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(54) Light control film and a production method of the same

(57) A light control film is disclosed. The light control film is produced employing a photosensitive material having a silver salt photosensitive layer on a transparent support. The light control film has dots, lines, checkered or honeycomb image of silver.

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Description

FIELD OF THE INVENTION

The present invention relates to a light control film which is employed to shield external light incident on the image surface of CRTs, and a production method of the same.

BACKGROUND OF THE INVENTION

Conventionally, a technique utilizing a light control film has been known. This film exhibits properties which can selectively scatter light having a predetermined incident angle.

The representative production methods are disclosed in Japanese Patent Publication No. 47-43845, and Japanese Patent Publication Open to Public Inspection Nos. 51-44186 and 50-92751, in which production methods associated with a louvered plastic are described; thin transparent plates and thin translucent or opaque plates are alternatively laminated; when the desired thickness is obtained, the louvered plastic film is produced by slicing the resultant assemblage into a film-like form in the vertical direction against the lamination direction. The resulting film transmits light parallel to the lamination direction, while shielding oblique light to the lamination direction. Namely, vertical incident light can be transmitted. On the other hand, the light at more than a predetermined angle is shielded and cannot be transmitted because the opaque area works as a kind of a blind.

Furthermore, Japanese Patent Publication No. 2-19449 and Japanese Patent Publication Open to Public Inspection No. 58-215880 disclose that a photosensitive resin is coated on a transparent support; relief of dots, stripes or a checkered pattern is formed employing light irradiation and a light control film is produced by dyeing the relief with a dye.

Japanese Patent Publication Open to Public Inspection No. 6-11606 describes that a resin composition comprising a plurality of compounds having a polymerizing double bond in a molecule with different refractive index is sustained in a film-like form and a light control film is produced in such a manner that in a first process, the composition is hardened by irradiating ultraviolet radiation from a first direction and in a second process, the above-mentioned resin composition is sustained in a film-like form on the resulting hardened composition and is hardened by irradiating it with ultraviolet radiation from a second direction.

However, the production methods according to the conventional technology exhibit the following problems. In the technology disclosed in Japanese Patent Publication No. 47-43845, and Japanese Patent Publication Open to Public Inspection Nos. 51-44186 and 50-92751, opaque portions and transparent portions are laminated to a predetermined thickness and when the lamination reaches the predetermined thickness, a light control film is produced by slicing the resultant assemblage to a film-like form. Furthermore, after lamination, a desired film is produced employing another process. This causes the process to become excessively complex which markedly increases the cost.

Furthermore, the technology disclosed in Japanese Patent Publication No. 2-19449 and Japanese Patent Publication Open to Public Inspection No. 58-215880 is that a relief image is formed employing the photosensitive resin on a transparent support and a predetermined incident light can be shielded by the relief image. However, because the relief image is finely structured, it results in defects such as low mechanical strength.

The technology disclosed in Japanese Patent Publication Open to Public Inspection No. 6-11606 depends on shielding of oblique incident light formed by reflection and scattering to result in defects such that light cannot be perfectly shielded.

The light control film can be produced by: (1) a skiving method in which thin transparent plates and thin translucent or opaque plates are alternatively laminated and when the desired thickness is obtained, the resulting lamination is sliced into a film-like form in the vertical direction against the lamination direction; (2) a method in which a relief image is formed employing a photosensitive resin on a transparent support; or (3) a method in which polymerizing compounds having differing refractive indexes are formed into a film-like form and is subjected to light irradiation from two directions. However, the light control films produced by these methods result in defects such that firstly, production is rather complicated; secondly, the mechanical strength is low, and thirdly, shielding predetermined incident light is not sufficient and other shortcomings.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a light control film which, firstly, is readily produced; secondly, is excellent in mechanical strength; thirdly, is excellent in shielding of predetermined incident light and exhibits a clear facing scene observed through transmission, and fourthly, enables formation of patterns such as dots, stripes, checks or honeycomb, and a production method of the same.

The present invention and its embodiments are described.

A light control film comprises a transparent support and a layer having silver image.

The light control film may be produced employing a photosensitive material having a transparent support comprising thereon a silver salt photosensitive layer.

In the light control film transmittance of vertical incident light is preferably not less than 40% and transmittance of 30° oblique light is preferably not more than 20%.

The light control film has preferably dots, stripes, a checkered pattern or a honeycomb pattern.

The light control film has the dots, stripes, checkered pattern or honeycomb pattern preferably formed with silver.

The light control film is prepared by exposing a silver salt photosensitive material through a mask or exposing imagewise using laser light, and processing the exposed silver salt photosensitive material of development and fixing.

BRIEF EXPLANATION OF THE DRAWINGS

Fig. 1 is a schematic sectional view and a top view illustrating a structure of the light control film of the present invention.

Fig. 2 is a graph showing the relationship between a light incident angle in the 90° angle direction (vertical direction in Fig. 1) to a striped silver image and the light transmittance.

Fig. 3 is a view illustrating a checkered pattern original.

Fig. 4 a graph showing the relationships between a light incident angle in both the and in the horizontal direction of a checkered type light control film, and the light transmittance.

DETAILED DESCRIPTION OF THE INVENTION

A silver salt photosensitive layer is coated on a transparent support plate, and is subjected to light exposure of dots, stripes or a checkered pattern, followed by development and fixing to obtain a light control film having a silver image on the transparent support plate. The light control film composed of the silver salt photosensitive layer, when compared to the skiving method, shows that the production is easy and a pattern such as dots, stripes, or a checkered pattern is readily prepared. Furthermore, the light control film exhibits a feature of higher mechanical strength than the light control film produced employing a relief image made of a photosensitive resin. This is due to the fact that the light control film produced by forming a relief image employing a photosensitive resin has a finely structured relief image and when force is applied to the relief image, the relief image is collapsed or crushed, On the contrary, when silver salt photosensitive layer is employed the silver salt photosensitive layer, the relief image is not collapsed nor crushed.

Furthermore, when dots, stripes or a checkered pattern is formed with black silver image, the specified incident light can be shielded completely.

As mentioned above, the light control film employing the sliver halide photosensitive layer exhibits excellent advantages which can not be obtained by the conventional technology.

As for the transparent support various types of materials mentioned below are available.

Materials for the transparent support include transparent glass, polymethyl methacrylate (PMMA), triacetyl cellulose, polystyrene, polyvinyl chloride, polycarbonate, polypropylene, polyethylene terephthalate, acetyl cellulose, polyvinylidene chloride, polyethylene vinyl acetate, polyacrylonitrile, polyamide, polyvinyl alcohol, etc. The thickness is generally between 1 to 10 mm. In the case of plastics, a film or sheet generally having a thickness of not less than 20 μ and preferably a thickness of not less than 50 μ can be employed.

Of these, transparent glass, polymethyl methacrylate (PMMA), polycarbonate, polyethylene terephthalate, etc. are preferred, in terms of ease of handling.

Furthermore, as for the silver salt emulsion to form the silver salt photosensitive layer, silver chloride emulsion, silver chlorobromide emulsion, silver chloroiodide emulsion, silver iodobromide emulsion, silver chloroiodobromide emulsion, etc. are available.

In order to make the finished silver pattern as fine and accurate as possible, fine silver halide grains are preferable. The grain size of the silver halide grain is not more than 0.5 μm and preferably not more than 0.2 μm. Furthermore, the distribution of the grain size is preferably as narrow as possible. Among so-called Lippmann type emulsions or photosensitive materials for graphic art, there exist emulsions suitably used.

"Transmittance of vertical incident light is not less than 40%" means that not less than 40% of light vertically incident on the surface of the light control film is transmitted. "Transmittance of 30° oblique light is not more than 20%" means that when the angle of the incident light to the surface of the film is 30°, the transmittance of the light is not more than 20%. Further, when this value varies in accordance with the direction of the incident light, the minimum transmittance should be not more than 20%. Still further, as mentioned below, it is possible to intentionally change the light transmittance from such oblique direction by varying the stripe width formed on the surface of a light control film in the upward or downward direction or in the right or left direction.

In regard to the silver image pattern prepared on a transparent support, either dots, stripes, a checkered pattern or a honeycomb pattern are acceptable.

In order to draw these patterns, methods may be preferably employed in which pattern exposure is carried out through a mask or a pattern is drawn employing laser beam exposure to form a latent image of these patterns.

The prepared latent image pattern is visualized through development and fixing followed by washing and drying, and thus a light control film can be prepared. As photographic processes, various types of modified processes, such as a monobath processing method, a washless method, etc. may be employed, if the transparency, storage stability, etc. are assured.

Silver halide emulsions employed for the silver salt photosensitive layer may be prepared employing any of several methods such as: acid methods, neutral methods, or ammonia methods. The grain size is preferably between 0.02 and 0.2 μm.

The silver halide grain of the emulsionmay be subjected to incorporation in the interior of the grain and/or on the surface of the grain, of water-soluble rhodium salts and water-soluble iridium salts which are added during the grain forming process. The added amount is preferably between 10^{-6} and 10^{-9} mole per mole of silver halide.

Furthermore, if desired, silver halide dissolving agents such as thioether, etc. or crystal habit control agents such as mercapto group-containing compounds or sensitizing dyes may be employed.

The silver halide grains may be those having a uniform silver halide composition distribution in the grain or core/shell grains having the silver halide composition of the interior of the grain different from that of the surface layer.

The shape of the silver halide grain is optional. One of the preferred examples is a cubic form having a (100) plane as the crystal surface. Furthermore, according to methods described in U.S. Pat. Nos. 4,183,756 and 4,225,666; Japanese Patent Publication Open to Public Inspection No. 55-26589; Japanese Patent Publication No. 55-42737, etc. and publications such as The Journal of Photographic Science, Volume 21, page 39 (1973), etc., octahedron, tetradecahedron, dodecahedron, etc. grains can be prepared and employed. Furthermore, grains having twin planes may also be employed.

The silver halide grains consisting of a single shape may be employed or a mixture of grains having various shapes are acceptable. Silver halide emulsions are individually prepared and two or more emulsions may be mixed and employed. Howeve, a monodispersed emulsion is preferably employed.

In regard to the monodispersed silver halide grains in the monodispersed emulsion, a silver halide weight contained in the range of ± 20% of the average grain size "r" is preferably not less than 60%, more preferably not less than 70%, and still more preferably not less than 80%.

The grain size herein designates, when the silver grain is spherical, the diameter, and when the silver grain is not spherical, the diameter of the circle obtained by converting the projected image to an equivalent circular area image.

The grain size may be obtained, for example, by enlarging the above-mentioned grain from 10,000 to 50,000 times employing an electron microscope and practically measuring the diameter of the circular grain image on a photographic print or calculating the diameter from the area of the projected grain image.

The particularly preferred high grade monodispersed emulsion exhibits a degree of monodispersibility of not more than 20 and more preferably not more than 15, which is defined by the following formula.

Degree of monodispersibility = standard deviation of grain size/average grain size

The monosispersed emulsion can be prepared in reference to Japanese Patent Publication Open to Public Inspection Nos. 54-48521, 58-49938, and 60-122935.

The photosensitive silver halide emulsion may undergo no chemical ripening and may be employed as being a so-called primitive emulsion. However, the emulsion generally undergoes chemical ripening.

Employed for the chemical sensitization, can be methods described in books written by Glafkides or Zelikman et al., or "Die Grundlagen der Photographischen Prozesse mit Silberhalogeniden", Editor, Frieser, Akademische Verlagsgesellschaft, 1968.

Namely, the following methods can be employed: sulfur sensitization utilizing compounds comprising sulfur capable of reacting with silver ions and active gelatin; reduction sensitization utilizing reducing compounds; and a method utilizing gold and other noble metal compounds. In the sulfur sensitization, thiosulfate salts, thioureas, thiazoles, rhodanines and other compounds can be employed. These specific examples are described in U.S. Pat. Nos. 1,574,944, 2,410,689, 2,278,947, 2,728,668, and 3,656,955. Employed as the reduction sensitizers, can be stannous salts, amines, hydrazine derivatives, formamidisulfinic acid, silane compounds, etc. These specific examples are described in U.S. Pat. Nos. 2,487,850, 2,419,974, 2,518,698, 2,983,609, 2,983,610, and 2,694,637. For the noble metal sensitization, in addition to gold complexes, complexes of metals such as platinum, iridium, palladium, etc. in Periodic Table VII Group can be employed. These specific examples are described in U.S. Pat. Nos. 2,399,083, 2,448,060, and U.K. Patent No. 618,061, etc.

Furthermore, conditions of pH, pAg, temperature, etc. are selected arbitrary. The pH is preferably kept to be between 4 and 9; more preferably between 5 and 8, while pAg is kept to be between 5 and 11, and preferably between 7 and 9. Furthermore, the desirable temperature is between 40 and 90 °C and preferably between 45 and 75 °C.

The photographic emulsion may undergo combinations of the above mentioned sulfur sensitization, gold-sulfur sensitization, reduction sensitization employing reducing compounds, noble metal sensitization, employing noble metals, etc.

In the embodiments of the present invention, after the above-mentioned chemical sensitization, there may be employed various stabilizers such as, for example, 4-hydroxy-6-methyl-1,3,3a,7-tetraazaindene, 5-mercapto-1-phenylterazole, 2-mercaptobenzothiazole, etc.

The emulsion may be subjected to either removal or retention of unnecessary water-soluble salts after completing the growth of silver halide grains. The removal of the above-mentioned salts can be carried out based on the method described in Research Disclosure No. 17643.

In order to prevent the decrease in sensitivity and prevent the formation of fog during production process, storage and processing of silver halide light-sensitive photographic materials, various additive can be added to the photographic emulsion. Namely, there may be added various compounds known as stabilizers such as, azoles, for example, benzothiazolium salts; nitroindazoles; triazoles; benzotriazoles; benzimidazoles (especially, nitro- or halogen substituents); heterocyclic mercapto compounds such as, for example, mercaptothiazoles; mercaptonenzimidazoles; mercaptotetrazoles (especially, 1-phenyl-5-mercaptotetrazole); mercaptopyridines; the above-mentioned heterocyclic compounds having a water-soluble group such as a carboxyl group, a sulfone group, etc.; mercapto compounds; thioketo compounds such as, for example, oxazolithion; azaindenes such as, for example, tetraazaindenes (especially, 4-hydroxy substituted (1,3,3a,7)tetraazaindenes); benzenethiosulfonic acids; benzenesulfinic acid; etc.

One example of the employable compound is described in K. Mees, "The Theory of the Photographic Process", Third Edition, 1966 in which original references are cited. In regard to more detailed specific examples and other application methods on these compounds, descriptions in U.S. Pat. Nos. 3,954,474, 3,982,947, 4,021,248 or Japanese Patent Publication No. 52-28660 can be referred to.

Furthermore, the light control film can be comprised, in a photographic constitution layer, of alkylacrylate series latex described in U.S. Pat. Nos. 3,411,911, 3,411,912 and Japanese Patent Publication No. 45-5331.

The silver salt photosensitive layer may be comprised of various kinds of additives such as mentioned below. Thickening agents or plasticizers include, for example, styrene-sodium maleate copolymers, dextran sulfate, etc. which are, for example, described in U.S. Pat. No. 2,960,404; Japanese Patent Publication No. 43-4939; West German Patent Publication No. 1,904,604; Japanese Patent Publication Open to Public Inspection No. 48-63715; Belgian Patent No. 762,833; U.S. Pat. No. 3,767,410; Belgian Patent No. 588,143. Hardening agents include various types of hardening agents such as the aldehyde series, epoxy series, ethyleneimine series, active halogen series, vinylsulfone series, isocyanate series, sulfonic acid ester series, carbodiimide series, mucochloric acid series, acyloyl series, etc. UV absorbers include compounds described in, for example, U.S. Pat. No. 3253,921 and U.K. Patent No. 1,309,349, such as, particularly, 2-(2'-hydroxy-5-tertiarybutylphenyl)benzotriazole, 2-(2'-hydroxy-3',5'-ditertiarybutylphenyl)benzotriazole, 2-(2-hydroxy-3'-tertiarybutyl-5'-butylphenyl)-5-chlorobenzotriazole, 2-(2'-hydroxy-3',5'-di-tertiarybutylphenyl)-5-chlorobenzotriazole, etc. Surface active agents employed as coating aids, emulsifying agents, penetration improving agents for processing solutions etc., anti-forming agents, or agents employed to improve various physical properties of photosensitive materials include anionic, cationic, nonionic or amphoteric compounds described in U.K. Patent Nos. 548,532, and 1,216,389; U.S. Pat. Nos. 2,026,202 and 3,514,293; Japanese Patent Publication Nos. 44-26580, 43-17922, 43-17926, 43-3166, and 48-20785; French Patent No. 202,588; Belgian Patent No. 773,459; Japanese Patent Publication Open to Public Inspection No. 48-101118, etc., and of these, particularly, anionic surface active agents having a sulfonic group, for example, succinic acid ester sulfonic compounds, alkylbenzenesulfonic compounds, etc. are preferred. Antistatic agents include compounds described in Japanese Patent Publication No. 46-24159; Japanese Patent Publication Open to Public Inspection No. 48-89979; U.S. Pat. Nos. 2,882,157 and 2,972,535; Japanese Patent Publication Open to Public Inspection Nos. 48-20785, 48-43130, and 48-90391; Japanese Patent Publication Nos. 46-24159, 46-39312, 48-43809, and 47-33627.

In the light control film production method, the pH of the coating composition is preferably 5.3 to 7.5. In the case of a multilayer coating, the pH of the coating composition prepared by mixing each coating composition in the ratio of the coated amounts is preferably 5.3 to 7.5, in view of suitable speed of hardening and desirable photographic performance.

The layer of the light control film may comprise lubricants such as, for example, higher aliphatic higher alcohol esters described in U.S. Pat. Nos. 2,588,756, and 3,121,060; casein described in U.S. Pat. No. 3,295,979; higher aliphatic calcium salts described in U.K. Patent No. 1,263,722; silicone compounds described in U.K. Patent No. 1,313,384, and U.S. Pat. Nos. 3,042,522 and 3,489,567. Liquid paraffin dispersion and the like may be employed for this purpose.

The light control film can furthermore comprise various additives in order to meet the specified requirements. These additives are described in more detail in Research Disclosure (RD) Volume 176, Item 17643 (December 1978) and Volume 187, Item 18716 (November 1979). The corresponding items are summarized below.

Type of Additives	RD Item 17643	RD Item 18716
1. Chemical Sensitizers	page 23	page 648 right column
2. Sensitizers		page 648 right column
3. Spectral Sensitizers, Super Sensitizers	pages 23-24	page 648 right column - page 649 right column
4. Brighteners	page 24	
5. Antifoggants and Stabilizers	pages 24-25	page 649 right column
6. Light Absorbing Agents, Filter Dyes, UV Absorbers	pages 25-26	page 649 right column - page 650 left column
7. Stain Inhibiting Agents	page 25 right column	page 650 left column - right column
8. Dye Image Stabilizing Agents	page 25	
9. Hardeners	page 26	page 651 left column
10. Binders	page 26	page 651 left column
11. Plasticizers, Lubricants	page 27	page 650 right column
12. Coating Aids, Surface Active Agents	pages 26-27	page 650 right column
13. Antistatic Agents	page 27	page 650 right column

The light control film exposed to image pattern is processed in usual developing process and various methods can be employed. It is processed at generally 18 to 50 °C.

As preferable examples of developing agent used in the black and white developer, dihydroxybenzens (e.g. hydroquinone), 3-pyrazolidones (e.g. 1-phenyl-3-pyrazolidone), aminophenols (e.g. N-metyl-p-aminophenol), etc. can be employed individually or in combination.

The silver salt photosensitive layer can be constituted with at least one silver halide emulsion layer on a transparent support, and other suitable layers, if desired, for example, a protective layer, etc., on the silver halide emulsion layer.

In the silver salt photosensitive layers, a backing layer comprising a light-absorbing dye can be provided on the reverse surface of the silver halide emulsion layer. The light-absorbing dye can be selected from optional dyes.

In the photographic processing of the silver salt photosensitive layer, the layer can be processed by a developer comprising any of imidazoles as a silver halide-dissolving agent. Furthermore, it can be processed by a developer comprising additives such as indazole, triazole, etc., together with the silver halide-dissolving agent. In addition to these, the developer generally comprises various types of preserving agents, alkali agents, pH buffering agents, antifoggants, etc. and further, may comprise dissolving aids, toning agents, development accelerators, surface active agents, antifoaming agents, water softeners, hardeners, thickeners, etc., if desired.

Furthermore, a so-called "lith type" photographic processing can be carried out. As the special system of the photographic processing, a developing agent is incorporated in a photosensitive material, for example in an emulsion layer, and development may be carried out employing an aqueous alkali solution. Of developing agents, hydrophobic ones can be incorporated in the emulsion layer employing methods described in Research Disclosure Item 169, etc. Such development processing may be combined with a silver salt stabilizing processing utilizing thiocyanate salts.

As a fixer, those having compositions used in general practices can be employed. The fixer may comprise water-soluble aluminum salts as a hardening agent.

Exposure on the photographic emulsion depends on the chemical sensitization status, purposes, etc. Many types of light sources are adequately employed such as tungsten lamps, fluorescent lamps, arc lamps, mercury lamps, xenon sun light lamps, xenon flash lamps, cathode-ray tube flying spot, laser beam sources, electron beam tubes, X-ray tubes, fluorescent screens used for X-ray exposure, and the like.

Ordinary exposure time is between 1/1,000 to 100 seconds. In addition, short exposure time between $1/10^{-4}$ and $1/10^{-9}$ is available with xenon flash lamps, cathode ray tubes, and laser beam sources.

EXAMPLES

In the following, the present invention is explained in detail with reference to Examples.

Example 1

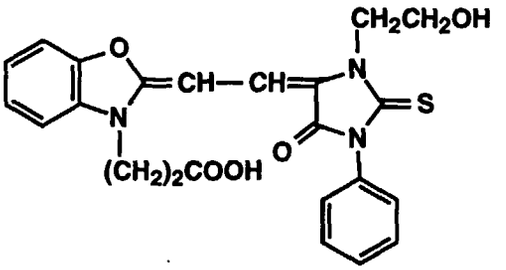
(Preparation of the Emulsion Layer Coating Composition)

A Lippmann type silver halide emulsion with an average grain size of 0.05 μm, composed of 4 mole percent silver iodide and 96 mole percent silver bromide underwent physical ripening and salt removal according to a conventional method and underwent chemical ripening with the addition of 1.0×10^{-4} mole of sodium thiosulfate and 1.0×10^{-4} mole of chloroauric acid per mole of Ag at 60 °C for 60 minutes. An emulsion layer coating composition was prepared by the addition of 500 mg of S-1 as a sensitizing dye per mole of Ag; 1.0 g and 0.2 g of F-1 and F-2 respectively as antiirradiation agents per mole of Ag; 10 mg and 1 g of H-1 and H-1 respectively as hardeners per g of gelatin; 2 g of 4-hydroxy-6-methyl-1,3,3a,7-tetraazaindene as a stabilizer per mole of Ag; 200 mg of 1-phenyl-5-mercaptotetrazole as an antifoggant per mole of Ag; 2 g of C-1 as a surface active agent per mole of Ag, and a polymer latex.

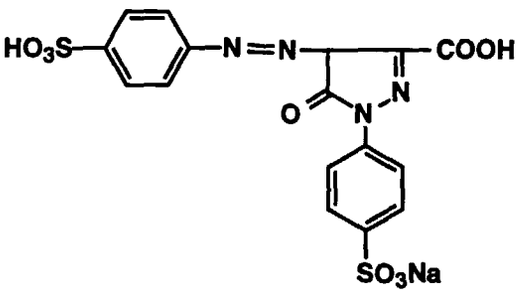
(Preparation of the Backing Composition)

Compound B	40 g
Dye F-3	10 g
Ethanol	900 ml

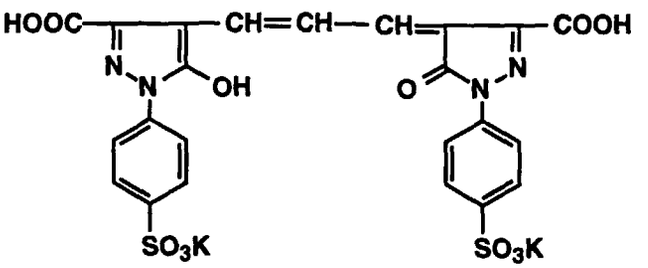
S–1



F–1



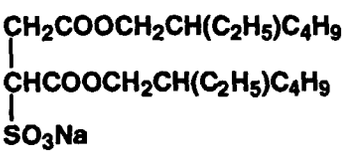
F–2



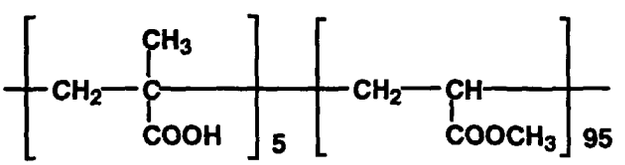
H–1

$(CH_2=CH-SO_2CH_2)_3-C-(CH_2SO_2CH_2CH_2)_2NCH_2CH_2SO_3$

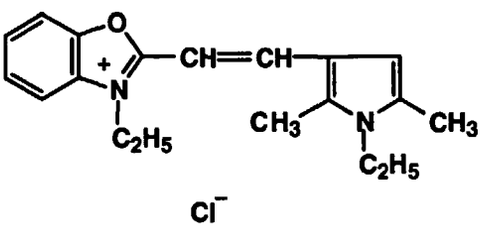
C–1



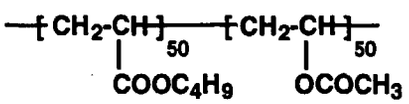
Compound B



Dye F-3



Polymer latex



(Preparation of the Support)

Coating of the Backing Layer

The backing layer was formed by coating the backing composition on an acrylic substrate plate (PMMA plate) of a thickness of 1 mm employing a napkin coater so as to obtain a thickness of 8 μm.

(Coating of the Emulsion Layer)

The emulsion coating composition was coated employing a curtain coater so as to obtain a dry thickness of 30 μm, while controlling the emulsion layer thickness. Further, prior to coating of the emulsion layer, a latex subbing composition was coated as an anchor layer.

The resulting sample was brought into contact with a chrome plate negative original having a line pattern with a line width of 5 μm and lines spaced at 15 μm so that the line width of each surface becomes 1 : 1; was subjected to contact exposure employing a Dark-room Printer P-605 (manufactured by Dainippon Screen Seizo Co., Ltd.), and was processed under the conditions listed below. After drying, a tomographic picture was taken employing an electron microscope and the layer thickness was measured.

(Processing Conditions)

As a developer, CDH-100, and as a fixer, CFL-881 (both manufactured by Konica Corp.) were employed. A 3% acetic acid solution was employed as a stop bath.

Step	Temperature (°C)	Time (seconds)
Development	20	300
Stop	20	30
Fix	20	180
Wash	Room temperature	600 (10 minutes)

The structure of the resulting light control film was as shown in Fig. 1 (Fig. 1 (a) is a sectional view and Fig. 1 (b) is a top view). Stripes, composed of silver image with a line width of 5 μm and a depth of 30 μm, were regularly arranged

at an interval of 15 μm.

In Fig. 1(a) and Fig. 1(b) numeral 1 is a silver image; 2 is a transparent support of a PMMA plate (1 mm thickness); 3 is a backing layer, and 4 is an anchor layer.

Furthermore, the properties of this light control film were as follows.

The transmittance of vertical incident light at a 90° angle to the support was 60%, while the transmittance of oblique light at a 30° angle to the support was 1%.

Fig. 2 shows the relationship between a light incident angle to the 90° direction (vertical direction in Fig. 1) against the stripe of the above-mentioned light control film and the resultant light transmittance.

Based on the above results, it has been found that the light control film having a striped silver image is readily prepared by forming a silver salt photosensitive layer on a support followed by exposure through a striped original and development.

Example 2

A silver salt photosensitive layer was coated on a transparent support and dried in the same manner as for Example 1. The resulting sample was exposed and processed in the same manner as for Example 1, except that instead of the striped original employed in Example 1, a negative original of a checkered pattern having a line width of 5 μm and a lines spaced at 15 μm, shown in Fig. 3, was employed, and a light control film having a checkered pattern silver image was thereby prepared.

Fig. 4(a) and 4(b) shows the relationships between light transmittance in the vertical direction and in the horizontal direction of the checkered type light control film and the light incident angles.

Based on the above results, it is found that when a checkered pattern original is employed, a light control film having a checkered pattern silver image is prepared which can readily vary the light transmittance in the vertical direction and the horizontal direction.

Example 3

A silver salt photosensitive layer was coated on a transparent support and dried in the same manner as for Example 1. The resulting sample was exposed and processed in the same manner as for Example 1, except that instead of the striped original employed in Example 1, a negative original of a dot pattern shown in Fig. 5, was employed, and a light control film having a dot pattern silver image was thereby prepared.

Figs. 6(a) and 6(b) show the relationships between light transmittance in the vertical direction and in the horizontal direction of the dot type light control film and the light incident angles, respectively.

Example 4

A silver salt photosensitive layer was coated on a transparent support and dried in the same manner as for Example 1. The resulting sample was exposed and processed in the same manner as for Example 1, except that instead of the striped original employed in Example 1, a negative original of a honeycomb pattern shown in Fig. 7, was employed, and a light control film having a honeycomb pattern silver image was thereby prepared.

Figs. 8(a) and 6(b) show the relationships between light transmittance in the vertical direction and in the horizontal direction of the honeycomb type light control film and the light incident angles, respectively.

Example 5

A silver salt photosensitive layer was coated on a transparent support and dried in the same manner as for Example 1. The resulting sample was exposed and processed in the same manner as for Example 1, except that instead of exposing through chrome plate negative original employing a Dark-room Printer P-605, stripes were exposed by a semi-conductor laser KX-J4012 (manufactured by Matsushita Electric Co., Ltd.) to obtain a light control film having stripes.

The similar a light control film having stripes was obtained by employing He-Ne laser GENASET (manufactured by Dainippon Screen Seizo Co., Ltd.), as an exposing means instead of the semi-conductor laser.

Based on the above results, it is found that when a checkered pattern original is employed, a light control film having a checkered pattern silver image is prepared which can readily vary the light transmittance in the vertical direction and the horizontal direction.

The present invention can provide a light control film which (1) is readily produced; (2) is excellent in mechanical strength; (3) is excellent in shielding predetermined incident light and gives a clear facing scene observed through transmission; (4) enables the formation of dots, stripes, checkered or honeycomb pattern, and also a production

method of the same.

Claims

1. A light control film comprising a transparent support and a layer having silver image.

2. The light control film of Claim 1 wherein the silver image is dots, stripes or a checkered pattern or a honeycomb pattern.

3. The light control film of Claim 2 wherein the silver image is stripes or a checkered pattern.

4. The light control film of Claim 1, 2 or 3, wherein the silver image is formed by developing light sensitive silver salt.

5. The light control film of Claim 4 wherein the light sensitive silver salt is light sensitive silver halide.

6. The light control film of Claims 1 to 5, wherein transmittance of vertical incident light is not less than 40 % and transmittance of 30° oblique light is not more than 20 %.

7. A preparation method of a light control film comprising

   imagewise exposing a silver halide light sensitive material, and
   developing, and fixing the exposed silver halide light sensitive material.

8. The method of Claim 7, wherein image is exposed through pattern mask.

9. The method of Claim 7 or 8, wherein image is exposed by means of laser light.

FIG. 1 (a)

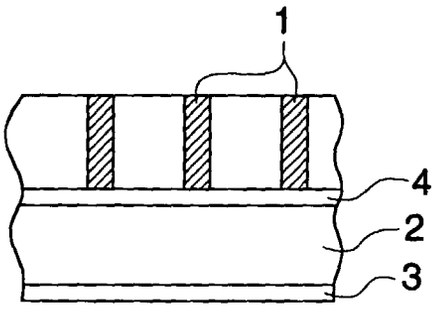


FIG. 1 (b)

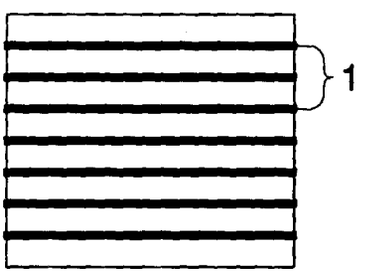


FIG. 2

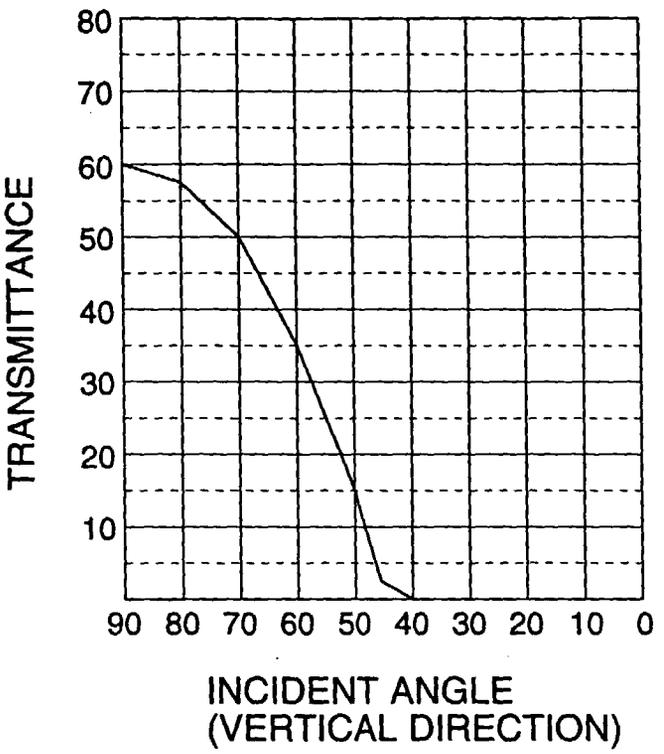

TRANSMITTANCE
80
70
60
50
40
30
20
10
90 80 70 60 50 40 30 20 10 0
INCIDENT ANGLE
(VERTICAL DIRECTION)

FIG. 3

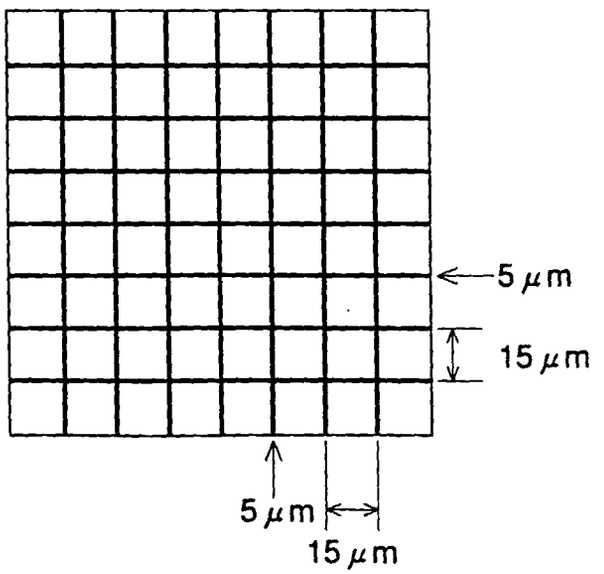

5 μm
15 μm
5 μm
15 μm

FIG. 4 (a)

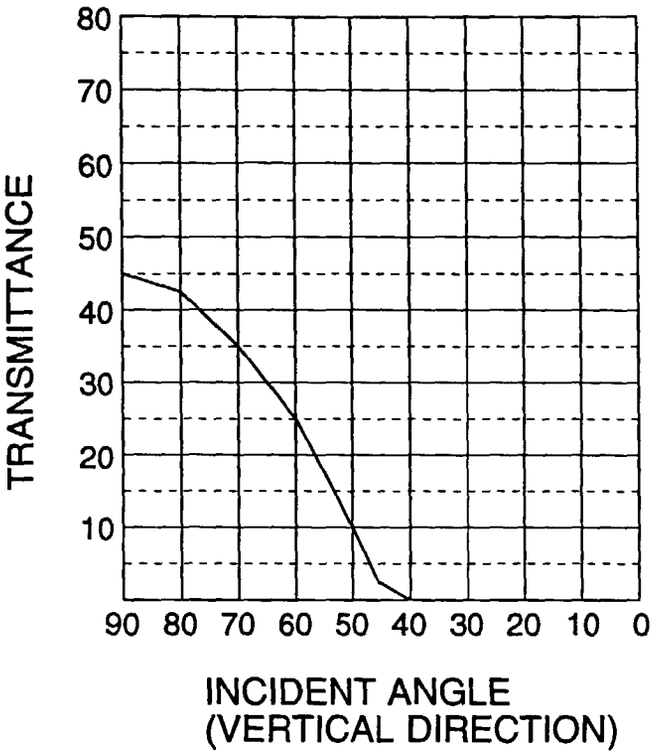

TRANSMITTANCE
80
70
60
50
40
30
20
10
90 80 70 60 50 40 30 20 10 0
INCIDENT ANGLE
(VERTICAL DIRECTION)

FIG. 4 (b)

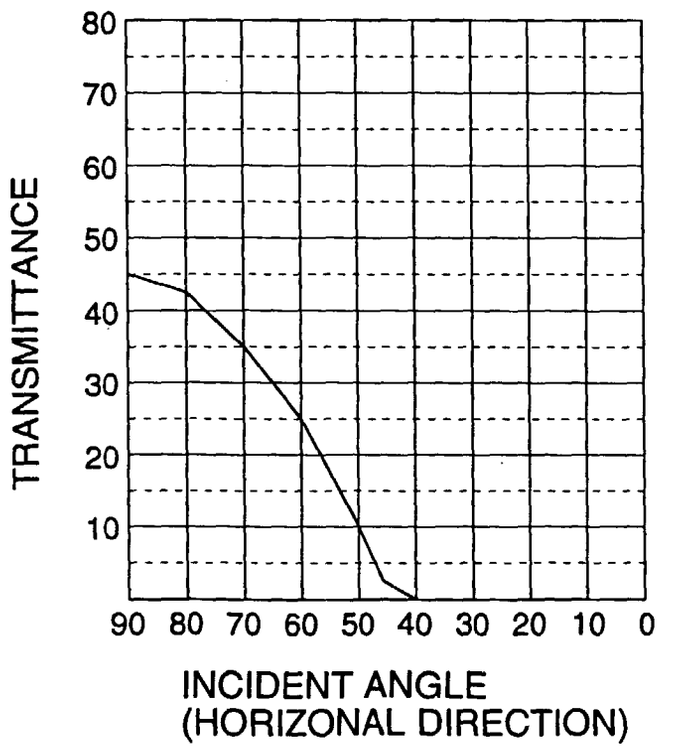

TRANSMITTANCE
80
70
60
50
40
30
20
10
90 80 70 60 50 40 30 20 10 0
INCIDENT ANGLE
(HORIZONAL DIRECTION)

FIG. 5

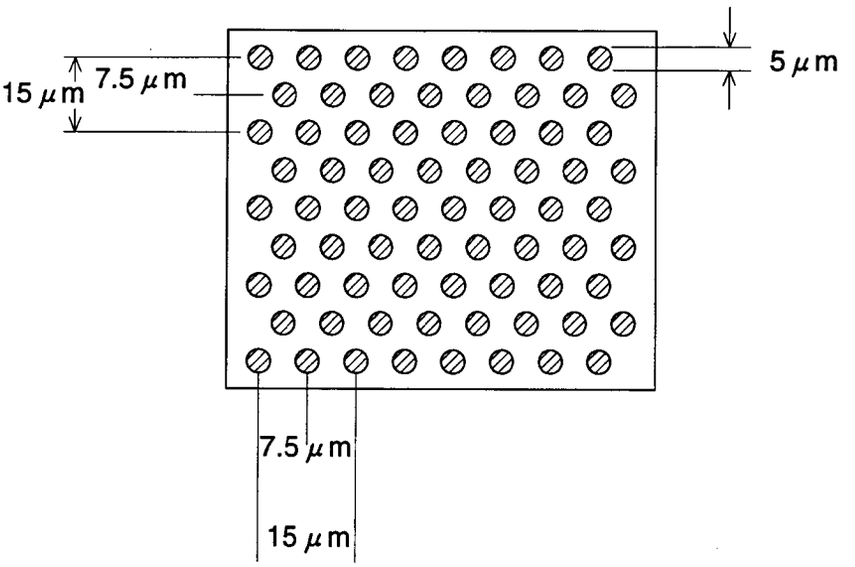


FIG. 6 (a)

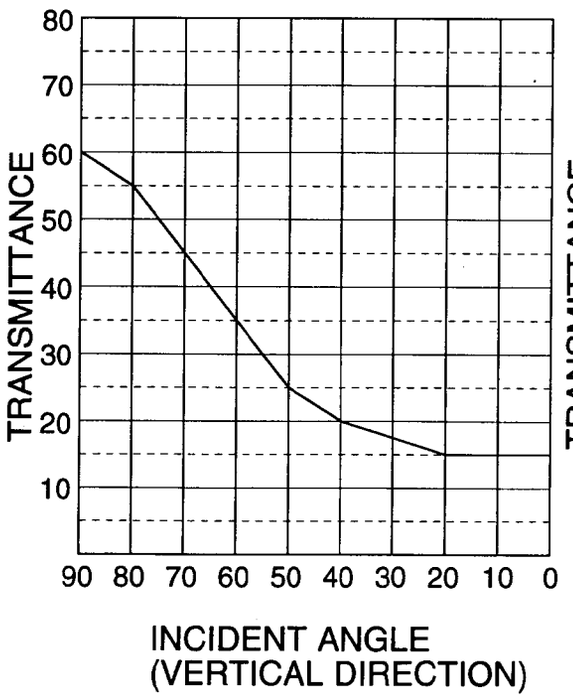


FIG. 6 (b)

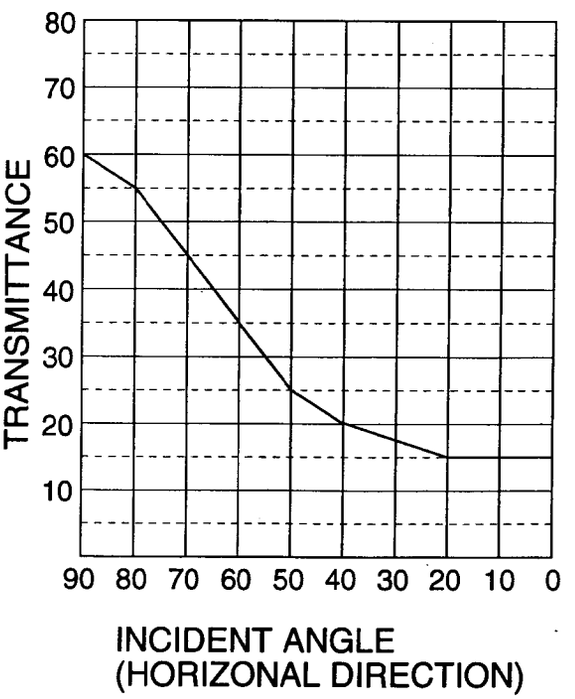


FIG. 7

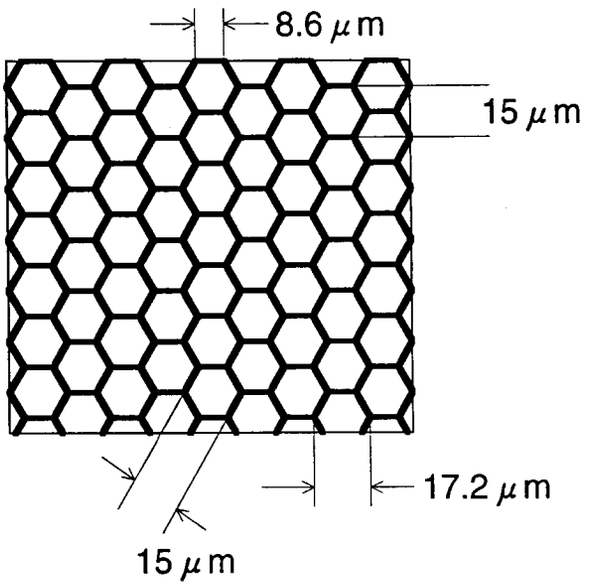


FIG. 8 (a)

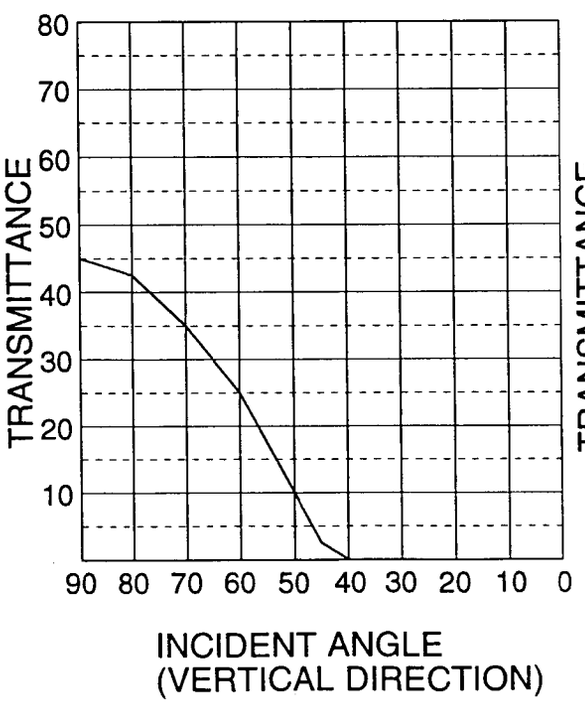
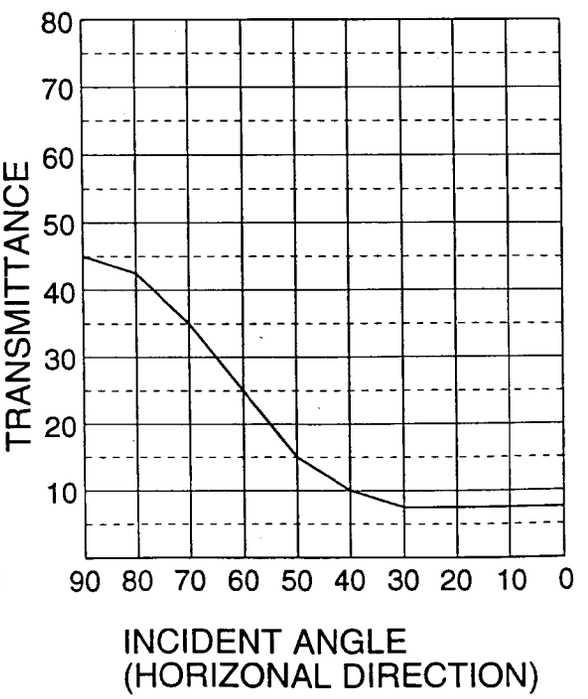


FIG. 8 (b)



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 11 1793

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	FR 2 534 032 A (THOMSON-CSF) 6 April 1984 * page 3, line 23 - page 4, line 4 * * page 4, line 27 - page 5, line 20 * * page 6, line 21 - line 28 * * page 7, line 10 - line 13; figures 1,3 *	1-8 9	G03C7/12 H01J29/89
X Y	US 3 037 419 A (NIXON) 5 June 1962 * column 1, line 20 - line 30 * * column 2, line 45 - line 57; claims 1-3; figure 1 *	1-7 9	
X	FR 2 366 688 A (SIEMENS) 28 April 1978 * claim *	1,4,5,7	
X	GB 2 188 446 A (SLETTEMOEN) 30 September 1987 * claims 1,6,8; figure *	1,4,5,7	
Y	EP 0 615 161 A (AGFA-GEVAERT) 14 September 1994 * page 2, line 24 - line 25 * * page 5, line 22 - line 31 * * page 8, line 8 - line 11 * * page 9, line 13 - line 14; claim 1 *	9	TECHNICAL FIELDS SEARCHED (Int.Cl.6) G03C H01J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	6 October 1998	Magrizos, S

CATEGORY OF CITED DOCUMENTS

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