time when it may be removed for additional prints or to interface with display equipment. Storage in the roll is preferred to facilitate location of the desired exposed frame and to minimize contact with the negative. U.S. Patent No. 5,173,739 discloses a cassette designed to thrust the photographic element from the cassette, eliminating the need to contact the film with mechanical or manual means. Published European Patent Application 0 476 535 A1 describes how the developed film may be stored in such a cassette.

[0026] The present invention will now be described in detail with reference to examples; however, the present invention should not limited by these examples.

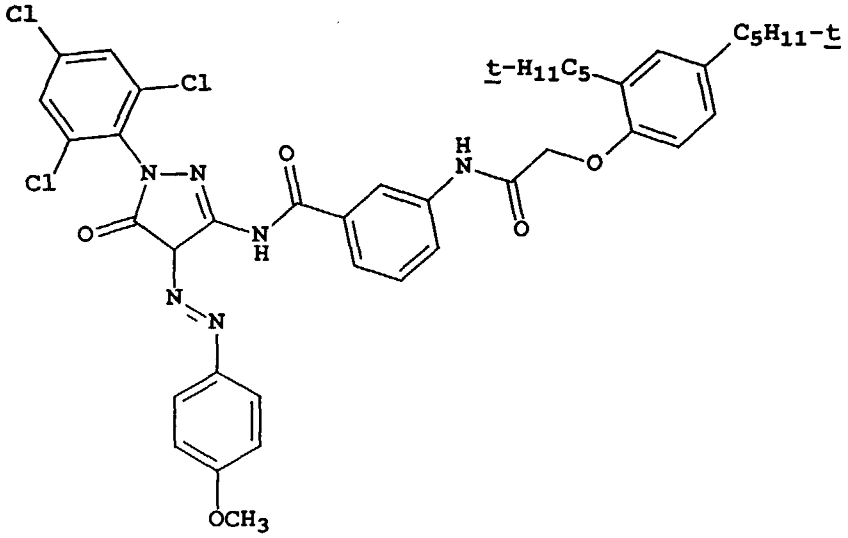
Examples 1 to 8: Preparation of visible light absorbing polymer particles

[0027] The following visible light absorbing dyes are used in the examples.

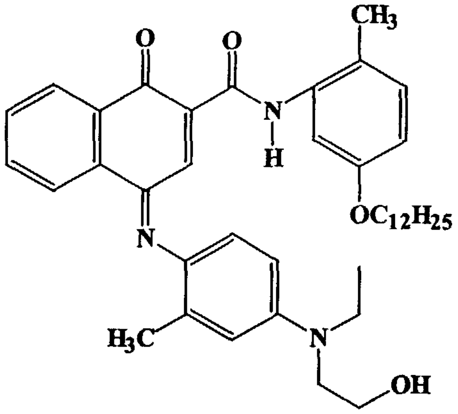
Dye-1



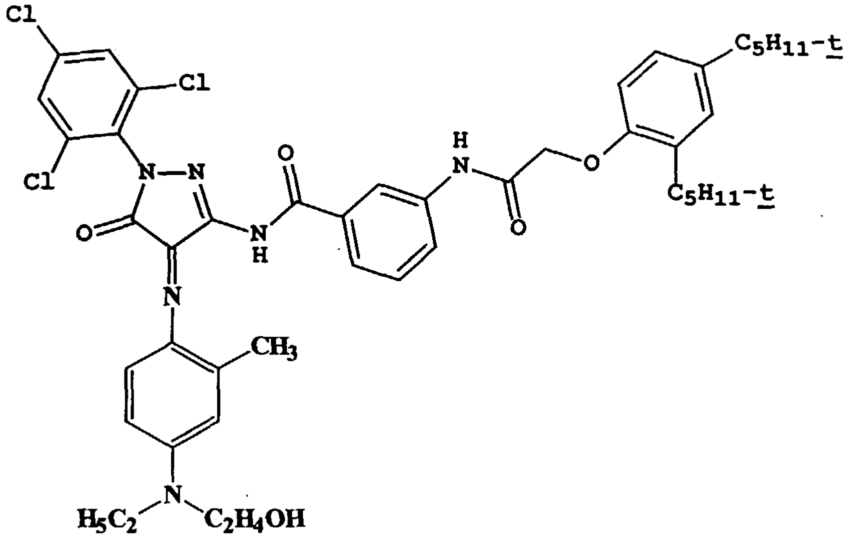
Dye-2



Dye-3



Dye-4



Example 1.

[0028] An aqueous solution was prepared by heating 40.0 grams of deionized gelatin, 32.0 grams of a 10 percent solution of alkanol XC surfactant, 1.0 grams of a 0.7 percent solution of Kathon biocide, and 305.6 grams of deionized water to 55 degrees C. To this aqueous phase was added 61.4 grams of a 30% polymer latex composed of t-butylacrylamide and butylacrylate monomers (50/50 weight ratio) using low shear mixing. 12.0 grams of the preformed Dye 1 was dissolved in 48.0 grams of 2-butoxyethoxy ethyl acetate by heating to 125 degrees C. This oil phase was mixed into the gelatin phase using a Silverson premixer at 5000 rpm and passed once through a Microfluidizer at 7200 psi. The resulting dispersion was quick chilled on a cold block and formed into noodles using a hydraulic press. The resulting noodled dispersion was washed for 6 hours using calcified water to remove the butoxyethoxy ethyl acetate. The final washed dispersion was remelted at 45 degrees C, mixed under low shear and chill set until coating.

Example 2.

[0029] The preparative procedure in example 1 was repeated except 12.0 grams of Dye 2 was used in place of Dye 1.

Example 3.

[0030] The preparative procedure in example 1 was repeated except 12.0 grains of Dye 3 was used in place of Dye 1.

Example 4.

[0031] The preparative procedure in example 1 was repeated except 12.0 grams of Dye 4 was dissolved in 48.0 grams of cyclohexanone and used to accomplish loading of dye into polymer.

Example 5.

[0032] An aqueous gelatin solution was prepared by heating 20 grams of deionized gelatin, 16.3 grams of a 10 percent solution of alkanol XC surfactant, and 151.2 grams of deionized water to 50 degrees C. To this aqueous phase was added 31.3 grams of a 20 percent poly(butyl acrylate) latex using low shear mixing. 6.25 grams of Dye 4 was dissolved in 25 grams of cyclohexanone by heating to 120 degrees C. The same homogenization and washing procedure from example 1 was used to load the dye into the polymer latex.

Example 6.

[0033] The preparative procedure from example 5 was used except 20.8 grams of a Poly(ethyl methacrylate) latex was used in place of the poly(butyl acrylate) latex.

Example 7.

[0034] The preparative procedure from example 5 was used except 20.8 grams of a Poly(t-butyl acrylamide) latex was used in place of the poly(butyl acrylate) latex.

Example 8.

[0035] An aqueous solution was prepared by heating 24.0 grams of deionized gelatin, 15.0 grams of a 10 percent solution of alkanol XC surfactant, and 204.8 grams of deionized water to 50 degrees C. To this aqueous phase was added 18.75 grams of a 40 percent solution of R-9699 polyurethane latex (available from Zeneca Resins). 7.5 grams of dye 4 were dissolved in 30.0 grams of cyclohexanone by heating to 120 degrees C. The same homogenization and washing procedure from example 1 was used to load the dye into the polymer latex.

Example 9 and 10: Photographic Elements

[0036] The photographic elements are prepared as follows: An acetate support is used having an antistatic layer overcoated with a transparent barrier/abrasion resistance layer on the other side. The support is coated on the side opposite to the antistatic layer with the antihalation layer having compositions as follows:

Example 9 (comparative):

[0037] The antihalation layer is prepared using visible light absorbing dyes dispersed in high boiling organic solvents and comprises gelatin (1.6 g/m^2), filamentary metallic silver (0.15 g/m^2), Dye-3 (0.0253 g/m^2), Dye-2 (0.013 g/m^2), Dye-4 (0.0108 g/m^2), S-1 (0.086 g/m^2), S-2 (0.2168 g/m^2) and triethyl hexyl phosphate (0.0108 g/m^2).

Example 10 (Invention):

[0038] The antihalation layer is prepared using visible light absorbing polymer particles and comprises gelatin (1.6 g/m^2), filamentary metallic silver (0.15 g/m^2),), Dye-3 (0.0253 g/m^2), Dye-2 (0.013 g/m^2), Dye-4 (0.0108 g/m^2), and poly(-t-butyl acryamide-cobutyl acrylate) (50/50) (0.0491 g/m^2)

[0039] The above photographic element Examples 9 and 10 are then prepared by coating on the top of the antihalation layer with the following layers:

Interlayer: This layer comprises compound 2,5-di-t-octyl-1,4-dihydroxy benzene (0.075 g/m^2), tri(2-ethylhexyl)phosphate (0.113 g/m^2), and gelatin (0.86 g/m^2).

Slow Cyan Dye-forming Layer: This layer comprises a red sensitive silver bromoiodide emulsion (3.3 mole percent iodide) (0.324 μm grain size) (0.387 g/m^2 silver), compound CC-1 (0.355 g/m^2), IR-4 (0.011 g/m^2), B-1 (0.075 g/m^2), S-2 (0.377 g/m^2), S-3 (0.098 g/m^2), and gelatin (1.64 g/m^2).

Mid Cyan Dye-forming Layer: This layer comprises a blend of a red sensitive silver bromoiodide emulsion (3.3 mole percent iodide) (0.488 μm grain size) (0.816 g/m^2 silver) and a red sensitive, tabular grain, silver bromoiodide emulsion (4.5 mole percent iodide) (0.98 μm diameter by 0.11 μm thick) (0.215 g/m^2 silver), compound CC-1 (0.183 g/m^2), IR-3 (0.054 g/m^2), B-1 (0.027 g/m^2), CM-1 (0.011 g/m^2), S-2 (0.183 g/m^2), S-3 (0.035 g/m^2), S-5 (0.054 g/m^2), and gelatin (1.35 g/m^2).

Fast Cyan Dye-forming Layer: This layer comprises a red sensitive, tabular grain, silver bromoiodide emulsion (4.5 mole percent iodide) (1.10 μm diameter by 0.11 μm thick) (1.08 g/m^2 silver), compound CC-1 (0.161 g/m^2), IR-3 (0.038 g/m^2), IR-4 (0.038 g/m^2), CM-1 (0.032 g/m^2), S-2 (0.237 g/m^2), S-5 (0.038 g/m^2), and gelatin (1.35 g/m^2).

Interlayer: This layer comprises compound 2,5-di-t-octyl-1,4-dihydroxy benzene (0.075 g/m^2), tri(2-ethylhexyl)phosphate (0.113 g/m^2), and gelatin (0.86 g/m^2).

Slow Magenta Dye-forming Layer: This layer comprises a blend of a green sensitive, tabular grain, silver bromoiodide emulsion (1.5 mole percent iodide) (0.7 μm diameter by 0.112 μm thick) (0.258 g/m^2 Ag), and a green sensitive, tabular grain, silver bromoiodide emulsion (1.3 mole percent iodide) (0.54 μm diameter by 0.086 μm thick) (0.409 g/m^2 Ag), compound M-1 (0.204 g/m^2), MM-1 (0.038 g/m^2), ST-1 (0.020 g/m^2), S-1 (0.26 g/m^2), and gelatin (1.18 g/m^2).

Mid Magenta Dye-forming Layer: This layer comprises a green sensitive, tabular grain, silver bromoiodide emulsion (4.5 mole percent iodide) (0.61 μm diameter by 0.12 μm thick) (0.646 g/m^2 Ag), compound M-1 (0.099 g/m^2), MM-1 (0.027 g/m^2), IR-2 (0.022 g/m^2), ST-1 (0.010 g/m^2), S-1 (0.143 g/m^2), S-2 (0.044 g/m^2), and gelatin (1.41 g/m^2).

Fast Magenta Dye-forming Layer: This layer comprises a green sensitive, tabular grain, silver bromoiodide emulsion (4.5 mole percent iodide) (0.98 μm diameter by 0.113 μm thick) (0.699 g/m^2 Ag), compound M-1 (0.052 g/m^2), MM-1 (0.032 g/m^2), IR-2 (0.022 g/m^2), ST-1 (0.005 g/m^2), S-1 (0.111 g/m^2), S-2 (0.044 g/m^2), and gelatin (1.123 g/m^2).

Yellow Filter Layer: This layer comprises 2,5-di-t-octyl-1,4-dihydroxy benzene (0.075 g/m^2), YD-2 (0.108 g/m^2), Irganox 1076 sold by Ciba-Geigy (0.01g /m^2), S-2 (0.121 g/m^2), and gelatin (0.861 g/m^2).

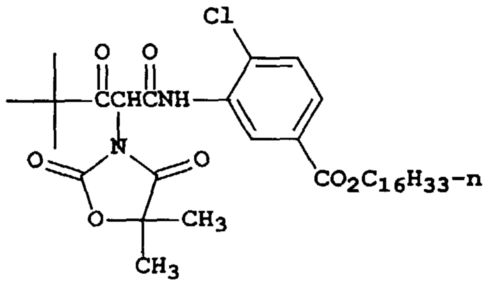
Slow Yellow Dye-forming Layer: This layer comprises a blend of a blue sensitive, tabular grain, silver bromoiodide emulsion (4.5 mole percent iodide) (1.4 μm diameter by 0.131 μm thick) (0.161 g/m^2 Ag), a blue sensitive, tabular grain, silver bromoiodide emulsion (1.5 mole percent iodide) (0.85 μm diameter by 0.131 μm thick) (0.0.108 g/m^2 Ag), and a blue sensitive, tabular grain, silver bromoiodide emulsion (1.3 mole percent iodide) (0.54 μm diameter by 0.086 μm thick) (0.161 g/m^2 Ag), compound Y-1 (0.915 g/m^2), IR-1 (0.032 g/m^2), B-1 (0.0065 g/m^2), S-1 (0.489 g/m^2), S-3 (0.0084 g/m^2), and gelatin (1.668 g/m^2).

Fast Yellow Dye-forming Layer: This layer comprises a blue sensitive, tabular grain, silver bromoiodide emulsion (4.5 mole percent iodide) (2.3 μm diameter by 0.128 μm thick) (0.43 g/m^2 Ag), compound Y-1 (0.15 g/m^2), IR-1 (0.032 g/m^2), B-1 (0.0054 g/m^2), S-1 (0.091 g/m^2), S-3 (0.0070 g/m^2), and gelatin (0.753 g/m^2).

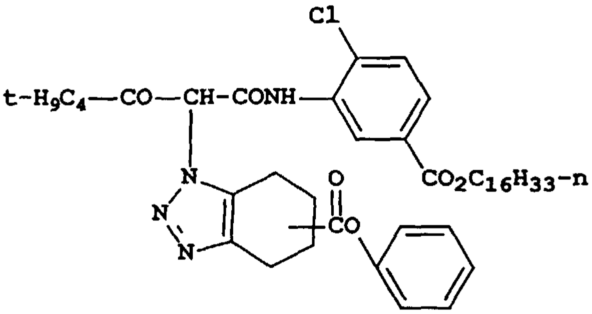
Second Protective Layer: This layer comprises gelatin (0.7 g/m^2), colloidal silver (0.215 g/m^2), UV-1 (0.108 g/m^2), UV-2 (0.108 g/m^2), and S-1 (0.151 g/m^2)

First Protective Layer: This layer comprises Gelatin (0.888 g/m^2),Silicone lube (DC-200 Dow Corning, 0.0401 g/m^2), Fluorad FC-134 (3M Co., 0.0039 g/m^2), Aerosol OT (American Cyanamide, 0.0215 g/m^2), Surfactant Olin 10G (Olin Corp., 0.0272 g/m^2), Poly(methyl methacrylate) matte (1.5 μm, 0.0538 g/m^2), and Poly(methyl methacrylate-co-methacrylic acid) (45/55 wt%, 2.7 μm, 0.107 g/m^2).

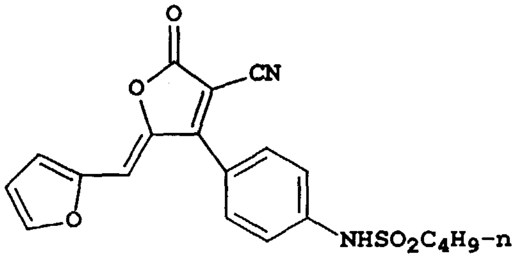
Y1



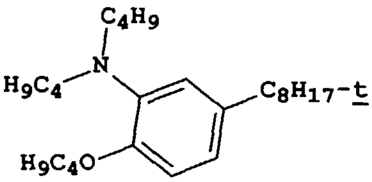
IR-1

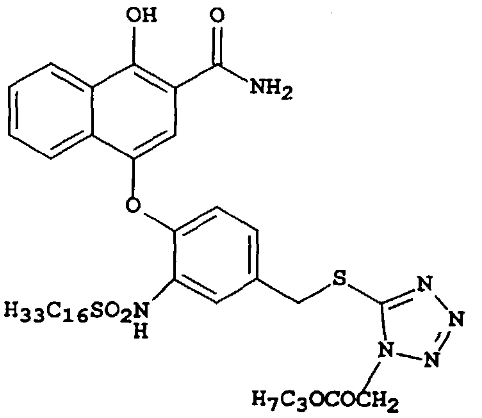


YD-2

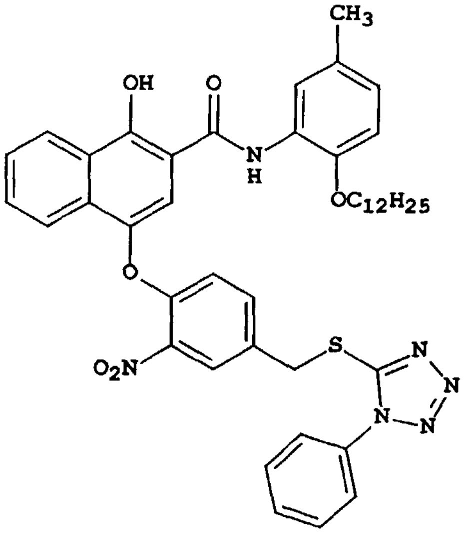


ST-1

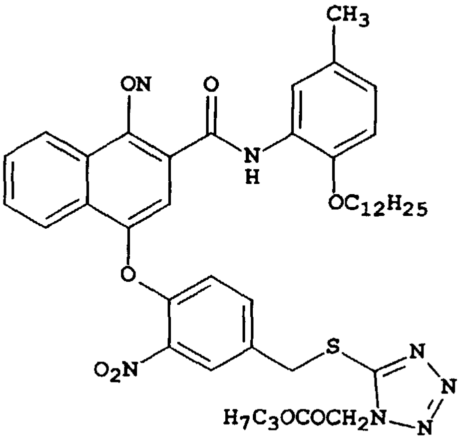



OH
O
NH2
O
H33C16SO2N
H
S
N
N
N
N
H7C3OCOCH2

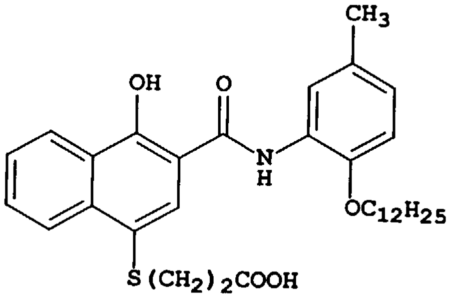
IR-2


CH3
OH
O
N
H
OC12H25
O
O2N
S
N
N
N
N

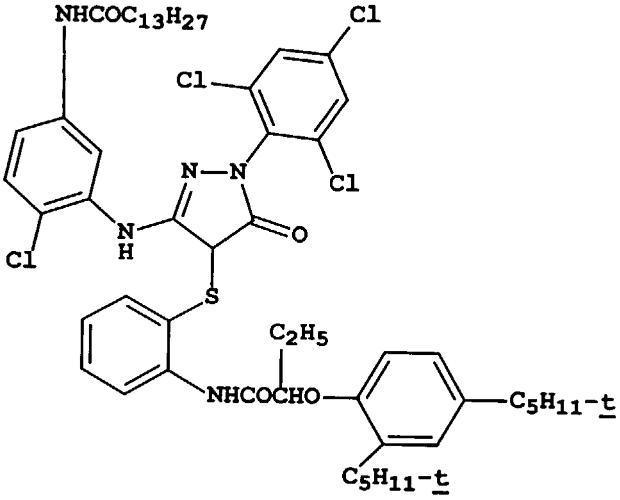
IR-3


CH3
ON
O
N
H
OC12H25
O
O2N
S
N
N
N
H7C3OCOCH2N

IR-4

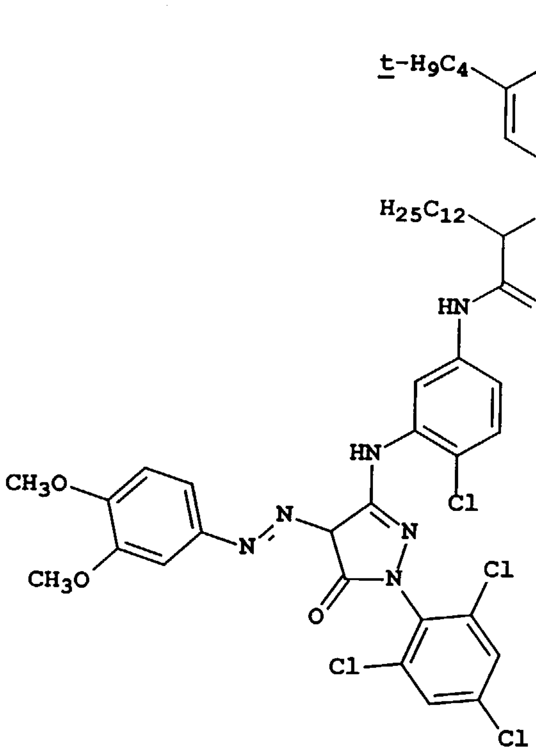

CH3
OH
O
N
H
OC12H25
S (CH2) 2COOH

B-1

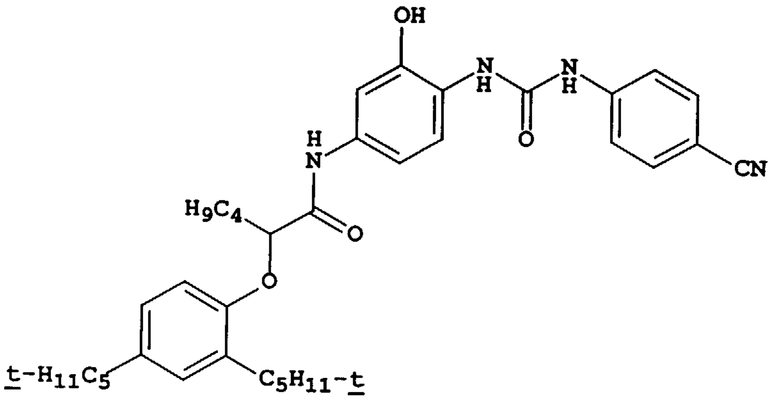

NHCOC13H27
Cl
Cl
N
N
Cl
N
H
O
Cl
S
C2H5
NHCOCHO
C5H11-t
C5H11-t

M-1

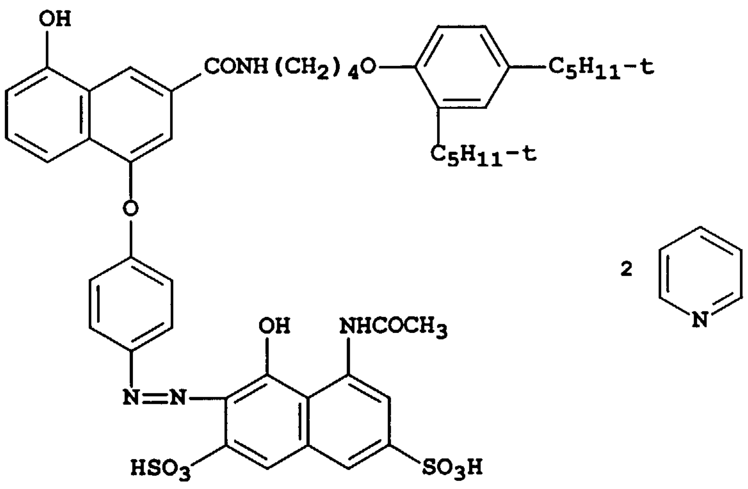
MM-1


OH
t-H9C4
H25C12
O
HN
O
HN
Cl
CH3O
CH3O
N
N
N
N
O
Cl
Cl
Cl

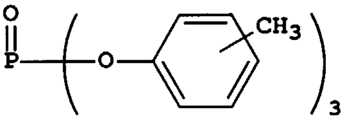
CC-1


OH
N H
N H
O
CN
H N
H9C4
O
O
t-H11C5
C5H11-t

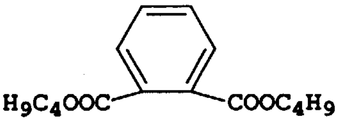
CM-1



S-1



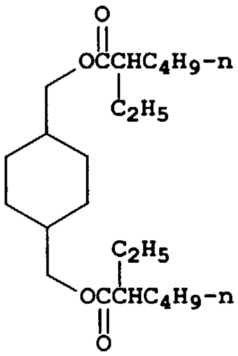
S-2

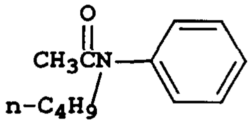


$C_{11}H_{23}CON(C_2H_5)_2$

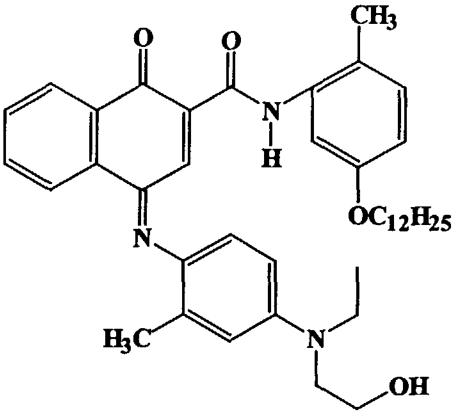
S-3

S-4

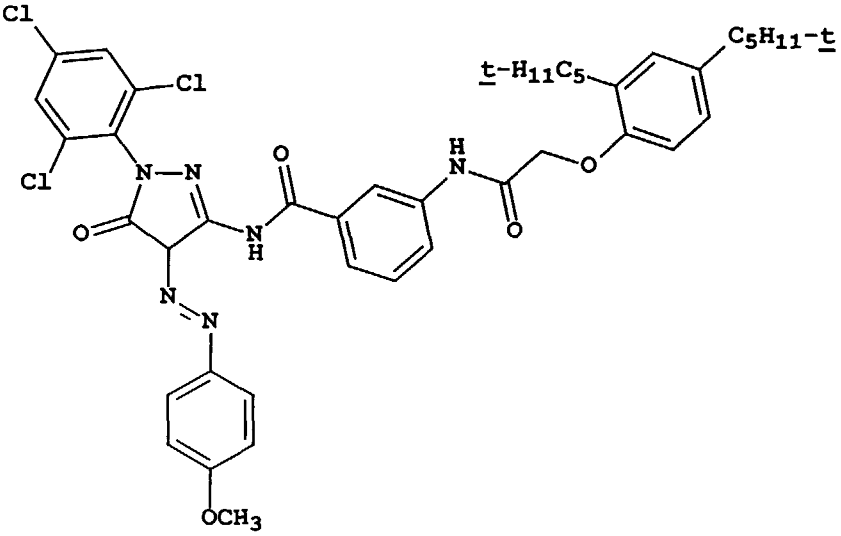



O
CH3CN
n-C4H9

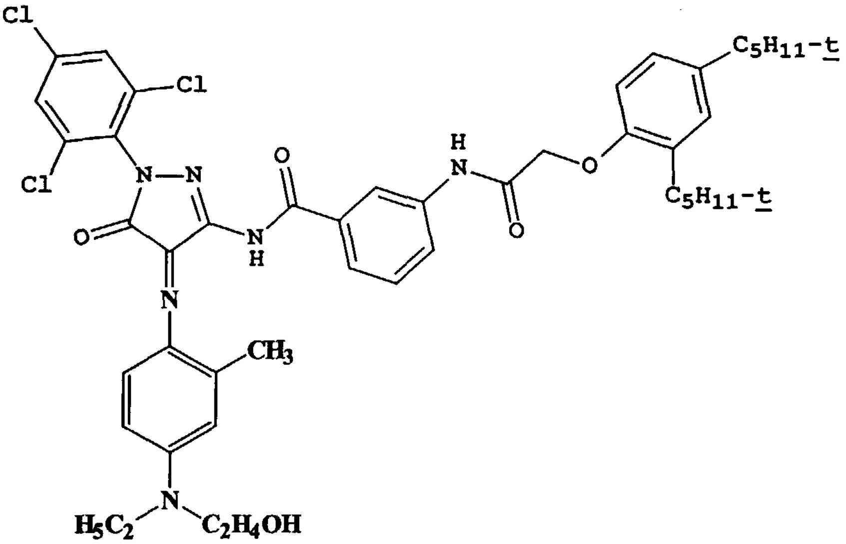
S-5


O
O
CH3
N
H
OC12H25
N
H3C
N
OH

AHU-1


Cl
Cl
Cl
N
N
O
N
H
O
H
N
O
O
t-H11C5
C5H11-t
N
N
OCH3

AHU-2



AHU-3

[0040] No performance difference was found between Comparative Example 9 and Invention Example 10. However, Invention Example 10 was prepared using visible light absorbing polymer particles that do not contain any organic solvent.

[0041] The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

Claims

1. A photographic element comprising:

   a support;
   at least one silver halide light sensitive emulsion layer; and
   an antihalation layer comprising a hydrophilic binder and a polymer particle having a size greater than 0.01 µm, said polymer particle comprising a polymer derived from monomer A comprising ethylenically unsaturated monomers which form water insoluble homopolymers and monomer B comprising ethylenically unsaturated monomers which form water soluble homopolymers wherein monomer B is less than 10 weight percent of the polymer and a visible light absorbing dye.

2. The photographic element of claim 1 wherein the support comprises cellulose nitrate film, cellulose acetate film, poly(vinyl acetal) film, polystyrene film, poly(ethylene terephthalate) film, poly(ethylene naphthalate) film or polycarbonate film.

3. The photographic element of claim 1 further comprising an adhesion promotion layer superposed on the support.

4. The photographic element of claim 1 wherein a weight ratio of visible light absorbing dye to polymer is from 1:40 to 3:1.

5. The photographic element of claim 1 wherein monomer A is selected from the group consisting of alkyl esters of acrylic acid, alkyl esters of methacrylic acid, hydroxyalkyl esters of acrylic acid, hydroxyalkyl esters of methacrylic acid, nitriles of acrylic acid, nitriles of methacrylic acid, amides of acrylic acid, amides of methacrylic acid, vinyl acetate, vinyl propionate, vinylidene chloride, vinyl chloride, vinyl aromatic compounds, dialkyl maleates, dialkyl itaconates and dialkyl malonates,.

6. The photographic element of claim 1 wherein monomer B is selected from the group consisting of (meth)acrylamides, poly(ethylene glycol)(meth)acrylates, N-vinyl-2-pyrrolidone, vinylimidazole, acrylic acid, methacrylic acid,

and sodium acrylamido-2-methylpropane sulfonate.

7. The photographic element of claim 1 wherein the visible light absorbing dye comprises a reaction product of imaging forming couplers and developers in a solvent using an oxidant.

8. The photographic element of claim 1 wherein the polymer further comprises crosslinking monomers selected from the group consisting of esters of unsaturated monohydric alcohols with unsaturated monocarboxylic acids, dienes, esters of saturated glycols with unsaturated monocarboxylic acids, esters of saturated diols with unsaturated monocarboxylic acids and polyfunctuional aromatic compounds.

9. A polymer particle comprising a polymer derived from monomer A comprising ethylenically unsaturated monomers which form water insoluble homopolymers and monomer B comprising ethylenically unsaturated monomers which form water soluble homopolymers wherein monomer B is less than 10 weight percent of the polymer and a visible light absorbing dye, said polymer particle having a size greater than 0.01 µm.

10. The polymer particle of claim 9 wherein a weight ratio of visible light absorbing dye to polymer is from 1:40 to 3:1.