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(54) Title: METHOD FOR MANUFACTURING A DISC-LIKE INFORMATION MEDIUM

(57) Abstract: The present invention provides a method for producing a disc-like information medium which comprises a printable layer having a base layer and a colorant-receiving layer on a substrate, comprising: providing the base layer on the substrate; and providing the colorant-receiving layer by applying a coating solution which comprises a particle, a binder and a cross-linking agent and has a liquid temperature of from 20 to 40°C on the base layer and, drying the thus-applied coating solution at from 2 to 25°C in the stated order, in which a viscosity of the coating solution at a liquid temperature at the time of coating is from 60 to 600 mPas and the viscosity thereof at a drying temperature is from 0.5 to 100 Pas.



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DESCRIPTION

METHOD FOR MANUFACTURING A DISC-LIKE INFORMATION MEDIUM

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a method for manufacturing a disc-like information medium provided with a printable layer on which characters and photographs can be printed.

Description of the Related Art

CDs (compact discs) and DVDs (digital versatile discs) are widely accepted as standardized information recording media in the marketplace.

Examples of CDs include CD-ROMs from which information can only be read, write-once type CD-Rs on which information is capable of being recorded only once, and rewritable CD-RWs on which information be rewritten numerous times.

The CD-ROMs have, for example, a structure in which a row of pits are formed at a track pitch of 1.6 μm on a transparent substrate having a diameter of 120 mm and a thickness of 1.2 mm, and have a recording capacity of about 650 MB. Information can be reproduced by irradiating the CD-ROMs with laser light having a wavelength of 770 to 790 nm at a constant linear velocity of 1.2 to 1.4 m/s.

The DVDs include DVD-ROMs, DVD-Rs, and DVD-RWs similarly to the CDs.

The DVD-ROMs have a recording density about 6 to 8 times that of the CDs and have, for example, a structure in which two substrates having a thickness of about 0.6 mm are applied to each other, wherein, for example, pits are formed at a track pitch of 0.74 μm and information can be reproduced by irradiating the DVD-ROMs with

laser light having a wavelength of 635 to 650 nm at a constant linear velocity of about 3.5 m/s.

In recent years, as disclosed in JP-A No. 2002-25671, in these CDs and DVDs, an information medium in which a printable layer is formed on a face opposite to a face on which information is reproduced such that printing of an image can be performed by an inkjet printer has been developed. In the printable layer of the information medium, an ultraviolet-curable resin is ordinarily used. However, there has been a problem in that an image of high image quality can not be obtained in the printable layer containing the ultraviolet-curable resin compared with a sheet for inkjet recording.

On the other hand, in order to achieve the high image quality, a printable layer provided with a same colorant-receiving layer as that of the sheet for the inkjet recording is proposed. In such printable layer as described above, a base layer of high opacity is interposed between the colorant-receiving layer and the disc substrate.

Such colorant-receiving layer as described above can be obtained by applying a coating solution containing a prescribed component on the base layer and, drying the thus-applied coating solution. On this occasion, properties of the coating solution give influences on a handling property, a coating aptitude and a drying property and become factors which not only give influences on productivity, but also give influences on surface features of the colorant-receiving layer to be formed; therefore, from the viewpoint of enhancing, productivity, surface features of the colorant-receiving layer, optimization of the properties of the coating solution has been required.

However, it is a present situation that satisfactory properties of the coating solution have not yet been proposed.

Although the high image quality can be attained by allowing the colorant-receiving layer to be present in such printable layer as described above, a dyeing extent of an ink varies depending on a condition of a surface of the colorant-receiving layer and, then, there is a problem in that unevenness of quality is locally generated.

SUMMARY OF THE INVENTION

According to the present invention, a method for producing a disc-like information medium which not only can perform printing of high quality but also can produce with high productivity the disc-like information medium containing a printable layer having a colorant-receiving layer which is excellent in a surface feature can be provided.

Further, according to the invention, a method for producing a disc-like information medium provided with a printable layer in which a colorant-receiving layer is excellent in a surface feature and capable of producing a uniform print of a high image quality can be provided.

A first aspect of the invention is to provide a method for producing a disc-like information medium which comprises a printable layer having a base layer and a colorant-receiving layer on a substrate, involving the steps of: providing the base layer on the substrate; and providing the colorant-receiving layer by applying a coating solution which comprises a particle, a binder and a cross-linking agent and has a liquid temperature of from 20 to 40°C on the base layer and, then, drying the applied coating solution at from 2 to 25°C, wherein the viscosity of the coating solution at a liquid temperature at the time of coating is from 60 to 600 mPa·s and the viscosity thereof at a drying temperature is from 0.5 to 100 Pa·s.

A second aspect of the invention is to provide a method for producing a disc-like information medium which comprises a printable layer having a base layer and a colorant-receiving layer on a substrate; providing the base layer on the substrate; and providing the colorant-receiving layer by applying a coating solution which comprises a particle, a binder and a cross-linking agent on the base layer and, drying the thus-applied coating solution at 15°C or less.

DETAILED DESCRIPTION OF THE INVENTION

A first production method of a disc-like information medium of the present invention is a method for producing a disc-like information medium which comprises a printable layer having a base layer and a colorant-receiving layer on a substrate, comprising; providing the base layer on the substrate (hereinafter, referred to also as “base layer forming step”); and providing the colorant-receiving layer by applying a coating solution which comprises a particle, a binder and a cross-linking agent and has a liquid temperature of from 20 to 40°C on the base layer and, then, drying the thus-applied coating solution at from 2 to 25°C (hereinafter, referred to also as “colorant-receiving layer forming step”) in the stated order, in which a viscosity of the coating solution at a liquid temperature at the time of coating is from 60 to 600 mPa·s and the viscosity thereof at a drying temperature is from 0.5 to 100 Pa·s.

In the first production method of a disc-like information medium of the present invention, in the colorant-receiving layer forming step, it is that, after the coating solution containing the particle, the binder and the cross-linking agent on the base layer and having a liquid temperature of from 20 to 40°C is applied, it is required to be dried at from 2 to 25°C and, also, the viscosity of the coating solution to be used on this occasion at the liquid temperature at the time of coating is from 60 to 600

mPa·s and the viscosity of thereof at a drying temperature is from 0.5 to 100 Pa·s.

Namely, in the first production method of the present invention, in a case of the colorant-receiving layer forming step in which the liquid temperature of the coating solution at the time of coating is 25°C and the drying temperature thereof is 5°C, it is essential to use the coating solution in which the viscosity at 25°C is in the range of from 60 to 600 mPa·s while the viscosity at 5°C is in the range of from 0.5 to 100 Pa·s.

As described above, according to the first production method according to the invention, in the colorant-receiving layer forming step, the coating solution having a liquid temperature of from 20 to 40°C is applied on the base layer and, then, dried at such a low temperature as being from 2 to 25°C, it is characterized that the coating solution exhibiting the above-described properties is used. Namely, the coating solution increases the viscosity thereof along the passage of steps of from coating to drying.

Since the coating solution in the first production method according to the invention is relatively low in viscosity at the time of coating, it is possible to enhance a handling property or a coating aptitude at the time the coating solution is transferred. Further, since the viscosity of the coating solution is increased at the time of drying, a drying property can be enhanced. Still further, since flowability of a coated film is reduced, transportation is easily performed. Even still further, in a process of such viscosity increase, a leveling mechanism is realized and, then, the surface feature of the colorant-receiving layer can be enhanced. Accordingly, the productivity in the colorant-receiving layer forming step is enhanced and, as a result, the productivity of the information medium itself can also be enhanced.

On the other hand, when the viscosity of the coating solution at the liquid

temperature at the time of coating is apart from the range of from 60 to 600 mPa·s, in a case in which the viscosity thereof is unduly low, it is necessary to repeat coating thereof in order to form a coated film with a predetermined thickness and, further, a problem of creeping of the coating solution to a reverse side is generated. On the other hand, in a case in which the viscosity thereof is unduly high, a leveling mechanism is not sufficiently realized and, then, a favorable surface feature can not be obtained.

When the viscosity of the coating solution at the drying temperature is apart from the range of from 0.5 to 100 Pa·s, in a case in which the viscosity thereof is unduly low, the coated face is not sufficiently set (immobilized) and, then, apt to be influenced by outside factors such as a drying wind at the time of drying and, accordingly, the surface feature is disturbed and a favorable surface feature can not be obtained. On the other hand, in a case in which the viscosity is unduly high, due to a volume change caused by a rapid drying, defects such as cracking may be generated during drying.

A second production method of a disc-like information medium according to the present invention, which is a method for producing a disc-like information medium which comprises a printable layer having a base layer and a colorant-receiving layer on a substrate, is characterized by involving the step of providing the base layer on the substrate (hereinafter, referred to also as “base layer forming step”); and the step of providing the colorant-receiving layer by applying a coating solution which comprises a particle, a binder and a cross-linking agent on the base layer and, drying the thus-applied coating solution at 15°C or less (hereinafter, referred to also as “colorant-receiving layer forming step”) in the stated order.

In the second production method of a disc-like information medium according

to the present invention, in the colorant-receiving layer forming step, it is that, after the coating solution containing the particle, the binder and the cross-linking agent is applied, it is dried at 15°C or less. Ordinarily, since the temperature of the coating solution at the time of coating is about 25°C, room temperature, the viscosity of the coating solution (coated film) becomes increased by drying at a temperature of 15°C or less. In the course of such viscosity increase, a leveling mechanism is realized in the coated film, to thereby allow the surface thereof to be uniform. Further, by increasing the viscosity of the coated film, there are effects in that rapid drying becomes possible and transportation thereof is facilitated.

On the other hand, when the coating solution is applied and, then, dried at a temperature higher than 15°C, since a solvent in the coated film is rapidly evaporated, there causes a problem in that defects such as cracks are generated.

Hereinafter, the base layer forming step and the colorant-receiving layer forming step are described in detail in the stated order.

Base layer forming step

In the present step, a base layer is provided on a substrate. The term “substrate”, on which the base layer is provided on this occasion, as used herein is denoted as a member having a face on which a printable layer is provided and such members differ from one another depending on types of information media and may be a substrate, a dummy substrate (protective substrate) or a protective layer depending on circumstances.

As for the base layer according to the invention, in a case in which opacity is increased, the base layer can have a diffusion property close to that of paper and have an enhanced image quality; therefore, this case is preferred. Particularly, when a white base layer is provided, a color reproduction can be enhanced. Further, when

the base layer is allowed to have a highly gloss property, a photograph having a high-gloss finish can be obtained, while, when the base layer is allowed to have a highly matte property, a photograph having a high-matte finish can be obtained. When various types of colors are imparted in the base layer, images having various types of impressions can be formed. Further, the base layer is provided with a fluorescent property, the base layer can have a fluorescent image.

Although there is no particular limitation to a method of forming such a base layer, it is preferable to form a radiation-curable resin (specifically, e.g., an ultraviolet curable ink) by screen printing from the viewpoint of productivity. The radiation-curable resin is one cured by an electromagnetic wave such as ultraviolet rays, electron beams, X-rays, γ -rays or infrared rays. Among these radiation rays, ultraviolet rays and electron beams are preferable as the radiation. The thickness of the base layer is preferably 0.1 to 100 μm , more preferably 1 to 50 μm , and most preferably 3 to 20 μm .

Colorant-receiving layer forming step

In the present step, a colorant-receiving layer containing a particle, a binder and a cross-linking agent is provided on the base layer obtained in the aforementioned base layer forming step.

Firstly, individual components composing the colorant-receiving layer according to the present invention are described and, then, a method for forming the colorant-receiving layer using any one of such components is described.

The colorant-receiving layer according to the present invention is, as described above, formed from the coating solution containing the particle, the binder and the cross-linking agent. The coating solution may optionally further contain any one of a compound represented by the following formula (1), a compound represented

by the following formula (2), various types of additives and the like:

Particle

As mentioned above, the coating solution for forming the colorant-receiving layer according to the invention includes particles. Examples of the particles include a vapor-phase-process silica, pseudo boehmite, aluminum oxide, titanium dioxide, barium sulfate, calcium silicate, zeolite, kaolinite, halloysite, mica, talc, calcium carbonate, magnesium carbonate, calcium sulfate and boehmite. Among these particles, a vapor-phase-process silica, pseudo boehmite and aluminum oxide are preferable.

Vapor-phase-process silica

Silica particles are roughly classified into wet method particles and dry method (vapor phase method) particles in general by its production method. In the wet method, a method in which a silicate is decomposed by an acid to produce active silica, the active silica is then moderately polymerized, and the polymerized silica is aggregated and precipitated to obtain hydrated silica is mainly used. As the vapor phase method which are currently and dominantly used, there are a method in which a silicon halide is subjected to high-temperature vapor phase hydrolysis (flame hydrolysis method), and a method (arc method) in which quartz sand and cokes are heated, reduced and vaporized by an arc in an electric furnace and the vaporized materials are oxidized with air. The "vapor-phase-process silica" means silica anhydride particles obtained by the vapor phase method.

The vapor-phase-process silica is suitable to form a three-dimensional structure having high percentage of void, though it is different from hydrated silica in density of silanol groups on the surfaces of particles and presence or absence of voids, and exhibits properties different from those of hydrated silica. The reason for this is

not clarified, but is thought as follows. In the case of hydrated silica, the density of silanol groups on the surface of particles is as many as 5 to 8 groups/nm² and therefore silica particles easily densely aggregate. Meanwhile, in the vapor-phase-process silica, the density of silanol groups on the surfaces of particles is as small as 2 to 3 groups/nm² and therefore silica particles thin flocculate and, as a result, form a structure having high percentage of void.

The vapor-phase-process silica has high ink absorbing ability and high retention efficiency due to its large specific surface area. Also, because this silica has a low refractive index, it can impart transparency to the colorant-receiving layer by dispersing it till it has a proper diameter and can provide a high color density and a good color developing property.

An average primary particle diameter of the vapor-phase-process silica particles is preferably 30 nm or less, more preferably 20 nm or less, still more preferably 10 nm or less, and most preferably 3 to 10 nm. The vapor-phase-process silica particles tend to adhere to each other due to hydrogen bond of their silanol groups. Therefore, when the average primary particle diameter is 30 nm or less, the vapor-phase-process silica can form a structure having high percentage of void and can effectively improve an ink absorbing property.

Further, a concentration of the vapor-phase-process silica in the coating solution is, from the viewpoint of the viscosity of the coating solution, dispersibility of the vapor-phase-process silica, formability of a porous structure and an aptitude of the coating solution, preferably 60% by mass or less, more preferably from 2 to 50% by mass and, still more preferably, from 5 to 30% by mass.

Further, it is preferable that the vapor-phase-process silica according to the present invention is dispersed in an aqueous solvent and, then, used. A content of the

vapor-phase-process silica in the dispersion is preferably 60% by mass or less, more preferably from 5 to 60% by mass and, particularly preferably, from 10 to 50% by mass.

The vapor-phase-process silica can effectively be dispersed in the above-described ranges. For example, at the time of dispersion, the viscosity increase, gelation or the like to be caused by allowing a space between any two particles of the vapor-phase-process silica to be narrower or the like can effectively be prevented.

A solid content of the aforementioned vapor-phase-process silica particles in the colorant-receiving layer is preferably 40% by mass or more, and more preferably 50% by mass or more based on a total solid amount of the colorant-receiving layer. When the content exceeds 50% by mass, it becomes possible to form a better porous structure, enabling a colorant-receiving layer having sufficient ink absorbing ability. The solid content of the vapor-phase-process silica particles in the colorant-receiving layer herein means the content of the vapor-phase-process silica particles calculated on the basis of components other than water in the composition of the colorant-receiving layer.

Other inorganic pigment particles such as hydrated silica particles, colloidal silica, titanium dioxide, barium sulfate, calcium silicate, zeolite, kaolinite, halloysite, mica, talc, calcium carbonate, magnesium carbonate, calcium sulfate, boehmite and pseudo boehmite may also be additionally used. When other inorganic pigment particles and the vapor-phase-process silica are used in combination, a content of the vapor-phase-process silica in a total amount of inorganic pigment particles is preferably 50 % by mass or more, and more preferably 70 % by mass or more.

Pseudo boehmite

The pseudo boehmite is a stratified compound which is represented by

$\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ ($1 < x < 2$) and whose crystal has a (020) plane forming a huge plane and has a lattice constant d of 0.67 nm. Here, the pseudo boehmite has a structure including excess water between layers of the (020) plane. The pseudo boehmite well absorbs ink and is fixed. It can also improve ink absorbing ability and prevent blurring over time.

A sol-like pseudo boehmite (pseudo boehmite sol) is preferably used as a raw material because a smooth layer is easily obtained.

An average primary particle diameter of the pseudo boehmite particles is preferably 50 nm or less, more preferably 30 nm or less and particularly preferably in a range of 3 to 20 nm. When the average primary particle diameter is within the above range, a structure having high percentage of void can be formed and the ink absorbing ability of the colorant-receiving layer can be further improved. The average primary particle diameter can be measured with, for example, an electron microscope.

The BET specific surface area of each of the pseudo boehmite particles is preferably in a range of 40 to 500 m^2/g and more preferably in a range of 200 to 500 m^2/g .

Moreover, an aspect ratio of each of the pseudo boehmite particles is preferably in a range of 3 to 10. As for a porous structure of the pseudo boehmite, an average pore radius thereof is preferably in a range of 1 to 30 nm, and more preferably 2 to 15 nm. A pore volume of the pseudo boehmite is preferably in a range of 0.3 to 2.0 ml/g (cc/g), and more preferably 0.5 to 1.5 ml/g (cc/g). Here, the pore radius and pore volume are measured by a nitrogen absorption and desorption method. For example, they may be measured with a gas absorption and desorption analyzer, for example, OMNISOAPTM369 (trade name, manufactured by Beckman Coulter, Inc.).

Further, a concentration of the pseudo boehmite in the coating solution is,

from the viewpoint of the viscosity of the coating solution, dispersibility of the pseudo boehmite, formability of a porous structure and an aptitude of the coating solution, preferably 60% by mass or less, more preferably from 2 to 50% by mass and, still more preferably, from 5 to 30% by mass.

Further, it is preferable that the pseudo boehmite is dispersed in an aqueous solvent and, then, used. When the pseudo boehmite is used in a dispersed state, a content of the pseudo boehmite in the dispersion is preferably 60% by mass or less, more preferably from 5 to 60% by mass and, particularly preferably, from 10 to 50% by mass.

The pseudo boehmite can effectively be dispersed in the above-described ranges. For example, at the time of dispersion, the viscosity increase, gelation or the like to be caused by allowing a space between any two particles of the pseudo boehmite to be narrower or the like can effectively be prevented.

A solid content of the aforementioned pseudo boehmite particles in the colorant-receiving layer is preferably 50 % by mass or more, and more preferably 60 % by mass or more based on a total solid amount of the colorant-receiving layer. When the content exceeds 60 % by mass, it becomes possible to form a better porous structure, enabling a colorant-receiving layer having sufficient ink absorbing ability. The solid content of the pseudo boehmite particles in the colorant-receiving layer herein means the content of the pseudo boehmite particles calculated on the basis of components other than water in the composition of the colorant-receiving layer.

A mass ratio of the vapor-phase-process silica (S) to the pseudo boehmite (A), namely (S:A), is preferably in a range of 95:5 to 5:95, more preferably in a range of from 80:20 to 20:80, and most preferably in a range of 70:30 to 30:70.

When the vapor-phase-process silica is used in combination with the pseudo

boehmite within the above range of the content ratio, blurring of all inks of plural colors over time can be effectively prevented regardless of hue. Even when a multicolor image is formed, a clear image with high resolution can be formed and kept.

Aluminum oxide

Examples of aluminum oxide according to the invention include anhydrous alumina such as α -alumina, δ -alumina, θ -alumina and χ -alumina and active aluminum oxide. δ -Alumina is preferable among them.

From the viewpoint of a production method, alumina particles produced by a vapor phase method, namely, vapor phase method alumina particles obtained by hydrolyzing a gaseous metal chloride in a presence of water generated in an oxy-hydrogen reaction or at a temperature that is characteristic in such a reaction are preferable because the particles have a high specific surface area.

The form of the aluminum oxide can be, for example, particles, particles, ultra particles, powders, impalpable powders, or ultra fine powders having predetermined particle diameters. An average primary particle diameter of these particles is preferably 200 nm or less, more preferably 5 to 100 nm, and particularly preferably 5 to 20 nm. When the average primary particle diameter of the alumina particles is in the above range, a structure having high percentage of void can be formed and the ink absorbing ability of the colorant-receiving layer can be further improved. It is noted that the average primary particle diameter can be measured with, for example, an electron microscope.

Further, a concentration of aluminum oxide in the coating solution is, from the viewpoint of the viscosity of the coating solution, dispersibility of aluminum oxide, formability of a porous structure and an aptitude of the coating solution, preferably 60% by mass or less, more preferably from 2 to 50% by mass and, still more preferably,

from 5 to 30% by mass.

In this invention, the aluminum oxide is preferably used in a form of a dispersion liquid in which it is dispersed in an aqueous solution. A content of aluminum oxide in the dispersion liquid is preferably 60% by mass or less, more preferably 5 to 60% by mass, and most preferably 10 to 50% by mass. When the content of aluminum oxide is in the above range, aluminum oxide can be more effectively dispersed. It is possible to effectively suppress thickening and gelation caused by, for example, a reduction in the distance between the aluminum oxide particles in the dispersion liquid.

A solid content of the aforementioned aluminum oxide in the colorant-receiving layer is preferably 50% by mass or more, and more preferably 60% by mass or more based on a total solid amount of the colorant-receiving layer. When the content exceeds 60% by mass, it becomes possible to form a better porous structure, enabling a colorant-receiving layer having sufficient ink absorbing ability. The solid content of the aluminum oxide in the colorant-receiving layer herein means the content of the aluminum oxide calculated on the basis of components other than water in the composition of the colorant-receiving layer.

Further, in this invention, the aluminum oxide may be combined with other particles. When aluminum oxide is combined with other particles, the content of aluminum oxide in all particles is preferably 30% by mass or more, and more preferably 50% by mass or more.

The particles may be any of organic particles and inorganic particles, and among them, inorganic particles are preferable from the viewpoint of ink absorbing ability and image stability.

Binder

As mentioned above, the coating solution for forming the colorant-receiving layer according to the invention comprises a binder. The binder is preferably a water-soluble resin.

Examples of the water-soluble resin include polyvinyl alcohol resins, which have hydroxyl groups as hydrophilic structural units (e.g., a polyvinyl alcohol (PVA), acetoacetyl modified PVA, cation modified PVA, anion modified PVA, silanol modified PVA and polyvinylacetal), cellulose resins (e.g., methyl cellulose (MC), ethyl cellulose (EC), hydroxyethyl cellulose (HEC), carboxymethyl cellulose (CMC), hydroxypropyl cellulose (HPC), hydroxyethylmethyl cellulose and hydroxypropylmethyl cellulose], chitins, chitosans, starch, resins having ether bonds [e.g., a polyethylene oxide (PEO), polypropylene oxide (PPO), polyethylene glycol (PEG) and polyvinyl ether (PVE)] and resins having carbamoyl groups [e.g., a polyacrylamide (PAAM), polyvinylpyrrolidone (PVP) and polyacrylic acid hydrazide.

As the water-soluble resin, polyacrylates, maleic acid resins, alginates and gelatins having carboxy groups as dissociable groups may also be utilized.

Among the above resins, polyvinyl alcohol (PVA) resins are particularly preferable. Examples of the polyvinyl alcohol resins include those described in Japanese Patent Application Publication (JP-B) Nos. 4-52786, 5-67432 and 7-29479, Japanese Patent No. 2537827, JP-B No. 7-57553, Japanese Patent Nos. 2,502,998 and 3,053,231, JP-A No. 63-176173, Japanese Patent No. 2,604,367, JP-A Nos. 7-276787, 9-207425, 11-58941, 2000-135858, 2001-205924, 2001-287444, 62-278080 and 9-39373, Japanese Patent No. 2,750,433, JP-A Nos. 2000-158801, 2001-213045, 2001-328345, 8-324105 and 11-348417.

Examples of the water-soluble resin other than the polyvinyl alcohol resins include compounds described in JP-A No. 11-165461, paragraph Nos. [0011] to

[0014].

These water-soluble resins as binders may be used either each individually or in combination of two types or more.

Further, a concentration of any one of the water-soluble resins as the binders in the coating solution is, from the viewpoint of the viscosity of the coating solution, dispersibility of aluminum oxide, formability of a porous structure and an aptitude of the coating solution, preferably from 1 to 25% by mass and, more preferably, from 2 to 15% by mass.

Further, in the present invention, a content of the aforementioned water-soluble resin as the binder in the formed colorant-receiving layer is, based on an entire solid content of the colorant-receiving layer, preferably from 9 to 40% by mass and, more preferably, from 12 to 33% by mass.

Still further, when the polyvinyl alcohol type resin and any one of other water-soluble resins are simultaneously used, a content of the polyvinyl alcohol type resin is, in the entire water-soluble resins, preferably 50% by mass or more and, more preferably, 70% by mass or more.

The polyvinyl alcohol resin suitable for a binder has a hydroxyl group in the structural unit thereof. This hydroxyl groups and the silanol groups on the surfaces of silica particles form hydrogen bond, which makes it easy to form a three-dimensional network structure in which secondary particles of the silica particles are chain units. It is thought that the formation of the three-dimensional network structure makes it possible to form a colorant-receiving layer having a porous structure with high percentage of void.

In the ink jet recording, the porous colorant-receiving layer thus obtained can rapidly absorb ink due to capillarity to form good circular dots free from ink blurring.

Polyvinyl alcohol resin having a degree of saponification of 70 to 99% is more preferable, and polyvinyl alcohol resin having a degree of saponification of 80 to 99% is particularly preferable from the viewpoint of transparency.

Ratio of particles to water-soluble resin (binder)

The ratio by mass (PB ratio (x/y)) of the particles (x) relative to the water-soluble resin as the binder (y) largely affects a structure and strength of the colorant-receiving layer. That is, when the mass ratio (PB ratio) is increased, percentage of void, pore volume and surface area (per unit mass) are increased, but the density and strength tend to be decreased.

In the colorant-receiving layer according to the invention, the mass ratio (PB ratio (x/y)) is preferably 1.5/1 to 10/1 from the viewpoint of prevention of defects caused by a too large PB ratio such as a reduction in layer strength and cracks at the time of drying, and prevention of deteriorated ink absorbing ability caused by a too small PB ratio, namely caused by voids being easily clogged with a resin and therefore percentage of void being reduced.

When the information medium of the invention is conveyed through a conveyor system of an ink jet recording printer, stress may be applied to the information medium. Accordingly, it is preferable that the colorant-receiving layer has a sufficient film strength. In consideration of such cases, the PB ratio (x/y) is preferably 4/1 or less. On the other hand, the PB ratio (x/y) is preferably 3/1 or more from the viewpoint of assuring of high-speed ink absorbing ability in an ink jet recording printer.

Cross-linking agent

The coating solution for forming the receiving layer according to the invention comprises a cross-linking agent which can cross-link the binder. When the

cross-linking agent is contained, the colorant-receiving layer can be formed as a porous layer cured by cross-linking reaction between the cross-linking agent and the binder.

A boron compound is preferable to cross-link a polyvinyl alcohol which is particularly preferable as the water-soluble resin as a binder. Examples of the boron compound include borax, boric acid, borates (e.g., orthoborates, InBO_3 , ScBO_3 , YBO_3 , LaBO_3 , $\text{Mg}_3(\text{BO}_3)_2$, $\text{Co}_3(\text{BO}_3)_2$, diborates (e.g., $\text{Mg}_2\text{B}_2\text{O}_5$ and $\text{Co}_2\text{B}_2\text{O}_5$), methaborates (e.g., LiBO_2 , $\text{Ca}(\text{BO}_2)_2$, NaBO_2 and KBO_2), tetraborates (e.g., $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$) and pentaborates (e.g., $\text{KB}_5\text{O}_8 \cdot 4\text{H}_2\text{O}$, $\text{Ca}_2\text{B}_6\text{O}_{11} \cdot 7\text{H}_2\text{O}$ and CsB_5O_5). Among these boron compounds, borax, boric acid and borates are preferable, and boric acid is particularly preferable from the viewpoint of rapid initiation of cross-linking reaction.

As the cross-linking agent for the water-soluble resin as a binder, a compound other than the boron compound may also be used. Examples of such a cross-linking agent include aldehyde compounds such as formaldehyde, glyoxal, succinaldehyde, glutaraldehyde, dialdehyde starch and dialdehyde derivatives of vegetable gum; ketone compounds such as diacetyl, 1,2-cyclopentanedione and 3-hexene-2,5-dione; active halogen compounds such as bis(2-chloroethyl)urea, bis(2-chloroethyl)sulfone and sodium salt of 2,4-dichloro-6-hydroxy-s-triazine; active vinyl compounds such as divinylsulfone, 1,3-bis(vinylsulfonyl)-2-propanol, N,N'-ethylenebis(vinylsulfonylacetamide), divinyl ketone, 1,3-bis(acryloyl)urea and 1,3,5-triacryloyl-hexahydro-s-triazine; N-methylol compounds such as dimethylolurea and methyloldimethylhydantoin; melamine compounds such as trimethylolmelamine, alkylated methylolmelamine, melamine, benzoguanamine and melamine resins; epoxy compounds such as ethylene glycol diglycidyl ether, propylene glycol diglycidyl ether, polyethylene glycol diglycidyl ether, diglycerin polyglycidyl ether, spiroglycol

diglycidyl ether and polyglycidyl ether of a phenol resin;
isocyanate compounds such as 1,6-hexamethylene diisocyanate and xylylene diisocyanate; aziridine compounds described in U.S. Patent Nos. 3,017,280 and 2,983,611; carbodiimide compounds described in U.S. Patent No. 3,100,704; ethyleneimino compounds such as 1,6-hexamethylene-N,N'-bisethyleneurea; halogenated carboxyaldehyde compounds such as mucochloric acid and mucophenoxychloric acid; dioxane compounds such as 2,3-dihydroxydioxane; metal-containing compounds such as titanium lactate, aluminum sulfate, chrome alum, potassium alum, zirconyl acetate and chromium acetate; polyamine compounds such as tetraethylenepentamine; hydrazide compounds such as dihydrazide adipate; low molecular-weight molecules and polymers containing two or more oxazoline groups; anhydrides of polyvalent acids, acid chlorides and bissulfonate compounds described in U.S. Patent Nos. 2,725,294, 2,725,295, 2,726,162 and 3,834,902 and active ester compounds described in U.S. Patent Nos. 3,542,558 and 3,251,972.

One of these cross-linking agents may be used singly or in combination of two or more of them.

When a gelatin is used in addition to the polyvinyl alcohol, following compounds, which are known as a film hardening agent for gelatin, can be used as a cross-linking agent in addition to the boron compound. Examples of such a cross-linking agent for gelatin include aldehyde compounds such as formaldehyde, glyoxal, and glutaraldehyde; ketone compounds such as diacetyl and cyclopentanedione; active halogen compounds such as bis(2-chloroethylurea)-2-hydroxy-4,6-dichloro-1,3,5-triazine and sodium salt of 2,4-dichloro-6-S-triazine; active vinyl compounds such as divinylsulfonic acid, 1,3-vinylsulfonyl-2-propanol, N,N'-ethylenebis(vinylsulfonylacetamide), and

1,3,5-triacryloyl-hexahydro-S-triazine; N-methylol compounds such as dimethylolurea and methyloldimethylhydantoin; isocyanate compounds such as 1,6-hexamethylene diisocyanate; aziridine compounds described in U.S. Patent Nos. 3,017,280 and 2,983,611; carbodiimide compounds described in U.S. Patent No. 3,100,704; epoxy compounds such as glycol triglycidyl ether; ethyleneimino compounds such as 1,6-hexamethylene-N,N'-bisethyleneurea; halogenated carboxyaldehyde compounds such as mucochloric acid and mucophenoxychloric acid; dioxane compounds such as 2,3-dihydroxydioxane; chrome alum, potassium alum, zirconium sulfate, chromium acetate; and the like.

The hardeners may be used singly or in combination of two or more of them.

When the boron compound and other cross-linking agents are used in combination, a content of the boron compound in all cross-linking agents is preferably 50 % by mass or more, and is preferably 70 % by mass or more based on a total amount of the all cross-linking agents.

A concentration of the cross-linking agents in the coating solution is, from the viewpoint of the viscosity of the coating solution, the cross-linking reaction with the binder, formability of a porous structure and an aptitude of the coating solution, preferably from 0.2 to 5% by mass and, more preferably, from 0.7 to 3% by mass.

Further, it is preferable that the cross-linking agent is dissolved in water and/or an organic solvent and is used as the cross-linking agent solution.

A concentration of the cross-linking agent in the cross-linking agent solution is preferably 0.1 to 10% by mass, and more preferably 0.5 to 8% by mass based on the mass of the cross-linking agent solution.

Water is generally used as the solvent of the cross-linking agent solution, and an aqueous mixture solvent containing water and an organic solvent miscible with

water may also be used.

Any solvent which dissolves the cross-linking agent may be used as the organic solvent. Examples of the organic solvent include alcohols such as methanol, ethanol, isopropyl alcohol and glycerin; ketones such as acetone and methyl ethyl ketone; esters such as methyl acetate and ethyl acetate; aromatic solvents such as toluene; ethers such as tetrahydrofuran; and halogenated carbon-including solvents such as dichloromethane.

Further, a content of the cross-linking agent in the formed colorant-receiving layer is, from the viewpoint of the formability of the porous structure, based on an entire solid content of the colorant-receiving layer, preferably from 1 to 20% by mass and, more preferably, from 2 to 10% by mass.

Mordant

The coating solution for forming the colorant-receiving layer in the invention preferably comprises a mordant to improve water resistance of a formed image and prevent blurring of the formed image over time.

A cationic polymer (cationic mordant) is preferable as the mordant. Presence of the mordant in the colorant-receiving layer can improve water resistance and prevent blurring over time because the mordant interacts with liquid ink having an anionic dye as a colorant to stabilize the colorant.

As the cationic mordant, a polymer mordant containing as a cationic group any of primary to tertiary amino groups and a quaternary ammonium base is preferably used. A cationic non-polymer mordant may also be used.

Preferable examples of the polymer mordant include a homopolymer of a monomer (mordant monomer) containing any of primary to tertiary amino groups and salts thereof and a quaternary ammonium base, and a copolymer or a condensed

polymer of the mordant monomer and any other monomer (hereinafter referred to as "non-mordant monomer"). These polymer mordants may be used in any form including a water-soluble polymer and water-dispersible latex particles.

Examples of the mordant monomer include trimethyl-p-vinylbenzylammonium chloride, trimethyl-m-vinylbenzylammonium chloride, triethyl-p-vinylbenzylammonium chloride, triethyl-m-vinylbenzylammonium chloride, N,N-dimethyl-N-ethyl-N-p-vinylbenzylammonium chloride, N,N-diethyl-N-methyl-N-p-vinylbenzylammonium chloride, N,N-dimethyl-N-n-propyl-N-p-vinylbenzylammonium chloride, N,N-dimethyl-N-n-octyl-N-p-vinylbenzylammonium chloride, N,N-dimethyl-N-benzyl-N-p-vinylbenzylammonium chloride, N,N-diethyl-N-benzyl-N-p-vinylbenzylammonium chloride, N,N-dimethyl-N-(4-methyl)benzyl-N-p-vinylbenzylammonium chloride, N,N-dimethyl-N-phenyl-N-p-vinylbenzylammonium chloride; trimethyl-p-vinylbenzylammonium bromide, trimethyl-m-vinylbenzylammonium bromide, trimethyl-p-vinylbenzylammonium sulfonate, trimethyl-m-vinylbenzylammonium sulfonate, trimethyl-p-vinylbenzylammonium acetate, trimethyl-m-vinylbenzylammonium acetate, N,N,N-triethyl-N-2-(4-vinylphenyl)ethylammonium chloride, N,N,N-triethyl-N-2-(3-vinylphenyl)ethylammonium chloride, N,N-diethyl-N-methyl-N-2-(4-vinylphenyl)ethylammonium chloride, N,N-diethyl-N-methyl-N-2-(4-vinylphenyl)ethylammonium acetate; and quaternary products of N,N-dimethylaminoethyl(meth)acrylate, N,N-diethylaminoethyl(meth)acrylate, N,N-dimethylaminopropyl(meth)acrylate, N,N-diethylaminopropyl(meth)acrylate, N,N-dimethylaminoethyl(meth)acrylamide,

N,N-diethylaminoethyl(meth)acrylamide, N,N-dimethylaminopropyl(meth)acrylamide or N,N-diethylaminopropyl(meth)acrylamide, and methyl chloride, ethyl chloride, methyl bromide, ethyl bromide, methyl iodide or ethyl iodide, and sulfonates, alkylsulfonates, acetates and alkylcarboxylates obtained by substituting the anions of these products.

Specific example of these salts include	
trimethyl-2-(methacryloyloxy)ethylammonium	chloride,
triethyl-2-(methacryloyloxy)ethylammonium	chloride,
trimethyl-2-(acryloyloxy)ethylammonium	chloride,
triethyl-2-(acryloyloxy)ethylammonium	chloride,
trimethyl-3-(methacryloyloxy)propylammonium	chloride,
triethyl-3-(methacryloyloxy)propylammonium	chloride,
trimethyl-2-(methacryloylamino)ethylammonium	chloride,
triethyl-2-(methacryloylamino)ethylammonium	chloride,
trimethyl-2-(acryloylamino)ethylammonium	chloride,
triethyl-2-(acryloylamino)ethylammonium	chloride,
trimethyl-3-(methacryloylamino)propylammonium	chloride,
triethyl-3-(methacryloylamino)propylammonium	chloride,
trimethyl-3-(acryloylamino)propylammonium	chloride,
triethyl-3-(acryloylamino)propylammonium chloride;	
N,N-dimethyl-N-ethyl-2-(methacryloyloxy)ethylammonium	chloride,
N,N-diethyl-N-methyl-2-(methacryloyloxy)ethylammonium	chloride,
N,N-dimethyl-N-ethyl-3-(acryloylamino)propylammonium	chloride,
trimethyl-2-(methacryloyloxy)ethylammonium	bromide,
trimethyl-3-(acryloylamino)propylammonium	bromide,

trimethyl-2-(methacryloyloxy)ethylammonium sulfonate and trimethyl-3-(acryloylamino)propylammonium acetate.

Examples of other copolymerizable monomers include N-vinylimidazole and N-vinyl-2-methylimidazole.

The non-mordant monomer means a monomer which comprises no basic or cationic moiety such as a primary to tertiary amino group or a salt thereof or a quaternary ammonium base and which does not interact or hardly interacts with the dye contained in ink jet ink.

Examples of the non-mordant monomer include alkyl (meth)acrylates; cycloalkyl (meth)acrylates such as cyclohexyl (meth)acrylate; aryl (meth)acrylates such as phenyl (meth)acrylate; aralkyl esters such as benzyl (meth)acrylate; aromatic vinyls such as styrene, vinyltoluene and α -methylstyrene; vinyl esters such as vinyl acetate, vinyl propionate and vinyl versatate; allyl esters such as allyl acetate; halogen-containing monomers such as vinylidene chloride and vinyl chloride; vinyl cyanides such as (meth)acrylonitrile; and olefins such as ethylene and propylene.

As the alkyl (meth)acrylate, alkyl (meth)acrylates with an alkyl moiety having 1 to 18 carbon atoms are preferable. Examples of the preferable alkyl (meth)acrylates include methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, isopropyl (meth)acrylate, n-butyl (meth)acrylate, isobutyl (meth)acrylate, t-butyl (meth)acrylate, hexyl (meth)acrylate, octyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, lauryl (meth)acrylate and stearyl (meth)acrylate.

Among these compounds, methyl acrylate, ethyl acrylate, methyl methacrylate, ethyl methacrylate and hydroxyethyl methacrylate are preferable.

The non-mordant monomers may be used singly or in combination of two or more of them.

Furthermore, preferable examples of the polymer mordant include polydiallyldimethylammonium chloride, polymethacryloyloxyethyl- β -hydroxyethyl dimethylammonium chloride, polyethylenimine, polyallylamine, polyallylamine hydrochloride, polyamide-polyamine resin, cationic starch, dicyandiamido-formalin condensate, dimethyl-2-hydroxypropylammonium salt polymer, polyamidine and polyvinylamine.

The molecular weight of the polymer mordant is preferably 1,000 to 200,000, and more preferably 3,000 to 60,000 in terms of weight average molecular weight. When the molecular weight is in the range of 1,000 to 200,000, water resistance of the medium is prevented from being insufficient and deterioration in handling aptitude of the medium caused by excessively increased viscosity is prevented.

As the cationic non-polymer mordant, for example, water-soluble metal salts such as aluminum sulfate, aluminum chloride, aluminum polychloride or magnesium chloride are preferable

A content of the mordant in the coating solution is, from the viewpoint of a coloring property and the aptitude of the coating solution, preferably from 0.1 to 2% by mass and, more preferably, from 0.2 to 1% by mass.

Further, a content of the mordant in the formed colorant-receiving layer is, from the viewpoint of prevention of blurring at the time of printing, based on the entire solid content in mass of the colorant-receiving layer, preferably from 2 to 30% by mass and, more preferably, from 5 to 20% by mass.

Compounds represented by Formulae (1) and (2)

The coating solution for forming the colorant-receiving layer according to the invention preferably comprises a compound represented by the following Formula (1) and/or a compound represented by the following Formula (2). These compounds

represented by Formulae (1) and (2) are solvents having high boiling points.



wherein R represents a saturated hydrocarbon group having 1 to 12 carbon atoms, an unsaturated hydrocarbon group having 1 to 12 carbon atoms, a phenyl group or an acyl group; and n represents an integer from 1 to 3.



wherein, R represents a saturated hydrocarbon group having 1 to 12 carbon atoms, an unsaturated hydrocarbon group having 1 to 12 carbon atoms, a phenyl group or an acyl group; and n represents an integer from 1 to 3.

Inclusion of the compound represented by Formula (1) and/or the compound represented by Formula (2) in the colorant-receiving layer can suppress drying shrinkage of the colorant-receiving layer when a three-dimensional network structure (porous structure) is formed. It is thought that this is because the compounds represented by Formulae (1) or (2) moderately inhibit hydrogen bondings between silanol groups on the surfaces of the vapor-phase-process silica particles and hydroxyl groups of polyvinyl alcohol. Thereby, cracks of the colorant-receiving layer when a three-dimensional network structure is formed can be prevented, and therefore production yield and quality of the information medium can be improved.

In Formulae (1) and (2), R represents a saturated hydrocarbon group having 1 to 12 carbon atoms, an unsaturated hydrocarbon group having 1 to 12 carbon atoms, a phenyl group or an acyl group, and is preferably a saturated hydrocarbon group having 1 to 4 carbon atoms.

The number of carbon atoms in the saturated hydrocarbon group is 1 to 12, preferably 1 to 8, and more preferably 1 to 4. Examples of the saturated hydrocarbon group include alkyl groups and alicyclic hydrocarbon groups. The saturated

hydrocarbon groups may be substituted by a substituent. Specific examples of the saturated hydrocarbon group include a methyl group, an ethyl group, a propyl group, a butyl group, and a hexyl group. Among these, a methyl group, an ethyl group, a propyl group, and a butyl group are preferable.

The number of carbon atoms of the unsaturated hydrocarbon group is 1 to 12, preferably 1 to 8, and more preferably 1 to 4. Examples of the unsaturated hydrocarbon group include alkenyl groups and alkynyl groups. The unsaturated hydrocarbon group may be substituted by a substituent. Specific examples of the unsaturated hydrocarbon group include a vinyl group, an allyl group, an ethynyl group, a 1,3-butadienyl group, and a 2-propynyl group, and among these, an allyl group is preferable.

The acyl group preferably has 1 to 8 carbon atoms and more preferably 1 to 4 carbon atoms. The acyl group may be substituted by a substituent. Specific examples of the acyl group include an acetyl group, a propionyl group, a butyryl group, and a valeryl group, and among these, a butyryl group is preferable.

In Formulae (1) and (2), n represents an integer from 1 to 3, and is preferably 2 or 3.

The compounds represented by Formulae (1) or (2) are preferably water-soluble compounds. Here, "water-soluble" compounds mean those soluble in water in an amount of 1 mass% or more.

Specific examples of the compounds represented by Formulae (1) or (2) include ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol monobutyl ether, ethylene glycol monohexyl ether, ethylene glycol monoallyl ether, ethylene glycol monophenyl ether, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monobutyl ether, diethylene

glycol monohexyl ether, diethylene glycol monododecyl ether, triethylene glycol monomethyl ether, triethylene glycol monoethyl ether, triethylene glycol monobutyl ether, propylene glycol monomethyl ether, propylene glycol monoethyl ether and propylene glycol monobutyl ether. Among these compounds, diethylene glycol monobutyl ether and triethylene glycol monobutyl ether are preferable.

It is sufficient that the colorant-receiving layer comprises at least one of the compounds represented by Formulae (1) or (2), which is used for a coating liquid for forming the colorant-receiving layer. Therefore, the colorant-receiving layer may contain one or more compounds represented by Formulae (1) or (2), or may contain a combination of the compound represented by Formula (1) and the compound represented by Formula (2). When the compound represented by Formula (1) (amount: x) is combined with the compound represented by Formula (2) (amount: y), the mixing ratio (mass ratio) x:y is not limited, but is preferably 100:1 to 100:100, and more preferably 100:10 to 100:50.

A content of the high-boiling-point solvents in the coating solution is, from the viewpoint of formability of a porous structure and an aptitude of the coating solution, preferably from 0.1 to 2% by mass and, more preferably, from 0.2 to 1% by mass.

Further, a total content of the compounds represented by Formulae (1) or (2) in the colorant-receiving layer is preferably 0.1 to 5.0 g/m², and more preferably 0.2 to 3.0 g/m².

Other components

The coating solution for the colorant-receiving layer according to the invention may contain the following components in accordance with necessity.

The colorant-receiving layer may contain an anti-color fading agent such as

an ultraviolet absorbent, an antioxidant, or a singlet oxygen quencher for the purpose of suppressing deterioration of the colorant.

Examples of the ultraviolet absorbent include cinnamic acid derivatives, benzophenone derivatives and benzotriazolylphenol derivatives. Specific examples of the ultraviolet absorbent include butyl α -cyano-phenylcinnamate, o-benzotriazolephenol, o-benzotriazole-p-chlorophenol, o-benzotriazole-2,4-di-t-butylphenol and o-benzotriazole-2,4-di-t-octylphenol. Hindered phenol compounds may also be used as the ultraviolet absorbent, and specifically, phenol derivatives being substituted by a branched alkyl group or groups at at least one of the second and sixth positions.

Benzotriazole ultraviolet absorbents, salicylic acid ultraviolet absorbents, cyanoacrylate ultraviolet absorbents and oxalic acid anilide ultraviolet absorbents may also be used. These ultraviolet absorbents are described in JP-A Nos. 47-10537, 58-111942, 58-212844, 59-19945, 59-46646, 59-109055 and 63-53544, JP-B Nos. 36-10466, 42-26187, 48-30492, 48-31255, 48-41572, 48-54965 and 50-10726, U.S. Patent Nos. 2,719,086, 3,707,375, 3,754,919 and 4,220,711.

A fluorescent whitening agent may also be used as the ultraviolet absorbent. Examples of the fluorescent whitening agent include coumarin fluorescent whitening agents. Specific examples of the coumarin fluorescent whitening agents are described, for example, in JP-B Nos. 45-4699 and 54-5324.

Examples of the antioxidant include those described in European Patent Application Laid-open Nos. 223,739, 309,401, 309,402, 310,551, 310,552 and 459,416, German Patent Laid-open No. 3,435,443, JP-A Nos. 54-48535, 60-107384, 60-107383, 60-125470, 60-125471, 60-125472, 60-287485, 60-287486, 60-287487, 60-287488, 61-160287, 61-185483, 61-211079, 62-146678, 62-146680, 62-146679, 62-282885,

62-262047, 63-051174, 63-89877, 63-88380, 66-88381, 63-113536, 63-163351, 63-203372, 63-224989, 63-251282, 63-267594, 63-182484, 1-239282, 2-262654, 2-71262, 3-121449, 4-291685, 4-291684, 5-61166, 5-119449, 5-188687, 5-188686, 5-110490, 5-1108437 and 5-170361, JP-B Nos. 48-43295 and 48-33212 and U.S. Patent Nos. 4,814,262 and 4,980,275.

Specific examples of the antioxidant include 6-ethoxy-1-phenyl-2,2,4-trimethyl-1,2-dihydroquinoline, 6-ethoxy-1-octyl-2,2,4-trimethyl-1,2-dihydroquinoline, 6-ethoxy-1-phenyl-2,2,4-trimethyl-1,2,3,4-tetrahydroquinoline, 6-ethoxy-1-octyl-2,2,4-trimethyl-1,2,3,4-tetrahydroquinoline, nickel cyclohexanoate, 2,2-bis(4-hydroxyphenyl)propane, 1,1-bis(4-hydroxyphenyl)-2-ethylhexane, 2-methyl-4-methoxy-diphenylamine and 1-methyl-2-phenylindole.

The anti-color fading agents may be used singly or in combination of two or more of them. The anti-color fading agent may be water-solubilized, dispersed, emulsified or included in microcapsules.

An amount of the anti-color fading agent to be added is preferably 0.01 to 10% by mass based on a total amount of the colorant-receiving layer coating solution.

The colorant-receiving layer may further contain various inorganic salts in view of improving dispersibility of the inorganic pigment particles, and/or an acid or an alkali serving as a pH control agent.

The colorant-receiving layer may further contain metal oxide particles having electronic conductivity in view of suppressing frictional electrification and peeling electrification of a surface of the colorant-receiving layer, and any matting agent in view of decreasing frictional characteristics of a surface of the colorant-receiving layer.

In addition, the coating solution according to the invention may contain a surfactant.

Formation of color-receiving layer

In the first production method, it is necessary that, after the coating solution containing the particle, the binder and the cross-linking agent and having a liquid temperature of from 20 to 40°C is applied on the base layer and, then, drying the thus-applied coating solution is performed at from 2 to 25°C. However, a forming method thereof is not particularly limited, so long as it is satisfied that a viscosity of the coating solution to be used on this occasion at a liquid temperature at the time of coating is from 60 to 600 mPa·s and the viscosity thereof at a drying temperature is from 0.5 to 100 Pa·s.

On this occasion, the viscosity of the coating solution in the first production method can be measured as described below.

First of all, the coating solution for forming the colorant-receiving layer is prepared in practice and, then, the viscosity of the coating solution at the liquid temperature at the time of coating and the viscosity thereof at the same liquid temperature as the drying temperature are measured. Further, the measurements of these viscosities can be performed by using a B-8L type viscometer made by Tokyo Keiki Co. Ltd.

As for the method for forming the colorant-receiving layer, for example, the colorant-receiving layer according to the invention is preferably use a method in which a coating solution to be obtained by adding a solution (first solution) containing at least one binder and another solution (second solution: cross-linking agent solution) containing at least one cross-linking agent to an aqueous dispersion containing the particle and, then, re-dispersing the resultant mixture is applied on the base layer and,

then, dried. A pH value of the coating solution for forming the colorant-receiving layer in the present method is from 2.5 to 4.0, showing acidic. When such method as described above is used, a degree of glossiness and a printing density can be enhanced, which is preferred.

Further, it is preferable that the first solution further comprises at least one of the compound represented by the above-described formula (1) and the compound represented by the above-described formula (2). Still further, it is preferable that the second solution (cross-linking agent solution) further comprises the mordant.

In the first production method, as described above, the coating solution containing the particle, the binder and the cross-linking agent and having the viscosity at the liquid temperature at the time of coating of from 60 to 600 mPa·s and the viscosity at the drying temperature of from 0.5 to 100 Pa·s is used.

Further, in order to enhance the productivity, in this coating solution, it is preferable that the viscosity at the liquid temperature at the time of coating is from 60 to 500 mPa·s and the viscosity at the drying temperature is from 1 to 100 Pa·s and it is more preferable that the viscosity at the liquid temperature at the time of coating is from 60 to 400 mPa·s and the viscosity at the drying temperature is from 5 to 100 Pa·s.

As for a method for controlling the viscosity of the coating solution in a manner as described above, a method of adjusting solid contents of essential components involving the particle, the binder and the cross-linking agent and any optional component or a method of performing the adjustment by selecting a type of solvent can be used.

Specifically, the solid content in the coating solution is preferably from 5 to 17% by mass and, more preferably, from 7 to 15% by mass.

In the second production method, a forming method is not particularly limited,

so long as it is satisfied that the coating solution containing the particle, the binder and the cross-linking agent is applied and, then, dried at 15°C or less.

For example, the colorant-receiving layer according to the second production method preferably use a method in which a coating solution to be obtained by adding a solution (first solution) containing at least one binder and another solution (second solution: cross-linking agent solution) containing at least one cross-linking agent to an aqueous dispersion containing the particle and, then, re-dispersing the resultant mixture is applied on the base layer and, then, dried at 15°C or less. A pH value of the coating solution for forming the colorant-receiving layer in the present method is from 2.5 to 4.0, showing acidic. When such method as described above is used, a degree of glossiness and a printing density can be enhanced, which is preferred.

Further, it is preferable that the first solution further comprises at least one of a compound represented by the formula (1) and a compound represented by the formula (2):

Still further, it is preferable that the second solution (cross-linking agent solution) further comprises the mordant.

Examples of solvents to be used in the preparation of the coating solution include water, organic solvents and mixed solvents thereof. As for the organic solvents, alcohols such as methanol, ethanol, n-propanol, i-propanol and methoxypropanol; ketones such as acetone and methyl ethyl ketone; tetrahydrofuran; acetonitrile; ethyl acetate; toluene; and the like are mentioned.

In the coating solution for forming the color-receiving layer, a surfactant, a pH adjusting agent, an antistatic agent or the like can further be optionally added.

According to the invention, a dispersing agent can be used at the time of preparing an aqueous dispersion of the particle. As for such dispersing agent, a

cationic polymer can be used. As for the cationic polymer, any one of primary to tertiary amino groups and salts thereof, a homopolymer of a monomer having a quaternary ammonium salt group, a copolymer of the monomer and another monomer or a polymer prepared by condensation polymerization can favorably be used. Further, these dispersing agents can preferably be used in states of respective water-soluble polymers.

A molecular weight of these dispersing agents is preferably in the range of from 1,000 to 200,000 and, more preferably, in the range of from 3,000 to 60,000. When the molecular weight is less than 1,000, the dispersion property is sometimes deteriorated, while, when it is over 200,000, the viscosity of the aqueous dispersion is sometimes increased. An amount of the dispersing agent to be added to the vapor-phase-process silica is preferably from 1% to 30% and, more preferably, from 3% to 20%. When the amount thereof to be added is less than 1%, the dispersing property is sometimes deteriorated, while, when the amount thereof to be added is more than 30%, in a case in which printing is performed on the colorant-receiving layer, a color density is sometimes decreased; therefore, the case is not preferred.

Further, an aqueous dispersion containing the particle and the dispersing agent may be prepared by previously preparing an aqueous dispersion of the particle and, then, adding the thus-prepared aqueous dispersion to an aqueous solution of the dispersing agent, or adding the aqueous solution of the dispersing agent to the aqueous dispersion of the particle, or both are simultaneously mixed with each other. Further, not only the aqueous dispersion of the particle, but also particle in powder form can simultaneously be added to the aqueous solution of the dispersing agent in a same manner as described above.

After the particle and the dispersing agent are mixed with each other, the

resultant mixture can be changed into fine grains by being treated with a dispersing machine and an aqueous dispersion having an average particle diameter of from 50 to 300 nm can be obtained. As for the dispersing machine for obtaining the aqueous dispersion, various types of known dispersing machine such as a high-speed rotary dispersing machine, a medium stirring type dispersing machine (ball mill, sand mill or the like), an ultrasonic-wave dispersing machine, a colloid mill dispersing machine and a high-pressure dispersing machine can be used. From the viewpoint of efficiently conducting the dispersion of once-aggregated particles, the colloid mill or a high-pressure mill is preferred.

Further, by using the dispersing machine, even from the aqueous dispersion using no dispersing agent, an aqueous dispersion having an average particle size of from 50 to 300 nm can be prepared.

Application of the colorant-receiving layer coating solution may be carried out by other methods, for example, by a contact coating method such as bar coating, roll coating, blade coating, screen coating or pad coating, or a non-contact coating method such as spray coating, spin coating, curtain coating or dip coating. Application by extrusion die coater may be also used from the viewpoint of easily forming a colorant-receiving layer in the predetermined range.

On this occasion, in the case of the first production method, a temperature of the coating solution at the time of coating is necessary to be from 20 to 40°C and, since it is preferred from the viewpoint of stability of the viscosity that the temperature of the coating solution is close to a temperature of a coating environment, it is preferably from 23 to 35°C and, more preferably from 25 to 30°C.

In the case of the second production method, since it is preferred from the viewpoint of stability of the viscosity that the temperature of the coating solution is

close to the temperature of the coating environment, it is preferably from 20 to 40°C, more preferably from 23 to 35°C and, still more preferably, from 25 to 30 since it is preferred from the viewpoint of stability of the viscosity that the temperature of the coating solution is close to a temperature of a coating environment, it is preferably from 23 to 35°C and, more preferably from 25 to 30°C.

Further, the temperature at the time of coating (temperature in the coating environment) is preferably from 20 to 40°C, more preferably from 23 to 35°C and, still more preferably, from 25 to 30°C. A moisture is preferably from 5 to 80% RH, more preferably from 20 to 70% RH and, still more preferably, from 30 to 80% RH.

When the colorant-receiving layer coating solution is applied by spray coating, the pressure is preferably 1.013 to 2026 hPa, more preferably 50.65 to 1013 hPa, and still more preferably 101.3 to 506.5 hPa. The spread angle of the spray is preferably 1 to 120°, more preferably 10 to 60°, and still more preferably 20 to 50°. The liquid particle diameter is preferably 0.1 to 1,000 μm , more preferably 1 to 500 μm , and still more preferably 10 to 100 μm . The distance between the spray and a work (information medium) is preferably 1 to 1,000 mm, more preferably 10 to 200 mm, and still more preferably 30 to 100 mm.

When the coating is performed by the spin coating, the viscosity of the coating solution is preferably from 0.1 to 10,000 mPa·s, more preferably from 1 to 6,000 mPa·s and, still more preferably, from 10 to 3,000 mPa·s. Rotations at the time of dispensing are preferably from 10 to 1,000 rpm, more preferably from 50 to 600 rpm and, still more preferably, from 100 to 400. The number of rotations at the time of spinning-off may be gradually increased and such increase can be performed either stepwise or incrementally. Specifically, it is set to be preferably from 100 to 10,000 rpm, more preferably from 200 to 5,000 rpm and, still more preferably, from 300 to

3,000 rpm. As for a shape of a nozzle, a length thereof is preferably from 1 to 100 mm, more preferably from 5 to 50 mm and, still more preferably from 10 to 30 mm. An inner diameter of the nozzle is preferably from 0.1 to 5 mm, more preferably from 0.3 to 3 mm and, still more preferably, from 0.5 to 2 mm. Thickness of the nozzle is preferably from 0.1 to 1 mm and, more preferably, from 0.2 to 0.5 mm. Further, the nozzle may be placed diagonally along a flow. A distance from a work is preferably from 0.5 to 100 mm, more preferably from 1 to 50 mm and, still more preferably, from 2 to 20 mm.

In the first production method, as for a method for drying a coated film formed by coating as described above, such drying method is not particularly limited and a contact drying, non-contact drying or the like can be used, so long as the coated film can be dried at from 2 to 25°C.

Further, in the second production method, as for a method for drying a coated film formed by coating as described above, such drying method is not particularly limited and contact drying, non-contact drying or the like can be used, so long as the coated film can be dried at 15°C or less.

By performing such drying as described above, as previously described, since the viscosity of the coating solution (coated film) is increased, there is an effect in that it becomes possible to perform a rapid dryness, or the transportation is facilitated. Further, in the course of the viscosity increase, a leveling mechanism is realized and, then, a surface feature of the colorant-receiving layer can be enhanced.

Further, on this occasion, a preferable extent of the viscosity increase is such extent as loses flowability of the coated film and the viscosity on this occasion is, specifically, from about 1 Pa·s to about 15 Pa·s at 5°C.

Now, in the first production method, a drying temperature in the

colorant-receiving layer forming step is, from the viewpoint of an extent of the viscosity increase and a load to be put on a cooling apparatus, preferably in the range of from 5 to 15°C and, above all, preferably lower than the liquid temperature of the coating solution by 15°C or more.

Particularly, by drying at a low temperature of 15°C or less, since the viscosity increase of the coating solution (coated film) is efficiently realized, an effect is increased such that a rapid drying becomes possible, flowability of the coated film is suppressed or transportation is facilitated.

Further, the drying moisture is, for the viewpoint of an extent of the viscosity increase or a load to be put on the cooling apparatus, preferably in the range of from 10 to 90% RH and, more preferably, in the range of from 10 to 85% RH.

As for the drying time, from 5 to 20 minutes are preferred.

In the second production method, a drying temperature in the colorant-receiving layer forming step is, from the viewpoint of an extent of the viscosity increase and a load to be put on a cooling apparatus, preferably in the range of from 2 to 15°C and, more preferably, in the range of from 5 to 15°C or more.

Further, the drying moisture is, for the viewpoint of an extent of the viscosity increase or a load to be put on the cooling apparatus, preferably in the range of from 10 to 50% RH and, more preferably, in the range of from 10 to 30% RH.

As for the drying time, from 5 to 20 minutes are preferred.

In the first production method, the coating solution is dried at from 2 to 25°C, preferably 15°C or less after 30 seconds or more have passed since it was applied. By starting drying at a low temperature after 30 seconds or more have passed since it was applied, the leveling mechanism of the coated film is efficiently realized and, then, the surface feature of the colorant-receiving layer becomes favorable.

In the second production method, according to the invention, the coating solution is preferably dried at 15°C or less after 30 seconds or more have passed since it was applied. By starting drying after 30 seconds or more have passed since it was applied, the leveling mechanism of the coated film is efficiently realized and, then, the surface feature of the colorant-receiving layer becomes favorable.

Further, a time period of from termination of the coating till the start of the drying is, from the viewpoint of the realization of the leveling mechanism and productivity, preferably in the range of from 30 to 60 seconds and, more preferably, in the range of from 30 to 40 seconds.

Further, according to the invention, it is preferable that, after drying (first drying) is performed at 15°C or less, another drying (second drying) is further performed at 20°C or more. In such manner as described above, by performing the drying at a low temperature of 15°C or less and, then, performing the drying at a higher temperature, the drying is efficiently progressed, to thereby enhance the productivity. Further, after the second drying, drying with a still higher temperature may be performed.

Still further, it is preferable that the second drying is performed, before the coated film shows a drying speed at a reduced ratio.

The term "before the coated film shows a drying speed at a reduced ratio" as used herein ordinarily indicates several minutes from immediately after the coating solution for forming the colorant-receiving layer according to the invention is applied and, in such period of time as several minutes, shows a drying speed at a constant ratio which is a phenomenon in which a content of the solvent present in the coated film is reduced in proportion to the passage of time. A relation ship between the drying speed at a constant ratio vs time is described in Chemical Engineering Handbook, pp.

707 to 712, Maruzen, October 25, 1980.

In the second drying, from the viewpoint of the productivity and the occurrence ratio of cracks and the like, the temperature is preferably in the range of from 20 to 80°C and, more preferably, in the range of from 30 to 60°C.

Further, the moisture in the second drying is, from the viewpoint of the productivity and the occurrence ratio of cracks and the like, preferably in the range of from 5 to 30% RH and, further preferably, in the range of from 10 to 20% RH.

Still further, at the time of the second drying, an air may be blasted on the coated film and such air blast is performed preferably at a rate of 3 m/s or more in parallel to the coated film.

According to the invention, as a specific technique for drying the coated film, it is preferable to use a non-contact drying which holds the coated film under a given temperature environment.

Specifically, in the first production method, from the viewpoint of the productivity, it is preferable that a substrate itself on which the coated film is formed is transferred under an environment with constant temperature and humidity showing the given temperature and a given moisture. Further, when the drying is performed in two stages as described above, a method in which, after the substrate is transferred under the environment of the first stage, the substrate is subsequently transferred in the environment of the second stage can be employed.

As for the second production method, specifically, from the viewpoint of the productivity, it is preferable that a substrate itself on which the coated film is formed is transferred under an environment with constant temperature and humidity showing the given temperature of 15°C or less and a given moisture. Further, when the drying is performed in two stages as described above, a method in which, after the substrate is

transferred under the environment of the first stage, the substrate is subsequently transferred in the environment of the second stage can be employed.

Since it is necessary that, in a case of being used in inkjet recording, a film thickness of the colorant-receiving layer formed in such manner as described above has a sufficient capacity to absorb all the ink droplets, it is preferable that the film thickness is determined in accordance with a ratio of void in the colorant-receiving layer. For example, in a case in which an amount of ink is 8 nm/mm^2 and the ratio of void is 60%, it is necessary that the film thickness of the colorant-receiving layer is $10 \text{ }\mu\text{m}$ or more.

When these circumstances are taken into consideration, the film thickness of the colorant-receiving layer is, from the viewpoint of an absorbed volume of ink droplets and an occurrence ratio of warpage of the information medium or the surface unevenness, preferably in the range of from 10 to $100 \text{ }\mu\text{m}$, more preferably in the range of from 15 to $80 \text{ }\mu\text{m}$ and, still more preferably, in the range of from 20 to $50 \text{ }\mu\text{m}$.

After the color-receiving layer is formed on the base layer in such a manner as described above, by allowing the color-receiving layer to be subjected to calendering by being passed through a gap between a roll and a nip under a pressure by means of super calendering, a gloss calendering or the like, it is possible to enhance a surface flatness, a degree of glossiness, a transparency and a coated film strength thereof. However, since the calendering sometimes becomes a factor of decreasing the ratio of void (namely, since the property of absorbing the ink is deteriorated), it is necessary to perform the calendering by setting such conditions as hardly decrease the ratio of void.

A temperature of the roll in a case of performing the calendering is preferably from 30 to 150°C and, more preferably, from 40 to 100°C .

Further, a linear pressure between rolls at the time of calendering, is

preferably from 50 to 400 kg/cm and, more preferably, from 100 to 200 kg/cm.

Still further, a pore diameter of the colorant-receiving layer is, in terms of a median diameter, preferably from 0.005 to 0.030 μm and, more preferably, from 0.01 to 0.025 μm .

The above-described ratio of void and pore median diameter can be measured by using a mercury porosimeter (trade name: Poresizer 9320-PC2; available from Shimadzu Corporation).

Further, it is preferable that the colorant-receiving layer is excellent in transparency. As a rough estimation, a haze value at the time of forming the colorant-receiving layer on a transparent film support is preferably 30% or less and, more preferably, 20% or less.

The haze value can be measured by a haze meter (trade name: HGM-2DP; available from Suga Test Instruments Co., Ltd.).

In the information medium to be obtained by the first production method, a degree of glossiness at 60° is preferably 30% or more. The degree of glossiness can be measured by using a digital variable gloss meter (trade name: UGV-50DP; available from Suga Test Instruments Co., Ltd.), a digital gloss meter (trade name: GK-45D; available from Suga Test Instruments Co., Ltd.) or the like.

Further, in the colorant-receiving layer in the first production method, as an indicator of the surface feature having no practical problem, the degree of glossiness at 60° is used. When the degree of glossiness at 60° shows 30% or more, it is indicated that the colorant-receiving layer has the surface feature of no practical problem. The degree of glossiness at 60° preferably shows 35% or more and, more preferably, shows from 40% to 90%.

In the information medium to be obtained by the second production method,

the degree of glossiness at 60° is preferably 30% or more. Further, the degree of glossiness at 45° is preferably 30% or more. The degree of glossiness can be measured by using a digital variable gloss meter (trade name: UGV-50DP; available from Suga Test Instruments Co., Ltd.), a digital gloss meter (trade name: GK-45D; available from Suga Test Instruments Co., Ltd.) or the like.

Further, in the colorant-receiving layer in the second production method, as an indicator of the surface feature having no practical problem, the degree of glossiness at 45° is used. When the degree of glossiness at 45° shows 30% or more, it is indicated that the surface feature is excellent. The degree of glossiness at 45° preferably shows 35% or more and, more preferably, shows from 40% to 90%.

Intermediate layer forming step

According to the invention, a step of interposing an intermediate layer between the base layer and the colorant-receiving layer may be contained. When the intermediate layer is allowed to be a layer having high ink absorption, an amount of ink to be received is increased and, then, at the time of printing, color density can be increased and an image quality can be enhanced.

In another aspect, the intermediate layer may be interposed between the base layer and the substrate. The intermediate layer on this occasion can enhance adhesiveness between the base layer and the substrate or adjust warpage of an entire information medium.

A film thickness of the intermediate layer is preferably from 0.1 to 100 μm , more preferably from 1 to 50 μm and, most preferably, from 3 to 20 μm .

Surface layer forming step

According to the invention, a step for providing a surface layer on the colorant-receiving layer may be contained. By this surface layer, a surface strength

can further be enhanced or storage stability of prints can be enhanced. The surface layer preferably has properties either to hold ink or allow ink to quickly pass through the layer. A film thickness of the surface layer is preferably from 0.01 to 100 μm , more preferably from 0.1 to 10 μm and, most preferably, from 0.5 to 5 μm .

By passing through these steps, the printable layer according to the invention can be provided. The disc-like information medium provided with such printable layer as described above (hereinafter, referred to also as "information medium" for short) can be applied to a magnetic medium, an optical medium, a semiconductor medium and the like and shapes thereof may be disc-like or a cartridge-contained type. When it is the cartridge-contained type, it is preferably removable. Particularly, it is preferably a disc-like optical information recording medium (optical disc).

In a case of the optical disc, any types of optical discs such as a CD, a DVD, a optical disc capable of recording and reproducing by a blue-violet laser are permissible. When the medium is subjected to recording by using the blue-violet laser, there are two types, namely, a laminate type such as the DVD and the other type in which a recording layer and a cover layer are formed on the substrate having a thickness of 1.1 mm in the stated order and, then, a laser light is incident from the side of the cover layer. Either type thereof is permissible.

A position on which the printable layer is formed is fundamentally on a face on an opposite side from the face into which the laser light is incident. However, the printable layer can be formed even on the same side into which the laser light is incident, so long as it is formed in other areas than the area into which the laser light is incident.

Further, the disc-like information medium according to the invention may be any type of a ROM type, a rewritable type and a recordable type; however, it is,

preferably, the recordable type thereamong.

Hereinafter, forming steps of other factors in the production method of the disc-like information medium according to the invention will be described. Further, on this occasion, the substrate, materials in individual layers and forming methods of layers in a case in which the disc-like information medium is an optical information recording medium (optical disc) are described; however, these embodiments are merely illustrative and the invention is by no means restricted to media of these constitutions.

Substrate

The substrate can be made of any material selected from various materials which are used as substrate materials of conventional optical recording media.

Specific examples of the substrate material include glass; polycarbonates; acrylic resins such as polymethyl methacrylate; vinyl chloride resins such as polyvinyl chloride and vinyl chloride copolymers; epoxy resins; amorphous polyolefins; polyesters; and metals such as aluminum. These materials may be combined, if desired.

Among the above materials, amorphous polyolefins and polycarbonates are preferable and polycarbonates are particularly preferable from the viewpoints of humidity resistance, dimensional stability, and low cost. The thickness of the substrate is preferably 0.5 to 1.2 mm, and more preferably 0.6 to 1.1 mm.

A guide groove or grooves for tracking, or an irregularity or irregularities (pre-groove) representing information such as address signals are formed on the substrate.

In a case of a medium in which information is recorded with a bluish violet laser, a track pitch of the pre-groove(s) is preferably in a range of 200 to 800 nm, more

preferably in a range of 200 to 500 nm, and still more preferably in a range of 200 to 400 nm.

Further, a depth of the pre-groove(s) (groove depth) is preferably in a range of 10 to 180 nm, and more preferably in a range of 20 to 150 nm.

Moreover, a half breadth of the pre-groove(s) is preferably in a range of 200 to 400 nm, more preferably in a range of 230 to 380 nm, and still more preferably in a range of 250 to 350 nm.

In a case of DVD-Rs or DVD-RWs, a track pitch of a pre-groove(s) is preferably in a range of 300 to 900 nm, more preferably in a range of 350 to 850 nm, and still more preferably in a range of 400 to 800 nm.

Further, the depth of the pre-groove(s) (groove depth) is preferably in a range of 100 to 160 nm, more preferably in a range of 120 to 150 nm, and still more preferably in a range of 130 to 140 nm.

Moreover, a half breadth of the pre-groove(s) is preferably in a range of 200 to 400 nm, more preferably in a range of 230 to 380 nm, and still more preferably in a range of 250 to 350 nm.

In a case of CD-Rs or CD-RWs, a track pitch of a pre-groove(s) is preferably in a range of 1.2 to 2.0 μm , more preferably in a range of 1.4 to 1.8 μm , and still more preferably in a range of 1.55 to 1.65 μm .

Further, a depth of the pre-groove(s) (groove depth) is preferably in a range of 100 to 250 nm, more preferably in a range of 150 to 230 nm, and still more preferably in a range of 170 to 210 nm.

Moreover, a half breadth of the pre-groove(s) is preferably in a range of 400 to 650 nm, more preferably in a range of 480 to 600 nm, and still more preferably in a range of 500 to 580 nm.

Recording layer

In a case of CD-Rs or DVD-Rs, a recording layer is formed in the following manner. A dye serving as a recording material and a binder are dissolved in a proper solvent and then the resulting coating solution is applied to the surface of the substrate, on which surface the pre-groove is formed, by a spin coating method to form a coating layer, followed by drying.

The temperature in the spin coating method is preferably 23 °C or more, and more preferably 25 °C or more. Although there is not any particular limitation to the upper limit of the temperature, the temperature must be lower than the flash point of the solvent and is preferably 35 °C.

When the temperature is lower than 23 °C, the drying rate of the solvent slows down and therefore an intended dye layer thickness (thickness of the recording layer) may not be obtained. Moreover, the application and drying require more time, reducing productivity.

Examples of the dye include a cyanine dye, an oxonol dye, a metal complex dye, an azo dye and a phthalocyanine dye. Among these dyes, a phthalocyanine dye is preferable.

Dyes described in JP-A Nos. 4-74690, 8-127174, 11-53758, 11-334204, 11-334205, 11-334206, 11-334207, 2000-43423, 2000-108513 and 2000-158818 are also preferably used.

Examples of the solvent of the coating solution include esters such as butyl acetate, ethyl lactate and 2-methoxyethyl acetate; ketones such as methyl ethyl ketone, cyclohexanone and methyl isobutyl ketone; chlorinated hydrocarbons such as dichloromethane, 1,2-dichloroethane and chloroform; amides such as dimethylformamide; hydrocarbons such as methylcyclohexane; ethers such as

tetrahydrofuran, ethyl ether and dioxane; alcohols such as ethanol, n-propanol, iso-propanol, n-butanol and diacetone alcohol; fluorinated solvents such as 2,2,3,3-tetrafluoropropanol; and glycol ethers such as ethylene glycol monomethyl ether, ethylene glycol monoethyl ether and propylene glycol monomethyl ether.

These solvents may be used singly or in combination of two or more of them in consideration of solubility of the recording material. Various additives such as an antioxidant, a UV absorbent, a plasticizer and a lubricant may be added to the coating solution according to the purpose.

When the coating solution includes a binder, examples of the binder include natural organic polymer materials such as a gelatin, cellulose derivative, dextran, rosin and rubber; and synthetic organic polymers such as hydrocarbon resins, e.g., polyethylene, polypropylene, polystyrene and polyisobutylene, vinyl resins, e.g., polyvinyl chloride, polyvinylidene chloride and polyvinyl chloride/polyvinyl acetate copolymer, acrylic resins, e.g., poly(methyl acrylate) and poly(methyl methacrylate), polyvinyl alcohol, chlorinated polyethylene, epoxy resins, butyral resins, rubber derivatives and initial condensates of thermosetting resins such as phenol/formaldehyde resins. When the binder is used as one of materials of the recording layer, the amount of the binder is usually 0.01 to 50 times, and preferably 0.1 to 5 times as much as that of the recording material in terms of mass ratio. The concentration of the recording material in the coating solution prepared in the above manner is generally in the range of 0.01 to 10 % by mass, and preferably 0.1 to 5 % by mass.

The coating method can be a spin coating method as mentioned above. An apparatus used in this method can be those conventionally known.

The recording layer may be formed as a single layer or multi layers. A

thickness thereof is generally in a range of 20 to 500 nm, preferably in a range of 30 to 300 nm, and more preferably in a range of 50 to 100 nm.

The recording layer may contain various anti-color fading agent(s) to improve light fastness of the recording layer.

A singlet oxygen quencher is generally used as the anti-color fading agent. Examples of the singlet oxygen quencher include those described in publications such as already known patent specifications.

Specific examples of the singlet oxygen quencher include those described in JP-A Nos. 58-175693, 59-81194, 60-18387, 60-19586, 60-19587, 60-35054, 60-36190, 60-36191, 60-44554, 60-44555, 60-44389, 60-44390, 60-54892, 60-47069, 63-209995 and 4-25492, JP-B Nos. 1-38680 and 6-26028, German Patent No. 350,399 and Journal of Japan Chemical Society, the October issue, 1992, page 1141.

An content of the anti-color fading agent to be used such as singlet oxygen quencher is usually in a range of 0.1 to 50 % by mass, preferably in a range of 0.5 to 45 % by mass, more preferably in a range of 3 to 40 % by mass, and still more preferably in a range of 5 to 25 % by mass based on the amount of the dye.

In a case of CD-RWs, or DVD-RWs, the recording layer is preferably made of an optical recording material whose phase can change, which is constituted of at least Ag, Al, Te and Sb, and which can take at least two states including a crystal state and an amorphous state. Such a recording layer can be formed by a known method.

A known dielectric layer may be formed on the recording layer in accordance with necessity.

Optical reflecting layer

After the recording layer is formed, a light reflecting layer is formed on the recording layer by vapor deposition, sputtering or ion plating a light reflecting material.

When the light reflecting layer is formed, a mask is usually used, whereby an area where the light reflecting layer is formed can be controlled.

The light reflecting layer comprises a light reflecting material having a high reflectance with respect to laser light. The reflectance is preferably 70% or more.

Examples of the light reflecting material having a high reflectance include metals and semimetals such as Mg, Se, Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Re, Fe, Co, Ni, Ru, Rh, Pd, Ir, Pt, Cu, Ag, Au, Zn, Cd, Al, Ga, In, Si, Ge, Te, Pb, Po, Sn and Bi, and stainless steel. These light reflecting materials may be used singly, in combination of two or more of them, or can be used as an alloy. Among these materials, Cr, Ni, Pt, Cu, Ag, Au, Al and stainless steel are preferable, Au, Ag, Al and alloys of these metals are more preferable, and Au and Ag and alloys of these metals are most preferable.

A thickness of the light reflecting layer is usually in a range of 10 to 300 nm, and preferably in a range of 50 to 200 nm.

Protective layer and Protective substrate

After the light reflecting layer is formed, a protective layer is formed on the light reflecting layer.

The protective layer is formed by a spin coating method. Use of the spin coating method makes it possible to form a protective layer without damaging the recording layer (e.g., dissolution of dyes and chemical reaction between the dye and the protective layer materials). The number of rotations in the spin coating is preferably 50 to 8,000 rpm, and more preferably 100 to 5,000 rpm from the viewpoint of formation of a uniform layer and prevention of any damage to the recording layer.

When a radiation-curable resin (ultraviolet ray-curable resin) is used as the protective layer material, the protective layer is formed by a spin coating method and

then irradiated with ultraviolet rays from an ultraviolet ray radiation lamp (metal halide lamp) to cure the ultraviolet ray-curable resin.

The protective layer can be allowed to stand for a fixed time before the resin is cured in order to prevent formation of a protective layer having uneven thickness.

The protective layer prevents ingress of moisture and generation of scratches. The material of the protective layer is preferably a radiation-curable resin, a visible ray-curable resin, a thermosetting resin or silicon dioxide, and particularly preferably a radiation-curable resin. Examples of the radiation-curable resin include ultraviolet ray-curable resins such as "SD-640" (trade name, manufactured by Dainippon Ink and Chemicals Incorporated), and "SD-347" (trade name, manufactured by Dainippon Ink and Chemicals Incorporated), "SD-694" (trade name, manufactured by Dainippon Ink and Chemicals Incorporated), or "SKCD1051" (trade name, manufactured by SKC) may also be used. A thickness of the protective layer is preferably in a range of 1 to 200 μm , and more preferably in a range of 50 to 150 μm .

In a layer structure in which the protective layer is used as a laser optical path, the protective layer must have transparency. Here, the term "transparency" means that the protective layer is transparent (transmittance: 90% or more) enough to transmit recording light and reproducing light.

In a case of DVD-Rs or DVD-RWs, an adhesive layer made of an ultraviolet ray-curable resin and a protective substrate having a thickness of about 0.6 mm and made of the similar material as that of the substrate are laminated on the light reflecting layer in place of the protective layer.

That is, after the light reflecting layer is formed, an ultraviolet ray-curable resin (e.g., SD640 as described above) is applied to the light reflecting layer by a spin coating method to form an adhesive layer having a thickness of 20 to 60 μm . Then, a

polycarbonate substrate (thickness: 0.6 mm) serving as a protective substrate is put on the formed adhesive layer, and the resultant is irradiated with ultraviolet rays from the substrate side to cure the ultraviolet ray-curable resin and bond these layers and the protective substrate.

An optical information recording medium containing a laminate in which the recording layer, the light reflecting layer, the protective layer or the adhesive layer, the protective substrate (dummy substrate) and the like are provided on the substrate in the stated order can be produced.

Further, by appropriately setting a track pitch of a pregroove to be formed on the substrate, a material constituting the recording layer and the like, the disc-like information medium according to the invention can be applied also to an information medium having a narrower track pitch than that of the conventional DVD or the like and capable of recording and reproducing the information by using laser light (for example, blue-violet laser) having a shorter wavelength than that of the laser light to be ordinarily used.

As for the thickness of the obtained information medium, the lower limit of thickness is preferably 0.3 mm, more preferably 0.5 mm, and still more preferably 0.7 mm. Also, the upper limit of thickness is preferably 100 mm, more preferably 20 mm, and still more preferably 5 mm. When the information medium is too thin, defects may occur by bending it. When the information medium is too thick, inferior removability may be obtained.

EXAMPLES

The invention will be explained in more detail by way of examples, which are not intended to limit the invention. In the examples, all designations of parts and %

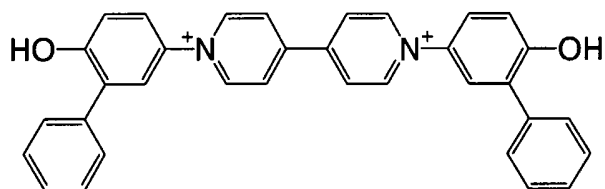
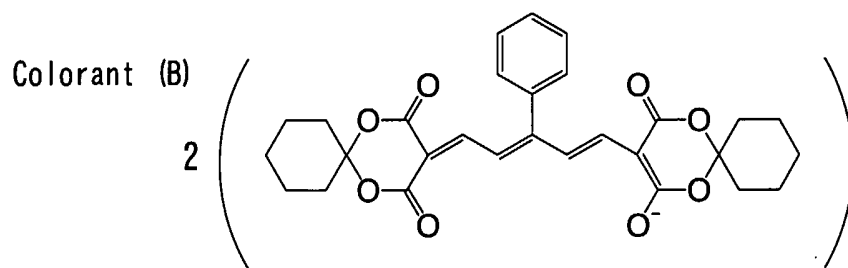
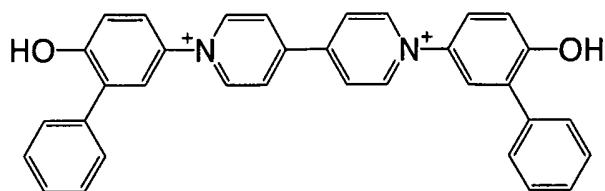
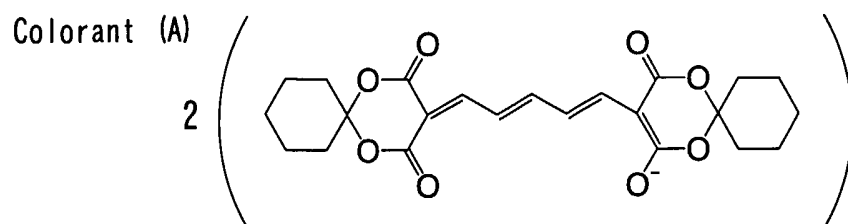
indicate parts by mass and mass percentage (% by mass), respectively.

Example 1

Manufacture of a disc-like substrate

A polycarbonate substrate (trade name: PANLIGHT AD5503, manufactured by Teijin Limited, thickness: 0.6 mm, outer diameter: 120 mm, inner diameter: 15 mm) formed by injected molding machine and having a spiral groove (land) and LPP on the surface thereof was prepared. A depth of the track, a track width, and a track pitch were 140 nm, 310 nm, and 740 nm, respectively.

1g of a die mixture containing an oxonol die (A) and an oxonol die (B) shown below at the mass ratio of 65:35 was dissolved in 100 ml of 2,2,3,3-tetrafluoro-propanol so as to prepare a recording layer forming coating solution. The recording layer forming coating solution was coated by spin coating on a grooved surface of the obtained substrate while changing a revolution speed from 300 to 3000 rpm, and was dried so as to form a recording layer. Thicknesses of the recording layer was measured by observing a cross section of the recording layer with an SEM, and was found to be 150 nm at a groove and 110 nm at a land portion.



Subsequently, a light reflection layer, which consists of Ag and has a thickness of about 150 nm, was formed on the recording layer by DC sputtering in an Ar atmosphere. The pressure in the chamber was 0.5 Pa.

Further, a UV curable resin (trade name: SD-318, manufactured by Dainippon Ink and Chemicals Inc.) was dispensed on the light reflection layer, in a ring shape. Furthermore, a separately-prepared disc-like protective substrate (diameter: 120 mm, thickness: 0.6 mm) made of polycarbonate was placed thereon with center alignment, and was rotated at a revolution speed of 5000rpm for 3 seconds, and a UV curable resin (trade name: SD-640, manufactured by Dainippon Ink and Chemicals Inc.) was

spread out over the entire surface thereof and spun so as to spin off an excessive amount of UV curable resin. When the UV curable resin had spread out over the entire surface, UV light was irradiated thereon by using a high pressure mercury vapor lamp so as to cure the UV curable resin. In this manner, the disc-like protective substrate was affixed to the substrate having the recording layer and the light reflection layer formed thereon. The thickness of the affixing layer was 25 μm , and it was affixed without air bubbles entering therebetween.

Subsequently, a printable layer was formed on a surface of the disc-like protective substrate opposite to the laser light incident surface thereof in the following manner.

A UV curable ink (trade name: WHITE No .3, manufactured by Teikoku Printing Inks Mfg. Co., Ltd.) was further printed on the disc-like protective substrate by screen printing. Thereafter, ultra-violet light at $80\text{W}/\text{cm}^2$ was irradiated thereon by using a metal halide lamp so as to cure the UV curable ink. Two undercoat layers (white layers), each of which having a thickness of 8 μm were formed and thus the total thickness of two undercoat layers was 16 μm . The screen used was a mesh screen of 300 lines per inch made of TETORON(R) having a yarn diameter of 31 μm and a mesh opening of 38 μm .

Next, the following process was carried out to form an colorant-receiving layer on the base layer.

Preparation of colorant-receiving layer coating solution

(1) Vapor-phase-process silica particles and (2) deionized water, which are described in the following composition, were mixed and the resultant was stirred for 20 minutes at 10,000 rpm with a high-speed rotary colloid mill (trade name: CLEARMIX, manufactured by M technique Co., Ltd.). Then, a first solution

containing (3) polyoxyethylene lauryl ether, (4) an aqueous 9 % polyvinyl alcohol solution and (5) diethylene glycol monobutyl, and a second solution containing (6) boric acid, (7) mordant and (8) deionized water were respectively added to the resultant water dispersion, and the mixture was dispersed in the same conditions as above to prepare a colorant-receiving layer coating solution A.

A ratio by mass of the silica particles to the water-soluble resin (PB ratio of the component (1): the component (4)) was 3.5:1 and a pH of the colorant-receiving layer coating solution A was 3.4, and the colorant-receiving layer showed acidity.

Composition of colorant-receiving layer coating solution A

(1) Vapor-phase-process silica particles (inorganic pigment microparticle) (average primary particle diameter: 7 nm) (trade name: AEROSIL(R) 300, manufactured by Nippon Aerosil Co., Ltd.)	10.0 parts
(2) Deionized water	55.2 parts

Composition of First solution

(3) Polyoxyethylene lauryl ether (surfactant) (trade name: EMULGEN 109P (10 %), manufactured by Kao Corporation, HLB value: 13.6)	3.5 parts
(4) 9 % aqueous solution of polyvinyl alcohol (water-soluble resin) (trade name: PVA420, manufactured by Kuraray Co., Ltd., degree of saponification: 81.8 %, degree of polymerization: 2,000)	31.7 parts
(5) Diethylene glycol monobutyl ether (compound represented by Formula (1))	0.5 parts

Composition of Second solution

(6) Boric acid (concentration: 6 %) (cross-linking agent)	10.4 parts
(7) Mordant (trade name: PAS-F5000 (concentration: 20 %), manufactured by Nitto Boseki Co.,Ltd.)	2.5 parts

(8) Deionized water

5.3 parts

Now, with reference to the thus-obtained coating solution A, viscosities at a liquid temperature at the time of coating in a case of forming a colorant-receiving layer to be described below and at a drying temperature were measured by using a viscometer (trade name: B-8L type; available from Tokyo Keiki Co., Ltd.).

As a result, the viscosity of the coating solution A at a liquid temperature of 25°C at the time of coating was 200 mPa·s and the viscosity thereof at a drying temperature of 5°C was 25 Pa·s.

Formation of colorant-receiving layer

After a corona discharge was performed on the face of the base layer of the information medium, the coating solution A was applied on the base layer by using an extrusion die coater. On this occasion, the temperature of the coating solution A was 25°C. After 30 seconds have passed since the coating was terminated, the thus-applied coating solution was dried while it is transferred for 5 minutes until flowability of the coated solution on the surface was suppressed under an environment of 5°C 10% RH in a low-temperature low-moisture chamber. Immediately thereafter, it was dried at 30°, 10% RH (wind speed 4 m/s) in a hot air blowing dryer for 5 minutes while being transferred.

Further, a film thickness of the colorant-receiving layer thus obtained was 30 μm .

In a manner as described above, the disc-like information medium provided with the printable layer was obtained.

Evaluation

Evaluation of surface feature of colorant-receiving layer

A degree of glossiness at 45° against the printable layer of the disc-like

information medium thus obtained was measured by using a digital gloss meter (trade name: GK-45D; available from Suga Test Instruments Co., Ltd.).

The printable layer in which a degree of glossiness is 30% or more was evaluated as the surface feature was excellent and the printable layer in which a degree of glossiness is less than 30% was evaluated as having a practical problem in that the surface feature was inferior and the images were fluctuated.

The printable layer (colorant-receiving layer) of the disc-like information medium in Example 1 was 38% and was found to have an excellent surface feature.

Examples 2 and 3, and Comparative Examples 1 and 2

Disc-like information media each independently provided with a printable layer were obtained in a same manner as in Example 1 except that a coating solution B (Example 2), a coating solution C (Example 3), a coating solution D (Comparative Example 1) and a coating solution E (Comparative Example 2) in which solid contents were each independently changed by adjusting the amount of ion-exchanged water of the coating solution A were used in place of the coating solution A in the colorant-receiving layer forming step in Example 1.

Further, with regard to the coating solutions B to E, the viscosities thereof at a liquid temperature of 25°C at the time of coating and at a drying temperature of 5°C were measured in a same manner as in Example 1 and the results are shown in Table 1.

Example 4

A disc-like information medium provided with a printable layer was obtained in a same manner as in Example 1 except that a coating solution C in Example 3 in which a solid content was changed by adjusting the amount of ion-exchanged water of the coating solution A was used in place of the coating solution A and the liquid temperature at the time of coating and the drying temperature were changed to 40°C

and 25°C, respectively, in the colorant-receiving layer forming step in Example 1.

Further, with regard to the coating solution C, the viscosities thereof at a liquid temperature of 40°C at the time of coating and at a drying temperature of 25°C were measured in a same manner as in Example 1 and the results are shown in Table 1.

Comparative Examples 3 and 4

Disc-like information media each independently provided with a printable layer were obtained in a same manner as in Example 1 except that a coating solution F (Comparative Example 3), a coating solution G (Comparative Example 4) in which solid contents were each independently changed by adjusting the amount of ion-exchanged water of the coating solution A were used in place of the coating solution A and the liquid temperature at the time of coating and the drying temperature were changed to 40°C and 25°C, respectively, in the colorant-receiving layer forming step in Example 1.

Further, with regard to the coating solutions F to G, the viscosities thereof at a liquid temperature of 40°C at the time of coating and at a drying temperature of 25°C were measured in a same manner as in Example 1 and the results are shown in Table 1.

Evaluation

Production methods of disc-like information media of Examples 1 to 4 thus obtained and production methods of disc-like information media of Comparative Examples 1 to 4 thus obtained were subjected to comparative evaluations.

Evaluation of smear of appearance at the time of coating

Smear of the appearance at the time of coating in the colorant-receiving layer forming step of each of Examples 1 to 4 and Comparative Examples 1 to 4 was visually observed. The results are shown in Table 1.

Evaluation of surface feature of colorant-receiving layer

Degrees of glossiness at 60° against printable layers (colorant-receiving layers) of the disc-like information media obtained in Examples 1 to 4 and Comparative Examples 1 to 4 were measured by using a digital gloss meter (trade name: GK-45D; available from Suga Test Instruments Co., Ltd.).

The printable layer in which a degree of glossiness is 30% or more was evaluated as the surface feature was excellent and the printable layer in which a degree of glossiness was less than 30% was evaluated as having a practical problem in that the surface feature was inferior and the images were fluctuated. The results are shown in

Table 1.

	Type of coating solution	Coating condition		Drying condition		Smear of appearance at the time of application	Surface feature of colorant-receiving layer (glossiness degree)
		Liquid temperature at the time of application (°C)	Viscosity (mPa·s)	Drying temperature (°C)	Viscosity (Pa·s)		
Example 1	Coating solution A	25	200	5	25	None	Favorable (40%)
Example 2	Coating solution B	25	60	5	1	None	Favorable (45%)
Example 3	Coating solution C	25	600	5	100	None	Favorable (35%)
Example 4	Coating solution C	40	100	25	0.6	None	Favorable (30%)
Comparative Example 1	Coating solution D	25	800	5	150	None	Rough surface found (25%)
Comparative Example 2	Coating solution E	25	20	5	0.3	Creeping of coating solution to reverse side	Rough surface found (23%)
Comparative Example 3	Coating solution F	40	60	25	0.3	None	Rough surface found (25%) Drying defect
Comparative Example 4	Coating solution G	40	800	25	1	None	Rough surface found (20%) Coating streak

As is apparent from Table 1, according to Examples 1 to 4, smear of appearance at the time of coating was not found. Further, it was found that the surface feature of the thus-formed colorant-receiving layer was excellent. From these findings, it is considered that Examples 1 to 4 were excellent in productivity.

To contrast, according to Comparative Example 1, it was found that viscosities at the liquid temperature at the time of coating and at the drying temperature were out of the scope of the invention and were unduly high and, although dirty appearance was not observed, the leveling mechanism of the coating solution has

not sufficiently been functioned and, therefore, the surface feature of the formed colorant-receiving layer was roughened.

Further, it was found that, according to Comparative Example 2, viscosities at the liquid temperature at the time of coating and the drying temperature were out of the scope of the invention and were unduly low and, accordingly, a problem of creeping of the coating solution to a reverse side is generated and, further, flowability at the time of drying was high and, therefore, the surface feature of the colorant-receiving layer was roughened by being influenced by a drying wind.

Further, according to Comparative Example 3, since the viscosity at the time of drying was unduly low, roughening of the surface caused by a drying defect was found in the colorant-receiving layer.

Still further, according to Comparative Example 4, since the viscosity was unduly high, roughening of the surface caused by a coating streak was found in the colorant-receiving layer.

Example 5

A disc-like information medium provided with a printable layer was obtained in a same manner as in Example 1 except that, after one minute has passed since the coating was finished in the colorant-receiving layer forming step in Example 1, the disc-like information medium was dried in a low-temperature low-moisture chamber.

When the degree of glossiness at 45° against the printable layer (colorant-receiving layer) of the thus-obtained disc-like information medium in Example 5 was measured in a same manner as in Example 1, it was found that the degree thereof was 43% and the disc-like information medium had an excellent surface feature.

Comparative Example 5

A disc-like information medium provided with a printable layer was obtained in a same manner as in Example 1 except that, a drying environment in a low-temperature low-moisture chamber was changed into 20°C 10% RH in the colorant-receiving layer forming step in Example 1.

When the degree of glossiness at 45° against the printable layer (colorant-receiving layer) of the thus-obtained disc-like information medium in Comparative Example 5 was measured in a same manner as in Example 1, it was found that the degree thereof was 28% and, accordingly, a practical problem of inferior surface feature was generated.

As described above, the first production method of the disc-like information medium according to the invention is a method for producing a disc-like information medium which comprises a printable layer having a base layer and a colorant-receiving layer on a substrate, involving the step of providing the base layer on the substrate; and the step of providing the colorant-receiving layer by applying a coating solution which comprises a particle, a binder and a cross-linking agent and has a liquid temperature of from 20 to 40°C on the base layer and, drying the thus-applied coating solution at from 2 to 25°C in the stated order, in which a viscosity of the coating solution at a liquid temperature at the time of coating is from 60 to 600 mPa·s and the viscosity thereof at a drying temperature is from 0.5 to 100 Pa·s.

The second production method of a disc-like information medium according to the present invention, which is a method for producing a disc-like information medium which comprises a printable layer having a base layer and a colorant-receiving layer on a substrate, is characterized by involving the step of providing the base layer on the substrate; and the step of providing the colorant-receiving layer by applying a coating solution which comprises a particle, a binder and a cross-linking agent on the

base layer and, drying the thus-applied coating solution at 15°C or less in the stated order.

According to the invention, the coating solution is dried at 15°C or less after 30 seconds or more have passed since it was applied. It is preferable that, after the coating solution is dried at 15°C or less, it is further dried at 20°C or more.

According to the invention, it is preferable that the particle is one selected from the group consisting of: a vapor-phase-process silica; pseudo boehmite; and aluminum oxide and the binder is a polyvinyl alcohol and, further, the cross-linking agent is a boron compound.

According to the invention, it is preferable that the coating solution further comprises a mordant and, also, comprises at least one of a compound represented by the following formula (1) and a compound represented by the following formula (2):



wherein R represents a saturated hydrocarbon group having from 1 to 12 carbon atoms, an unsaturated hydrocarbon group having from 1 to 12 carbon atoms, a phenyl group or an acyl group; and

n represents an integer of from 1 to 3; and



wherein R represents a saturated hydrocarbon group having from 1 to 12 carbon atoms, an unsaturated hydrocarbon group having from 1 to 12 carbon atoms, a phenyl group or an acyl group; and

n represents an integer of from 1 to 3.

Above all, it is preferable that the compound represented by the formula (1) and the compound represented by the formula (2) are water-soluble, and it is more preferable that R in the formulae (1) and (2) represents a saturated hydrocarbon group

having from 1 to 4 carbon atoms.

According to the invention, a method for producing a disc-like information medium which can produce with high productivity the disc-like information medium containing the printable layer having the colorant-receiving layer which is capable of performing printing of high quality and excellent in the surface feature can be provided.

Further, according to the invention, a method for producing a disc-like information medium provided with a printable layer in which a colorant-receiving layer is excellent in a surface feature and capable of producing a uniform print of a high image quality can be provided.

CLAIMS

1. A method for producing a disc-like information medium which comprises a printable layer containing a base layer and a colorant-receiving layer on a substrate, comprising;

providing the base layer on the substrate; and

providing the colorant-receiving layer by applying a coating solution which comprises a particle, a binder and a cross-linking agent and has a liquid temperature of from 20 to 40°C on the base layer and, drying the applied coating solution at from 2 to 25°C,

wherein the viscosity of the coating solution at a liquid temperature at the time of coating is from 60 to 600 mPa·s and the viscosity thereof at a drying temperature is from 0.5 to 100 Pa·s.

2. The method for producing the disc-like information medium according to Claim 1, wherein the particle is one selected from the group consisting of a vapor-phase-process silica, pseudo boehmite, and aluminum oxide.

3. The method for producing the disc-like information medium according to Claim 1, wherein the binder is polyvinyl alcohol.

4. The method for producing the disc-like information medium according to Claim 1, wherein the cross-linking agent is a boron compound.

5. The method for producing the disc-like information medium according to

Claim 1, wherein the coating solution further comprises a mordant.

6. The method for producing the disc-like information medium according to Claim 1, wherein the coating solution comprises at least one of a compound represented by the following formula (1) and a compound represented by the following formula (2):



wherein R represents a saturated hydrocarbon group having from 1 to 12 carbon atoms, an unsaturated hydrocarbon group having from 1 to 12 carbon atoms, a phenyl group or an acyl group; and n represents an integer of from 1 to 3; and



wherein R represents a saturated hydrocarbon group having from 1 to 12 carbon atoms, an unsaturated hydrocarbon group having from 1 to 12 carbon atoms, a phenyl group or an acyl group; and n represents an integer of from 1 to 3.

7. The method for producing the disc-like information medium according to Claim 6, wherein the compound represented by the formula (1) and the compound represented by the formula (2) are water-soluble.

8. The method for producing the disc-like information medium according to Claim 6, wherein R in the formula (1) and the formula (2) represents a saturated hydrocarbon group having from 1 to 4 carbon atoms.

9. A method for producing a disc-like information medium which comprises a printable layer containing a base layer and a colorant-receiving layer on a substrate,

comprising;

providing the base layer on the substrate; and

providing the colorant-receiving layer by applying a coating solution which comprises a particle, a binder and a cross-linking agent on the base layer and, then, drying the applied coating solution at 15°C or less.

10. The method for producing the disc-like information medium according to Claim 9, wherein the coating solution is dried at 15°C or less after 30 seconds or more have passed since it was applied.

11. The method for producing the disc-like information medium according to Claim 9, wherein the coating solution is dried at 15°C or less and, then, further dried at 20°C or more.

12. The method for producing the disc-like information medium according to Claim 9, wherein the particle is one selected from the group consisting of a vapor-phase-process silica pseudo boehmite and aluminum oxide.

13. The method for producing the disc-like information medium according to Claim 9, wherein the binder is polyvinyl alcohol.

14. The method for producing the disc-like information medium according to Claim 9, wherein the cross-linking agent is a boron compound.

15. The method for producing the disc-like information medium according

to Claim 9, wherein the coating solution further comprises a mordant.

16. The method for producing the disc-like information medium according to Claim 9, wherein the coating solution comprises at least one of a compound represented by the following formula (1) and a compound represented by the following formula (2):



wherein R represents a saturated hydrocarbon group having from 1 to 12 carbon atoms, an unsaturated hydrocarbon group having from 1 to 12 carbon atoms, a phenyl group or an acyl group; and n represents an integer of from 1 to 3; and



wherein R represents a saturated hydrocarbon group having from 1 to 12 carbon atoms, an unsaturated hydrocarbon group having from 1 to 12 carbon atoms, a phenyl group or an acyl group; and n represents an integer of from 1 to 3.

17. The method for producing the disc-like information medium according to Claim 16, wherein the compound represented by the formula (1) and the compound represented by the formula (2) are water-soluble.

18. The method for producing the disc-like information medium according to Claim 16, wherein R in each of the formula (1) and the formula (2) represents a saturated hydrocarbon group having from 1 to 4 carbon atoms.

INTERNATIONALSEARCHREPORT

International application No.

PCT/JP2005/024217

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. *G11B7/26 (2006.01)*, *G11B7/24 (2006.01)*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. *G11B7/26 (2006.01)*, *G11B7/24 (2006.01)*

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
 Published unexamined utility model applications of Japan 1971-2006
 Registered utility model specifications of Japan 1996-2006
 Published registered utility model applications of Japan 1994-2006

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2004-276298 A (Fuji Photo Film Co., Ltd.), 07 Oct. 2004 (07.10.2004) claim 1-7; paragraph 0006; paragraph 0009-0094; paragraph 0137-0152 & US 2004/0180153 A1 & EP 1457978 A2	1-18
A	JP 2004-249610 A (Fuji Photo Film Co., Ltd.), 09 Sep. 2004 (09.09.2004) whole document & US 2004/0167025 A1 & EP 1450359 A2	1-18
A	JP 2002-352478 A (Taiyo Yuden Co., Ltd.), 06 Dec. 2002 (06.12.2002) whole document (Family: none)	1-18

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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